

BID OF _____

2015

PROPOSAL, CONTRACT, BOND AND SPECIFICATIONS

FOR

UNIT WELL 12 UPGRADE AND CONVERSION TO A TWO ZONE WELL

CONTRACT NO. 7498

MUNIS NO. 10452

IN

MADISON, DANE COUNTY, WISCONSIN

AWARDED BY THE COMMON COUNCIL
MADISON, WISCONSIN ON _____

CITY ENGINEERING DIVISION
1600 EMIL STREET
MADISON, WISCONSIN 53713

<https://bidexpress.com/login>

**UNIT WELL 12 UPGRADE AND CONVERSTION TO A TWO ZONE WELL
CONTRACT NO. 7498**

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This Proposal, and Agreement have
been prepared by:

**MADISON WATER UTILITY
CITY OF MADISON
MADISON, DANE COUNTY, WISCONSIN**


Alan L. Larson, P.E., BCEE

6/12/15




6-12-2015

SECTION A: ADVERTISEMENT FOR BIDS AND INSTRUCTIONS TO BIDDERS

REQUEST FOR BID FOR PUBLIC WORKS CONSTRUCTION CITY OF MADISON, WISCONSIN

A BEST VALUE CONTRACTING MUNICIPALITY

PROJECT NAME:	Unit Well 12 Upgrade and Conversion to a Two Zone Well
CONTRACT NO.:	7498
SBE GOAL	10%
BID BOND	5%
PRE BID MEETING (10:00 A.M.)	July 3rd, 2015
PREQUALIFICATION APPLICATION DUE (1:00 P.M)	July 3rd, 2015
BID SUBMISSION (1:00 P.M.)	July 10th, 2015
BID OPEN (1:30 P.M.)	July 10th, 2015
PUBLISHED IN WSJ	6/12/15, 6/19/15, 6/26/15 & 7/3/15

PRE BID MEETING: Representatives of the Affirmative Action Department will be present to discuss the Small Business Enterprise requirements at 1600 Emil Street, Madison Wisconsin.

PREQUALIFICATION APPLICATION: Forms are available on our website, www.cityofmadison.com/business/pw/forms.cfm. If not currently prequalified in the categories listed in Section A, an amendment to your Prequalification will need to be submitted prior to the same due date. Postmark is not applicable.

BIDS TO BE SUBMITTED by hand to 1600 EMIL ST., MADISON, WI 53713 or online at www.bidexpress.com.

THE BID OPENING is at 1600 EMIL ST., MADISON, WI 53713.

STANDARD SPECIFICATIONS

The City of Madison's Standard Specifications for Public Works Construction - 2015 Edition, as supplemented and amended from time to time, forms a part of these contract documents as if attached hereto.

These standard specifications are available on the City of Madison Public Works website, www.cityofmadison.com/Business/PW/specs.cfm.

The Contractor shall review these Specifications prior to preparation of proposals for the work to be done under this contract, with specific attention to Article 102, "BIDDING REQUIREMENTS AND CONDITIONS" and Article 103, "AWARD AND EXECUTION OF THE CONTRACT." For the convenience of the bidder, below are highlights of three subsections of the specifications.

SECTION 102.1: PRE-QUALIFICATION OF BIDDERS

In accordance with Wisconsin State Statutes 66.0901 (2) and (3), all bidders must submit to the Board of Public Works proof of responsibility on forms furnished by the City. The City requires that all bidders be qualified on a biennial basis.

Bidders must present satisfactory evidence that they have been regularly engaged in the type of work specified herein and they are fully prepared with necessary capital, materials, machinery and supervisory personnel to conduct the work to be contracted for to the satisfaction of the City. All bidders must be pre-

qualified by the Board of Public Works for the type of construction on which they are bidding prior to the opening of the bid.

In accordance with Section 39.02(9)(a)l. of the General Ordinances, all bidders shall submit in writing to the Affirmative Action Division Manager of the City of Madison, a Certificate of Compliance or an Affirmative Action Plan at the same time or prior to the submission of the proof of responsibility forms.

The bidder shall be disqualified if the bidder fails to or refuses to, prior to opening of the bid, submit a Certificate of compliance, Affirmative Action Plan or Affirmative Action Data Update, as applicable, as defined by Section 39.02 of the General Ordinances (entitled Affirmative Action) and as required by Section 102.11 of the Standard Specifications.

SECTION 102.4 PROPOSAL

No bid will be accepted that does not contain an adequate or reasonable price for each and every item named in the Schedule of Unit Prices.

A lump sum bid for the work in accordance with the plans and specifications is required. The lump sum bid must be the same as the total amounts bid for the various items and it shall be inserted in the space provided.

All papers bound with or attached to the proposal form are considered a part thereof and must not be detached or altered when the proposal is submitted. The plans, specifications and other documents designated in the proposal form will be considered a part of the proposal whether attached or not.

A proposal submitted by an individual shall be signed by the bidder or by a duly authorized agent. A proposal submitted by a partnership shall be signed by a member/partner or by a duly authorized agent thereof. A proposal submitted by a corporation shall be signed by an authorized officer or duly authorized registered agent of such corporation, and the proposal shall show the name of the State under the laws of which such corporation was chartered. The required signatures shall in all cases appear in the space provided thereof on the proposal.

Each proposal shall be placed, together with the proposal guaranty, in a sealed envelope, so marked as to indicate name of project, the contract number or option to which it applies, and the name and address of the Contractor or submitted electronically through Bid Express (www.bidexpress.com). Proposals will be accepted at the location, the time and the date designated in the advertisement. Proposals received after the time and date designated will be returned to the bidder unopened.

The Bidder shall execute the Disclosure of Ownership form. REFER TO SECTION F.

SECTION 102.5: BID DEPOSIT (PROPOSAL GUARANTY)

All bids, sealed or electronic, must be accompanied with a Bid Bond equal to at least 5% of the bid or a Certificate of Annual/Biennial Bid Bond or certified check, payable to the City Treasurer. Bid deposit of the successful bidders shall be returned within forty-eight (48) hours following execution of the contract and bond as required.

PREVAILING WAGE RATES

Prevailing Wage Rates may be required and are attached in Section J of the contract. See Special Provisions to determine applicability.

Bidders for this Contract(s) must be Pre-Qualified for at least one of the following type(s) of construction denoted by an

Building Demolition

- 101 Asbestos Removal
- 120 House Mover

- 110 Building Demolition

Street, Utility and Site Construction

- 201 Asphalt Paving
- 205 Blasting
- 210 Boring/Pipe Jacking
- 215 Concrete Paving
- 220 Con. Sidewalk/Curb & Gutter/Misc. Flat Work
- 221 Concrete Bases and Other Concrete Work
- 222 Concrete Removal
- 225 Dredging
- 230 Fencing
- 235 Fiber Optic Cable/Conduit Installation
- 240 Grading and Earthwork
- 241 Horizontal Saw Cutting of Sidewalk
- 242 Infrared Seamless Patching
- 245 Landscaping, Maintenance
- 250 Landscaping, Site and Street
- 251 Parking Ramp Maintenance
- 252 Pavement Marking
- 255 Pavement Sealcoating and Crack Sealing
- 260 Petroleum Above/Below Ground Storage Tank Removal/Installation
- 262 Playground Installer
- 265 Retaining Walls, Precast Modular Units

- 270 Retaining Walls, Reinforced Concrete
- 275 Sanitary, Storm Sewer and Water Main Construction
- 276 Sawcutting
- 280 Sewer Lateral Drain Cleaning/Internal TV Insp.
- 285 Sewer Lining
- 290 Sewer Pipe Bursting
- 295 Soil Borings
- 300 Soil Nailing
- 305 Storm & Sanitary Sewer Laterals & Water Svc.
- 310 Street Construction
- 315 Street Lighting
- 318 Tennis Court Resurfacing
- 320 Traffic Signals
- 325 Traffic Signing & Marking
- 332 Tree pruning/removal
- 333 Tree, pesticide treatment of
- 335 Trucking
- 340 Utility Transmission Lines including Natural Gas, Electrical & Communications
- 399 Other _____

Bridge Construction

- 501 Bridge Construction and/or Repair

Building Construction

- 401 Floor Covering (including carpet, ceramic tile installation, rubber, VCT)
- 402 Building Automation Systems
- 403 Concrete
- 404 Doors and Windows
- 405 Electrical - Power, Lighting & Communications
- 410 Elevator - Lifts
- 412 Fire Suppression
- 413 Furnishings - Furniture and Window Treatments
- 415 General Building Construction, Equal or Less than \$250,000
- 420 General Building Construction, \$250,000 to \$1,500,000
- 425 General Building Construction, Over \$1,500,000
- 428 Glass and/or Glazing
- 429 Hazardous Material Removal
- 430 Heating, Ventilating and Air Conditioning (HVAC)
- 433 Insulation - Thermal
- 435 Masonry/Tuck pointing

- 437 Metals
- 440 Painting and Wallcovering
- 445 Plumbing
- 450 Pump Repair
- 455 Pump Systems
- 460 Roofing and Moisture Protection
- 464 Tower Crane Operator
- 461 Solar Photovoltaic/Hot Water Systems
- 465 Soil/Groundwater Remediation
- 466 Warning Sirens
- 470 Water Supply Elevated Tanks
- 475 Water Supply Wells
- 480 Wood, Plastics & Composites - Structural & Architectural
- 499 Other _____

State of Wisconsin Certifications

- 1 Class 5 Blaster - Blasting Operations and Activities 2500 feet and closer to inhabited buildings for quarries, open pits and road cuts.
- 2 Class 6 Blaster - Blasting Operations and Activities 2500 feet and closer to inhabited buildings for trenches, site excavations, basements, underwater demolition, underground excavations, or structures 15 feet or less in height.
- 3 Class 7 Blaster - Blasting Operations and Activities for structures greater than 15' in height, bridges, towers, and any of the objects or purposes listed as "Class 5 Blaster or Class 6 Blaster".
- 4 Petroleum Above/Below Ground Storage Tank Removal and Installation (Attach copies of State Certifications.)
- 5 Hazardous Material Removal (Contractor to be certified for asbestos and lead abatement per the Wisconsin Department of Health Services, Asbestos and Lead Section (A&LS).) See the following link for application: www.dhs.wisconsin.gov/Asbestos/Cert. State of Wisconsin Performance of Asbestos Abatement Certificate must be attached.
- 6 Certification number as a Certified Arborist or Certified Tree Worker as administered by the International Society of Arboriculture
- 7 Pesticide application (Certification for Commercial Applicator For Hire with the certification in the category of turf and landscape (3.0) and possess a current license issued by the DATCP)
- 8 State of Wisconsin Master Plumbers License.

SECTION B: PROPOSAL

Please refer to the
Bid Express Website
at <https://bidexpress.com>
look up contract number
and go to
Section B: Proposal Page

You can access all City of Madison bid solicitations for FREE at www.bidexpress.com

Click on the "Register for Free" button and follow the instructions to register your company and yourself. You will be asked for a payment subscription preference, since you may wish to bid online someday. Simply choose the method to pay on a 'per bid' basis. This requires no payment until / unless you actually bid online. You can also choose the monthly subscription plan at this time. You will, however, be asked to provide payment information. Remember, you can change your preference at anytime. You will then be able to complete your free registration and have full access to the site. Your free access does not require completion of the 'Digital ID' process, so you will have instant access for viewing and downloading. To be prepared in case you ever do wish to bid online, you may wish to establish your digital ID also, since you cannot bid without a Digital ID.

If you have any problems with the free registration process, you can call the bidexpress help team, toll free at 1-888-352-2439 (option 1, option1).

SECTION C: SMALL BUSINESS ENTERPRISE

Instructions to Bidders City of Madison SBE Program Information

2 Small Business Enterprise (SBE) Program Information

2.1 Policy and Goal

The City of Madison reaffirms its policy of nondiscrimination in the conduct of City business by maintaining a procurement process which remains open to all who have the potential and ability to sell goods and services to the City. It is the policy of the City of Madison to allow Small Business Enterprises (SBE) maximum feasible opportunity to participate in City of Madison contracting. The bidder acknowledges that its bid has been submitted in accordance with the SBE program and is for the public's protection and welfare.

Please refer to the "ADVERTISEMENT FOR BIDS" for the goal for the utilization of SBEs on this project. SBEs may participate as subcontractors, vendors and/or suppliers, which provide a commercially useful function. The dollar value for SBE suppliers or 'materials only' vendors shall be discounted to 60% for purposes of meeting SBE goals.

A bidder which achieves or exceeds the SBE goal will be in compliance with the SBE requirements of this project. In the event that the bidder is unable to achieve the SBE goal, the bidder must demonstrate that a good faith effort to do so was made. Failure to either achieve the goal or demonstrate a good faith effort to do so will be grounds for the bidder being deemed a non-responsible contractor ineligible for award of this contract.

A bidder may count towards its attainment of the SBE goal only those expenditures to SBEs that perform a commercially useful function. For purposes of evaluating a bidder's responsiveness to the attainment of the SBE goal, the contract participation by an SBE is based on the percentage of the total base bid proposed by the Contractor. The total base bid price is inclusive of all addenda.

Work performed by an SBE firm in a particular transaction can be counted toward the goal only if it involves a commercially useful function. That is, in light of industry practices and other relevant considerations, does the SBE firm have a necessary and useful role in the transaction, of a kind for which there is a market outside the context of the SBE Program, or is the firm's role a superfluous step added in an attempt to obtain credit towards goals? If, in the judgment of the Affirmative Action Division, the SBE firm will not perform a commercially useful function in the transaction, no credit towards goals will be awarded.

The question of whether a firm is performing a commercially useful function is completely separate from the question of whether the firm is an eligible SBE. A firm is eligible if it meets the definitional criteria and ownership and control requirements, as set forth in the City of Madison's SBE Program.

If the City of Madison determines that the SBE firm is performing a commercially useful function, then the City of Madison must then decide what that function is. If the commercially useful function is that of an SBE vendor / supplier that regularly transacts business with the respective product, then the City of Madison will count 60% of the value of the product supplied toward SBE goals.

To be counted, the SBE vendor / supplier must be engaged in selling the product in question to the public. This is important in distinguishing an SBE vendor / supplier, which has a regular trade with a variety of customers, from a firm which performs supplier-like functions on an ad hoc basis or for only one or two contractors with whom it has a special relationship.

A supplier of bulk goods may qualify as an eligible SBE vendor / supplier if it either maintains an inventory or owns or operates distribution equipment. With respect to the distribution equipment; e.g., a fleet of trucks, the term "operates" is intended to cover a situation in which the supplier leases the equipment on a regular basis for its entire business. It is not intended to cover a situation in which the firm simply provides drivers for trucks owned or leased by another party; e.g., a prime contractor, or leases such a party's trucks on an ad hoc basis for a specific job.

If the commercially useful function being performed is not that of a qualified SBE vendor / supplier, but rather that of delivery of products, obtaining bonding or insurance, procurement of personnel, acting as a broker or manufacturer's representative in the procurement of supplies, facilities, or materials, etc., only the fees or commissions will apply towards the goal.

For example, a business that simply transfers title of a product from manufacturer to ultimate purchaser; e. g., a sales representative who re-invoices a steel product from the steel company to the Contractor, or a firm that puts a product into a container for delivery would not be considered a qualified SBE vendor / supplier. The Contractor would not receive credit based on a percentage of the cost of the product for working with such firms.

Concerning the use of services that help the Contractor obtain needed supplies, personnel, materials or equipment to perform a contract: only the fee received by the service provider will be counted toward the goal. For example, use of a SBE sales representative or distributor for a steel company, if performing a commercially useful function at all, would entitle the Contractor receiving the steel to count only the fee paid to the representative or distributor toward the goal. This provision would also govern fees for professional and other services obtained expressly and solely to perform work relating to a specific contract.

Concerning transportation or delivery services: if an SBE trucking company picks up a product from a manufacturer or a qualified vendor / supplier and delivers the product to the Contractor, the commercially useful function it is performing is not that of a supplier, but simply that of a transporter of goods. Unless the trucking company is itself the manufacturer or a qualified vendor / supplier in the product, credit cannot be given based on a percentage of the cost of the product. Rather, credit would be allowed for the cost of the transportation service.

The City is aware that the rule's language does not explicitly mention every kind of business that may contribute work on this project. In administering these programs, the City would, on a case-by-case basis, determine the appropriate counting formula to apply in a particular situation.

2.2 Contract Compliance

Questions concerning the SBE Program shall be directed to the Contract Compliance Officer of the City of Madison Department of Civil Rights, Affirmative Action Division, 210 Martin Luther King, Jr. Blvd., Room 523, Madison, WI 53703; telephone (608) 266-4910.

2.3 Certification of SBE by City of Madison

The Affirmative Action Division maintains a directory of SBEs which are currently certified as such by the City of Madison. Contact the Contract Compliance Officer as indicated in Section 2.2 to receive a copy of the SBE Directory or you may access the SBE Directory online at www.cityofmadison.com/dcr/aaTBDDir.cfm.

All contractors, subcontractors, vendors and suppliers seeking SBE status must complete and submit the **Targeted Business Certification Application** to the City of Madison Affirmative Action Division by the time and date established for receipt of bids. A copy of the Targeted Business Certification Application is available by contacting the Contract Compliance Officer at the address and telephone indicated in Section 2.2 or you may access the Targeted Business Certification Application online at www.cityofmadison.com/dcr/aaTBDDir.cfm. Submittal of the Targeted Business Certification Application by the time specified does not guarantee that the applicant will be certified as a SBE eligible to be utilized towards meeting the SBE goal for this project.

2.4 Small Business Enterprise Compliance Report

2.4.1 Good Faith Efforts

Bidders shall take all necessary affirmative steps to assure that SBEs are utilized when possible and that the established SBE goal for this project is achieved. A contractor who self performs a portion of the work, and is pre-qualified to perform that category of work, may subcontract that portion of the work, but shall not be required to do so. When a bidder is unable to achieve the established SBE goal, the bidder must demonstrate that a good faith effort to do so was made. Such a good faith effort should include the following:

- 2.4.1.1 Attendance at the pre-bid meeting.
- 2.4.1.2 Using the City of Madison's directory of certified SBEs to identify SBEs from which to solicit bids.
- 2.4.1.3 Assuring that SBEs are solicited whenever they are potential sources.
- 2.4.1.4 Referring prospective SBEs to the City of Madison Affirmative Action Division for certification.
- 2.4.1.5 Dividing total project requirements into smaller tasks and/or quantities, where economically feasible, to permit maximum feasible SBE participation.
- 2.4.1.6 Establishing delivery schedules, where requirements permit, which will encourage participation by SBEs.
- 2.4.1.7 Providing SBEs with specific information regarding the work to be performed.
- 2.4.1.8 Contacting SBEs in advance of the deadline to allow such businesses sufficient time to prepare a bid.
- 2.4.1.9 Utilizing the bid of a qualified and competent SBE when the bid of such a business is deemed reasonable (i.e. 5% above the lowest bidder), although not necessarily low.
- 2.4.1.10 Contacting SBEs which submit a bid, to inquire about the details of the bid and confirm that the scope of the work was interpreted as intended.

2.4.2 Reporting SBE Utilization and Good Faith Efforts

The Small Business Enterprise Compliance Report is to be submitted by the bidder with the bid. This report is due by the specified bid closing time and date. Bids submitted without a completed SBE Compliance Report as outlined below

shall be deemed non-responsible and the bidder ineligible for award of this contract.

2.4.2.1 If the Bidder meets or exceeds the goal established for SBE utilization, the Small Business Enterprise Compliance Report shall consist of the following:

2.4.2.1.1 **Cover Page**, Page C-6; and

2.4.2.1.2 **Summary Sheet**, C-7.

2.4.2.2 If the bidder does not meet the goal established for SBE utilization, the Small Business Enterprise Compliance Report shall consist of the following:

2.4.2.2.1 **Cover Page**, Page C-6;

2.4.2.2.2 **Summary Sheet**, C-7; and

2.4.2.2.3 **SBE Contact Report**, C-8 and C-9. (A separate Contact Report must be completed for each applicable SBE which is not utilized.)

2.5 Appeal Procedure

A bidder which does not achieve the established goal and is found non-responsible for failure to demonstrate a good faith effort to achieve such goal and subsequently denied eligibility for award of contract may appeal that decision to the Small Business Enterprises Appeals Committee. All appeals shall be made in writing, and shall be delivered to and received by the City Engineer no later than 4:30 PM on the third business day following the bidder's receipt of the written notification of ineligibility by the Affirmative Action Division Manager. Postmark not acceptable. The notice of appeal shall state the basis for the appeal of the decision of the Affirmative Action Division Manager. The Appeal shall take place in accordance with Madison General Ordinance 33.54.

2.6 SBE Requirements After Award of the Contract

The successful bidder shall identify SBE subcontractors, suppliers and vendors on the subcontractor list in accordance with the specifications. The Contractor shall submit a detailed explanation of any variances between the listing of SBE subcontractors, vendors and/or suppliers on the subcontractor list and the Contractor's SBE Compliance Report for SBE participation.

No change in SBE subcontractors, vendors and/or suppliers from those SBEs indicated in the SBE Compliance Report will be allowed without prior approval from the Engineer and the Affirmative Action Division. The contractor shall submit in writing to the City of Madison Affirmative Action Division a request to change any SBE citing specific reasons which necessitate such a change. The Affirmative Action Division will use a general test of reasonableness in approving or rejecting the contractor's request for change. If the request is approved, the Contractor will make every effort to utilize another SBE if available.

The City will monitor the project to ensure that the actual percentage commitment to SBE firms is carried out.

2.7 SBE Definition and Eligibility Guidelines

A Small Business Enterprise is a business concern awarded certification by the City of Madison. For the purposes of this program a Small Business Enterprise is defined as:

- A. An independent business operated under a single management. The business may not be a subsidiary of any other business and the stock or ownership may not be held by any individual or any business operating in the same or a similar field. In determining whether an entity qualifies as a SBE, the City shall consider all factors relevant to being an independent business including, but not limited to, the date the business was established, adequacy of its resources for the work in which it proposes to involve itself, the degree to which financial, equipment leasing and other relationships exist with other ineligible firms in the same or similar lines of work. SBE owner(s) shall enjoy the customary incidents of ownership and shall share in the risks and profits commensurate with their enjoyment interests, as demonstrated by an examination of the substance rather than form or arrangements that may be reflected in its ownership documents.
- B. A business that has averaged no more than \$4.0 million in annual gross receipts over the prior three year period and the principal owner(s) do not have a personal net worth in excess of \$1.32 million.

Firm and/or individuals that submit fraudulent documents/testimony may be barred from doing business with the City and/or forfeit existing contracts.

SBE certification is valid for one (1) year unless revoked.

**UNIT WELL 12 UPGRADE AND CONVERSION TO A TWO ZONE WELL
CONTRACT NO. 7498**

Small Business Enterprise Compliance Report

**This information may be submitted electronically through
Bid Express or submitted with bid in sealed envelope.**

Cover Sheet

Prime Bidder Information

Company: _____

Address: _____

Telephone Number: _____ Fax Number: _____

Contact Person/Title: _____

Prime Bidder Certification

I, _____, _____ of
Name Title

_____ certify that the information
Company

contained in this SBE Compliance Report is true and correct to the best of my knowledge and belief.

Witness' Signature

Bidder's Signature

Date

**UNIT WELL 12 UPGRADE AND CONVERSION TO A TWO ZONE WELL
CONTRACT NO. 7498**

Small Business Enterprise Compliance Report

SBE Contact Report

Submit separate copy of this form for each SBE which you are not able to utilize towards meeting the SBE goal for this project. Attach separate sheets if necessary.

SBE Information

Company: _____

Address: _____

Telephone Number: _____

Contact Person/Title: _____

1. Outline below all efforts to solicit a bid from the above SBE. Include date, means of contact, who from your company made this contact and the result.

2. Describe the information provided to the aforementioned SBE regarding the scope of work for which he/she was to provide a bid.

Is this the same scope of work on which the subcontractor you intend to utilize based his/her bid?

Yes No

3. Did this SBE submit a bid? Yes No

4. Is the General Contractor pre-qualified to self-perform this category of work?

Yes No

5. If you responded "Yes" to Question 3, please check the items below which apply and provide the requested detail. If you responded "No" to Question 3, please skip ahead to item 6 below.

The SBE listed above is unavailable for work on this project for the following reasons. Provide specific detail for this conclusion.

The SBE listed above is unqualified for work on this project. Provide specific details for this conclusion.

The SBE listed above provided a price that was unreasonable (i.e. more than 5% above the lowest bidder). Provide specific detail for this conclusion including the SBE's price and the price of the subcontractor you intend to utilize.

A contract with the SBE listed above may constitute a breach of the bidder's collective bargaining agreements. Provide specific detail for this conclusion including, but not limited to, correspondence from the SBE indicating it will not sign a project labor agreement and/or correspondence from the applicable trade union indicating a project labor agreement will not be allowed at the time of project bidding.

Other; please specify reason(s) other than listed above which made it impossible for you to utilize this SBE on this project.

6. Describe any other good faith efforts:

SECTION D: SPECIAL PROVISIONS

UNIT WELL 12 UPGRADE AND CONVERSION TO A TWO ZONE WELL CONTRACT NO. 7498

It is the intent of these Special Provisions to set forth the final contractual intent as to the matter involved and shall prevail over the Standard Specifications and plans whenever in conflict therewith. In order that comparisons between the Special Provisions can be readily made, the numbering system for the Special Provisions is equivalent to that of the Specifications.

Whenever in these Specifications the term "Standard Specifications" appears, it shall be taken to refer to the City of Madison Standard Specifications for Public Works Construction and Supplements thereto.

SECTION 102.10: PREVAILING WAGE

For this project, payment of prevailing wages (white sheet) shall be required unless the box indicating prevailing wages are not required is checked below.

Prevailing wages shall not be required when this box is checked.

If prevailing wages (white sheets) are required, the wages and benefits paid on the contract shall not be less than those specified in the Prevailing Wage Determination included with these contract documents for the following types of work:

- Building or Heavy Construction
- Sewer, Water, or Tunnel Construction
- Local Street or Miscellaneous Paving Construction
- Residential or Agricultural Construction

When multiple boxes are checked, worker's wages may vary according to the type and area of work performed. It is the responsibility of the Contractor to determine and apply the appropriate wage rate for the specific work assigned.

SECTION 102.12: BEST VALUE CONTRACTING

This Contract shall be considered a Best Value Contract if the Contractor's bid is equal to or greater than \$55,500 for a single trade contract; or equal to or greater than \$271,500 for a multi-trade contract pursuant to MGO 33.07(7).

SECTION 103.2: AWARD OF CONTRACT

Revise Section 103.2 to read:

All bids shall remain open for ninety (90) calendar days after the day of bid opening. Award will be made based on the BASE BID amount. Award will be made to the lowest responsible bidder submitting a conforming bid, unless all bids are rejected. No consideration with respect to award of the contract shall be given to any alternate bid submitted.

ALTERNATE BID PROPOSAL: Additions to or deductions from the BASE BID amount proposed shall not be considered until after award of the contract. Modifications to the contract price shall be made by Change Order following execution of the Contract.

SECTION 103.5:

The Contractor shall file with the City prior to the time of execution of the contract a payment and Performance Bond on the prescribed form in the full amount of the contract price as security for the payment of all persons supplying labor, services, and materials for the execution of the work and the

faithful performance of the contract. The bond shall remain in effect for a period of two years after the date of Certificate of Substantial Completion. The surety furnishing this bond shall have a sound financial standing, a record of service satisfactory to the City, and shall be authorized to do business in the State of Wisconsin.

SECTION 105.1: AUTHORITY OF THE ENGINEER

The Engineer shall resolve all questions which arise as to the quality and acceptability of materials furnished, work performed, manner of performance, rate progress of the work, interpretation of the plans and Specifications, acceptable fulfillment of the contract, compensation, and disputes, and mutual rights between Contractors under the Specifications. The Engineer shall determine the amount and quantity of work performed and materials furnished.

All decisions of the Engineer shall, when so requested, be rendered in writing. They shall be final and conclusive in all matters unless within ten (10) days after such decision the Contractor applies in writing to the Board of Public Works for a review such decision.

Any change proposed by a Contractor in SBE subcontractors, vendors or suppliers from those SBEs indicated on the SBE Compliance Report must be approved by the Engineer and the City's Manager of the Affirmative Action Division (hereafter, AAD). When requested, such decision shall be rendered in writing. Such decisions shall be final and conclusive in all matters unless within ten (10) days after such decision the Contractor or the affected SBE applies in writing to the Board of Public Works for review of such decision.

In the event the Engineer and the AAD disagree over the proper decision to be made regarding an SBE, the Mayor shall appoint a third person to resolve the disagreement, within 30 days of appointment. The decision thus rendered may be reviewed by the Board of Public Works upon request of the Contractor or the affected SBE as set forth in Section 105.1 and 105.2 of the City's standard specifications.

SECTION 105.6: CONTRACTOR'S RESPONSIBILITY FOR WORK

Add the following paragraph to the end of Section 105.6:

CONTRACTOR shall keep at the Site at all times during the progress of the Work a competent person to comply with OSHA trenching and excavation requirements. The competent person shall be one who is capable of identifying existing and predictable hazards in the surroundings, or working conditions which are unsanitary, hazardous or dangerous to employees, and who has authorization to take prompt corrective measures to eliminate them.

CONTRACTOR shall provide a photographic record of construction and construction progress. Provide a minimum of 10 photos per week. All utilities that are buried or hidden within the construction shall be photographed prior to covering. CONTRACTOR shall submit photographs in the format described below with each payment application.

Photographs shall be color digital photographs. Photographs shall be date-stamped. Photographs shall be provided in a digital format only on compact disc media. Photographs shall be submitted in the .jpg format. Alternate formats may be approved by the OWNER. Photos shall be taken with a minimum 5.0 megapixel camera at highest quality resolution.

CONTRACTOR shall provide a photo log in a Word document stored on compact disk. The photo log shall include photo identification, file name, location information, brief description, and date of photo. Photo log shall contain a minimum of ten photographs per week.

CONTRACTOR shall provide and maintain an e-mail address for electronic communication.

SECTION 105.7: CONTRACT DRAWINGS

Add the following paragraph to the end of Section 105.7:

CONTRACTOR shall keep one record copy of all specifications, drawings, addenda, modifications, and shop drawings at the site in good order and shall record on the drawings all changes made during the construction process. CONTRACTOR providing buried or concealed piping, conduit, or similar items shall locate all such items by dimensions and elevations. The daily record of changes shall be the responsibility of CONTRACTOR's field superintendent. No arbitrary mark-ups shall be permitted. CONTRACTOR shall submit his marked up record documents to ENGINEER prior to final payment. See Section 105.19 Schedule of Values regarding payment for record documents.

SECTION 105.15: SUBSTANTIAL COMPLETION

Add the following to the end of Section 105.15:

The Project shall be substantially complete and ready for final payment no later than May 1st 2016.

SECTION 105.17: PROGRESS SCHEDULE

Section 105.17 is added as follows:

Within 10 days after delivery of the Notice to Proceed, CONTRACTOR shall submit to OWNER, for approval, an estimated progress schedule indicating the starting and completion dates of the various stages of work, and a preliminary schedule of shop drawing submissions.

Progress schedule shall be updated prior to each construction meeting and an updated schedule submitted with each payment application.

SECTION 105.18: PRECONSTRUCTION CONFERENCE

Section 105.18 is added as follows:

Before starting the work at the project sites, a conference will be held to review schedules, to establish procedures for handling shop drawings and other submissions and for processing Applications for Payment, to review list of proposed subcontractors, to establish a working understanding between the parties as to the project, and to discuss project details.

SECTION 105.19: SCHEDULE OF VALUES OF THE WORK

Section 105.19 is added as follows:

At least ten days following the issuance of the Notice to Proceed, CONTRACTOR shall submit to ENGINEER a schedule of values of the work. This schedule shall include quantities and unit prices aggregating the Contract price and shall subdivide the work into component parts according to Specification sections in sufficient detail to serve as the basis for progress payments during construction. This schedule, when approved by ENGINEER, shall be used as a basis for CONTRACTOR's Application for Payment.

Include lump sum items in the following amounts in the Schedule of Values:

1. Training \$5,000
2. Operation and Maintenance Manuals \$5,000
3. Record Documents \$5,000

Payment of these items will only be made upon completion of these items.

SECTION 106.6: SUBSTITUTE MATERIALS OR EQUIPMENT

Section 106.6 is added as follows:

Whenever in any of the Contract Documents an article, material, or equipment is defined by describing a proprietary product, or by using the name of a manufacturer or vendor, the term 'or equal," if not inserted, shall be implied. The specific article, material, or equipment mentioned shall be understood as indicating the type, function, minimum standard of design, efficiency, and quality desired, and shall not be construed in such a manner as to exclude manufacturer's products of comparable quality, design and efficiency. If CONTRACTOR wishes to furnish or use a proposed substitute, he shall, prior to the preconstruction conference, make written application to the ENGINEER, for approval of such a substitute certifying, in writing, that the proposed substitute will perform adequately the functions called for by the general design, be similar and of equal substance to that specified and be suited to the same use and capable of performing the same function as that specified; stating whether or not its incorporation in or use in connection with the project is subject to the payment of any license fee or royalty; and identifying all variations of the proposed substitute from that specified and indicating available maintenance service. No substitute shall be ordered or installed without the written approval of the ENGINEER, who will be the judge of equality and may require CONTRACTOR to furnish such other data about the proposed substitute as considered pertinent. No substitute shall be ordered or installed without such performance guarantee and bonds as the ENGINEER may require which shall be furnished at CONTRACTOR's expense.

SECTION.107.1: PROTECTION OF PUBLIC AND UTILITY INTERESTS

Section 1 07.1 is amended as follows:

In order to abate objectionable noise to the extent feasible, motorized construction equipment shall not be operated between the hours of 7:00 P.M. and 7:00 A.M. without the prior written approval of ENGINEER.

The contractor shall use Whitney Way for access to the site. Contractor shall comply with the City's noise ordinance at all times.

SECTION 108.2: PERMITS AND LICENSING

Add the following to the end of Section 108.2:

CONTRACTOR shall secure all required building permits.

Madison Water Utility will pay any required building permit fees.

SECTION 109.6: SUSPENSE OF WORK

Add the following to the end of Section 109.6:

The contractor shall meet the following project time line (Time line is not guaranteed by the Owner and can be adjusted to meet City requirements). The following schedule shall serve as written notification to Contractor for suspension of work for specified periods:

September 1 st , 2015	Start of Construction
May 1 st , 2016	Construction Complete, Facility Tested, Commissioned and Fully Operational.

SECTION 110.2: PARTIAL PAYMENTS

Add the following to the end of Section 110.2:

All stored equipment and materials for which payment is requested shall have two copies of invoices included with the pay request. Equipment shall be identified thoroughly on the invoices, including serial numbers. Payment for the stored equipment and material which are on the site shall not exceed the invoiced amount for each item, less the contract retainage. The overhead and profit for the stored items shall not be invoiced until the item is installed.

Payment for off-site storage is normally reserved for sensitive or very large pieces of equipment that in ENGINEER's opinion would not be practical to have stored on the site. Payment for off-site stored items shall be limited to 75% of the invoiced value of the item, less contract retainage. CONTRACTOR shall reimburse OWNER the cost of inspecting off-site stored items. When off-site storage is approved CONTRACTOR shall provide Insurance Certificates and Document of Ownership to OWNER.

No partial payments shall be permitted for line items for training, operation and maintenance manuals, or record drawing called for under Section 105.19.

CERTIFICATION



I hereby certify that this specification was prepared by me or under my direct supervision and that I am a duly Licensed Professional Engineer under the laws of the State of Wisconsin.

Jon I. Strand

Jon I. Strand, PE
Date: 6-12-2015 Lic. No. 29237
Reviewed By: *Susan D. Kuehn*

Date: 6-12-2015

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DOCUMENT 00 01 10

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SECTION 01 11 00
SUMMARY OF WORK

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Work Included in Contract Documents
 - 2. Contract Information
 - 3. Contractor Use of Premises
 - 4. Occupancy Requirements
 - 5. Products Ordered in Advance
 - 6. Work Restrictions

1.02 WORK INCLUDED IN CONTRACT DOCUMENTS

- A. Description of the Project:
 - 1. Well house upgrade and conversion to a two zone well.

1.03 CONTRACT INFORMATION

- A. Type of Contract: Owner will award a Single Prime Contract.
- B. Scope of Contract:
 - 1. This Contractor is solely responsible for the Work.
 - 2. The Contract will include:
 - a. Contract Forms:
 - 1) Agreement
 - 2) Performance Bond
 - 3) Payment Bond
 - 4) Certificates
 - b. Conditions of the Contract:
 - 1) General Conditions
 - 2) Supplementary Conditions
 - c. Specifications:
 - 1) Division 1 - General Requirements
 - 2) Applicable Technical Sections
 - d. Addenda
 - e. Contract Modifications

1.04 CONTRACTOR USE OF PREMISES

- A. Confine operations at Site to areas permitted under contract or as directed by Owner.
- B. Conform to site rules and regulations affecting Work while engaged in Project construction.
- C. Existing Structures:
 - 1. Keep existing driveways, and adjacent streets clear and available to public in accordance with Owner's or local authority's requirements.
 - 2. Maintain buildings in weathertight condition throughout the construction period.
 - 3. Protect building and occupants during construction period.
 - 4. Repair damages caused to existing public and private property and structures due to operations of Contractor to the satisfaction of, and at no additional cost to Owner.

5. Take complete field measurements affecting all existing construction, wiring, piping, and equipment in this Contract, and assume responsibility for proper fit between Work and existing structures and other equipment.
- D. Construction personnel may park only in areas designated by the Owner.
- E. Nonsmoking Building: Smoking is not permitted within the building or within 25 feet of entrances, operable windows, or outdoor air intakes.
- F. Damaged Property:
 1. Patch and/or clean existing improvements and restore damage of property on, or adjacent to Site occasioned by this Work, including, but not limited to, lawns, walks, curbs, pavements, roadways, structures, and utilities which are cut or damaged by operations and are not designated for removal, relocation, or replacement in the course of construction.
 2. Public Property or Utilities: Comply with laws, ordinances, rules, regulations, standards, orders of utility owner or any public authority having jurisdiction.
 3. Provide written acceptance of restoration work by authority or Owner.

1.05 OCCUPANCY REQUIREMENTS

- A. General Requirements:
 1. Cooperate with Owner to minimize conflict and to facilitate Owner's operations.
 2. Schedule the Work to accommodate this requirement.
 3. Coordinate activities which could cause interruption to Owner's activities.
 4. Provide not less than 72 hours notice to Owner of activities that will affect Owner's operations.
- B. Owner Occupation During Construction:
 1. Owner will occupy Site during the Work.
- C. Owner Occupancy of Completed Areas of Construction:
 1. Owner reserves the right to place and install equipment as necessary in completed areas of the facilities and to occupy such completed areas prior to Substantial Completion in accordance with the Supplementary Conditions. Such use shall not constitute acceptance of such portions of the Work or relieve the Contractor of any obligations except for improper use or damage caused by employees or agents of Owner.
 2. Obtain a Certificate of Occupancy from authorities having jurisdiction before Owner occupancy.
 3. Mechanical and electrical systems shall be fully operational and required tests and inspection successfully completed.

1.06 PRODUCTS ORDERED IN ADVANCE

- A. Storage:
 1. Products will be allowed to be stored at the Site prior to commencement of construction activities.
 2. Contractor shall store such items as directed by Owner.

1.07 WORK RESTRICTIONS

- A. On-Site Work Hours:
 1. Normal business working hours of 7:00 a.m. to 7:00 p.m. Monday through Friday.
 2. Weekend Hours: only with prior permission.
 3. Legal Holidays: defined in General Conditions.
 4. Hours for Utility Shutdowns: 7:00 am to 3:00 pm Monday through Friday.
- B. Existing Utility Interruption:
 1. Do not interrupt utilities serving facilities occupied by Owner or others without written permission by Owner.
 2. Notify Owner not less than 3 days in advance of proposed utility interruptions.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

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SECTION 01 21 00

ALLOWANCES

PART 1 GENERAL

1.01 SUMMARY

- A. Administrative and procedural requirements governing handling and processing allowances.
- B. Types of Allowances:
 - 1. Lump-sum allowance.
 - 2. Unit cost allowance
- C. Schedule of Allowances

1.02 DEFINITIONS

- A. A monetary amount or product quantity established by Owner to be included in Bid for an otherwise undefined item.
- B. Lump-Sum Allowance: Amount to be included in Contract Price to cover selection of products after Contract has been awarded.
- C. Unit Cost Allowance: Amount to be included in Contract Price for a single unit of Work when number of units is unknown or likely to change.

1.03 SELECTION AND PURCHASE

- A. At earliest feasible date after Contract award, advise Engineer of date when final selection and purchase of each product or system described by an allowance must be completed in order to avoid delay in performance of Work.
- B. When requested by Engineer, obtain proposals for each allowance for use in making final selections; include recommendations relevant to performance of Work.
- C. Purchase products and systems as selected by Engineer from designated supplier.

1.04 SUBMITTALS

- A. Proposals for Purchase of Products or Systems: Submit in form specified for Change Orders.
- B. Invoices or Delivery Slips: Submit to indicate actual quantities of materials delivered to Site.

1.05 LUMP SUM/UNIT COST ALLOWANCE

- A. Costs Included:
 - 1. Include the following costs; submit invoice from manufacturer to Engineer.
 - a. Wholesale cost of material.
 - b. Shipping cost.
 - c. Tax.
- B. Costs Not Included in Allowance (Include in Base Bid):
 - 1. Contractor/Subcontractor overhead and profit.
 - 2. Labor for installation.
 - 3. Accessory materials.

4. Incidental costs such as equipment rental.

1.06 UNUSED MATERIAL

- A. Return unused material to supplier for credit to Owner, after installation has been completed and accepted.
- B. When it is not economically practical to return material for credit, prepare unused material for storage by Owner and deliver when directed by Engineer.
- C. Disposal of material not wanted by Owner is Contractor's responsibility.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.01 INSPECTION

- A. Inspect products covered by allowance promptly upon delivery for damage or defects.

3.02 PREPARATION

- A. Coordinate materials, installation for each allowance with related materials and installations, to ensure that each is completely integrated and interfaced with related construction activities.

3.03 SCHEDULE OF ALLOWANCES

- A. Lump Sum Allowance: Include allowance of \$4,000 to be used for Tyco security system and Boldtronics video as specified in Division 26 09 01, as directed by Engineer.
- B. Unit Cost Allowance: Include allowance for per 300 linear feet of tuck pointing as specified in Section 04 20 00.
- C. Unit Cost Allowance: Include allowance for 100 square feet of tuck pointing as specified in Section 09 24 00.
- D. Unit Cost Allowance: Include allowance for 30 square feet of wall tile replacement as specified in Section 09 30 00.

END OF SECTION

SECTION 01 25 13

PRODUCT SUBSTITUTION PROCEDURES

PART 1 GENERAL

1.01 SUMMARY

- A. Administrative and procedural requirements for handling requests for substitutions.
- B. The following is not included in this Section:
 - 1. Procedural requirements governing Contractor's selection of product options (Section 01 60 00).

1.02 DEFINITIONS

- A. Definitions used in this Article are not intended to change or modify the meaning of other terms used in the Contract Documents.
- B. Substitutions: Requests for changes in products, materials, equipment and methods of construction required by Contract Documents proposed by Contractor.
- C. The following are not considered substitutions:
 - 1. Revisions to Contract Documents requested by Owner or Engineer.
 - 2. Specified options of products and construction methods included in Contract Documents.
 - 3. Contractor's determination of and compliance with governing regulations and orders issued by governing authorities.

1.03 SUBMITTALS

- A. Substitution Request Prior to Bid: For a Product Substitution to be considered, the following conditions must be met:
 - 1. All requests must be submitted in writing no later than 10 calendar days prior to the date for receipt of the bids.
 - 2. Faxed submittals will not be considered.
 - 3. Submit each request for substitution (one material or product per form) on the attached "Substitution Request Form" attached at the end of this section (either duplicated from the Project Manual or available from Engineer's office) together with a self-addressed, stamped envelope. Submittals not accompanied by this form properly filled in and endorsed will be discarded without review. NO EXCEPTIONS.
 - 4. Identify any impact of the substituted product on related items.
 - 5. Approved items will be listed in addenda. Requests for substitution will be returned in the self-addressed, stamped envelope provided by bidder at Engineer's earliest convenience.
- B. All substitutions permitted on addenda must meet or exceed requirements of the specifications including, but not limited to:
 - 1. Warranty.
- C. Substitution Request After Bid: Requests for substitution will be considered if received within 60 days after commencement of the work. Requests received more than 60 days after commencement of the work may be considered or rejected at the discretion of Engineer.
 - 1. Submit 3 copies of each request for substitution for consideration. Submit requests in the form and in accordance with procedures required for change order proposals.
 - 2. Identify the product, or the fabrication or installation method to be replaced in each request. Include related specification section and Drawing numbers.

3. Provide complete documentation showing compliance with the requirements for substitutions, and the following information, as appropriate:
 - a. Product data, including drawings and descriptions of products, fabrication and installation procedures.
 - b. Samples, where applicable or requested.
 - c. A detailed comparison of significant qualities of the proposed substitution with those of the work specified. Significant qualities may include elements such as size, weight, durability, performance and visual effect.
 - d. Coordination information, including a list of changes or modifications needed to other parts of the work and to construction performed by Owner and separate contractors, that will become necessary to accommodate the proposed substitution.
 - e. A statement indicating the substitution's effect on Contractor's construction schedule compared to the schedule without approval of the substitution. Indicate the effect of the proposed substitution on overall contract time.
 - f. Cost information, including a proposal of the net change, if any in the contract sum.
 - g. Certification by Contractor that the substitution proposed is equal-to or better in every significant respect to that required by the Contract Documents, and that it will perform adequately in the application indicated.
 - h. Include Contractor's waiver of rights to additional payment or time, which may subsequently become necessary because of the failure of the substitution to perform adequately.
- D. Substitution Conditions:
 1. Contractor's substitution request will be received and considered by Engineer when one or more of the following conditions are satisfied, as determined by Engineer, otherwise requests will be returned without action except to record noncompliance with these requirements:
 - a. Extensive revisions to Contract Documents are not required.
 - b. Proposed changes are in keeping with the general intent of Contract Documents.
 - c. The request is timely, fully documented and properly submitted.
 - d. Contractors and suppliers will be expected to provide the specified product unless prior approval is received from Engineer's office in sufficient time so that all bidders can be notified through an addendum.
 - e. The specified product or method of construction cannot be provided within the contract time. The request will not be considered if the product or method cannot be provided as a result of failure to pursue the work promptly or coordinate activities properly.
 - f. The specified product or method of construction cannot receive necessary approval by a governing authority, and the requested substitution can be approved.
 - g. A substantial advantage is offered to Owner, in terms of cost, time, energy conservation, or other considerations of merit, after deducting offsetting responsibilities Owner may be required to bear. Additional responsibilities for Owner may include additional compensation to Engineer for redesign and evaluation services, increased cost of other construction by Owner, or separate contractors, and similar considerations.
 - h. The specified product or method of construction cannot be provided in a manner that is compatible with other materials, and where Contractor certifies that the substitution will overcome the incompatibility.
 - i. The specified product or method of construction cannot be coordinated with other materials, and where Contractor certifies that the proposed substitution can be coordinated.
 - j. The specified product or method of construction cannot provide a warranty required by the Contract Documents and where Contractor certifies that the proposed substitution provides the required warranty.
 - k. Where a proposed substitution involves more than one prime contractor, each contractor shall cooperate with the other contractors involved to coordinate the work, provide uniformity and consistency, and to assure compatibility of products.
- E. Limitations: Contractor's submittal and Engineer's acceptance of Shop Drawings, Product Data, or Samples that relate to construction activities not complying with the Contract Documents does not constitute an acceptable or valid request for substitution, nor does it constitute approval.
- F. Substitution Causing Redesign: Engineer time for redesign as a result of substitution, will be charged to Owner, then deducted by Construction Change Directive from Contract Amount.

- G. Engineer's Action:
1. Request Prior to Bid: If approved, substitution will be included in an addendum.
 2. Request After Bid:
 - a. If necessary, within one week of receipt of the request for substitution, Engineer will request additional information or documentation necessary for evaluation of the request.
 - b. Within two weeks of receipt of the request, or one week of receipt of the additional information or documentation, whichever is later, Engineer will notify Contractor of acceptance or rejection of the proposed substitution.
 - c. If a decision on use of a proposed substitute cannot be made or obtained within the time allocated, use the product specified by name.
 - d. Acceptance will be in the form of a change order.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

SUBSTITUTION REQUEST FORM

TO: Attn: Jon Strand, PE
 Short Elliott Hendrickson Inc.
 10 North Bridge Street
 Chippewa Falls, WI 54729-2550
 715-720-6200

PROJECT: Unit Well 12 Upgrade and Conversion to a Two Zone Well

SECTION NO.	ARTICLE NO.	SPECIFIED PRODUCT	PROPOSED SUBSTITUTION
-------------	-------------	-------------------	-----------------------

- A. Does the substitution affect dimensions shown on Drawings? Yes No
- B. Does the substitution affect other trades? Yes No
- C. Does the manufacturer's guarantee differ from that specified? Yes No
- D. If you indicated "Yes" to Items A, B, or C above, attach a thorough explanation on your company letterhead.
- E. If there are other differences between proposed substitution and specified product, attach a thorough explanation on your company letterhead. If differences are not noted and acknowledged in writing by Engineer, product must comply with specification requirements.
- F. The proposed substitution was used within the last 24 months on the following project:
 Project Name _____
 Location _____
 Engineer _____
 Telephone No. _____
- G. Has the proposed substitution been used on an SEH project within the last 12 months? Yes No
 If yes, which project? _____

**All questions must be answered. Incomplete forms will not be reviewed.
 Include a self-addressed, stamped envelope for reply.**

Submitted By: _____

 Signature _____

 Firm _____

 Address _____

 Date _____

 Phone _____

 E-mail _____

For Use by Design Consultant	
<input type="checkbox"/>	Not Accepted, Not Enough Information
<input type="checkbox"/>	Not Accepted, Does Not Appear to be Equal
<input type="checkbox"/>	Accepted <input type="checkbox"/> Accepted as Noted
<input type="checkbox"/>	Received Too Late
By _____	
Date _____	
Remarks _____	

SECTION 01 33 00

SUBMITTAL PROCEDURES

PART 1 GENERAL

1.01 SUMMARY

- A. Requirements Included:
 - 1. Procedures
 - 2. Construction Progress Schedule
 - 3. Schedule of Values
 - 4. Shop Drawings
 - 5. Product Data
 - 6. Samples
 - 7. List of Proposed Subcontractors
 - 8. List of Proposed Suppliers
 - 9. Material Safety Data Sheets
 - 10. Payment Schedule

1.02 PROCEDURES

- A. Deliver submittals to Engineer at address listed in Project Manual with a Transmittal.
- B. Transmit each item under Engineer-accepted form.
 - 1. Identify Project, Contractor, subcontractor, major supplier.
 - 2. Identify pertinent Drawing sheet and detail number, and specification Section number.
 - 3. Identify deviations from Contract Documents.
 - 4. Provide space for Engineer and consultant review stamps.
- C. Submit initial progress schedules and schedule of values in duplicate within 10 days after date of Owner-Contractor Agreement. After review by Engineer, revise and resubmit as required.
- D. Submit revised schedules with each Application for Payment, reflecting changes since previous submittal.
- E. Comply with progress schedule for submittals related to Work progress. Coordinate submittal of related items.
- F. After Engineer review of submittal, revise and resubmit as required, identifying changes made since previous submittal.
- G. Distribute copies of reviewed submittals to concerned persons. Instruct recipients to promptly report any inability to comply with provisions.

1.03 CONSTRUCTION PROGRESS SCHEDULE

- A. Submit horizontal bar chart with separate bar for each major trade or operation, identifying first work day of each week.

1.04 SCHEDULE OF VALUES

- A. Submit typed schedule on 8-1/2 by 11-inch paper
- B. Format:
 - 1. Table of Contents of this Project Manual.
 - 2. Identify each line item with number and title of the major technical sections.

- C. Include in each line a directly proportional amount of Contractor's overhead and profit.
- D. Provide a subschedule for each separate stage of Work.
- E. Revise schedule to list Change Orders for each application for payment submittal.

1.05 SHOP DRAWINGS

- A. Shop Drawings will not be accepted for review by Engineer until after they have been checked and approved by the Contractor as evidenced by his approval stamp and signature.
- B. Submit all Shop Drawings electronically in pdf format via the Project website.
- C. Submit showing system fabrication, installation drawings including plans, elevations, section details of components, and configuration between system and adjoining systems.

1.06 PRODUCT DATA

- A. Mark each copy to identify applicable products, models, options, testing compliance, warranty, and other data; supplement manufacturers' standard data to provide information unique to the Work.
- B. Submit all Product Data electronically in pdf format via the Project website.
- C. Submit manufacturer's printed instructions for delivery, storage, assembly, installation start-up, adjusting, finishing, and maintenance.

1.07 SAMPLES

- A. Submit full range of manufacturer's standard colors, textures, and patterns for Engineer's selection. Submit samples for selection of finishes within 30 days after date of Contract.
- B. Submit samples to illustrate functional characteristics of the product, with integral parts and attachment devices. Coordinate submittal of different categories for interfacing Work.
- C. Include identification on each sample, giving full information.
- D. Submit the number specified in respective specification section; 1 will be retained by Engineer. Reviewed samples that may be used in the Work are indicated in the technical sections.
- E. Field Samples:
 - 1. Provide field samples of finishes as required by individual technical section.
 - 2. Install sample complete and finished.
 - 3. Acceptable samples in place may be retained in completed Work.

1.08 LIST OF PROPOSED SUBCONTRACTORS

- A. Submit a list of subcontractors who will provide Work on the Project.
- B. The submitted list shall include:
 - 1. Name of Subcontractor
 - 2. Address
 - 3. Type of work to be provided
 - 4. Contact list for administrative and supervisory personnel.

1.09 LIST OF PROPOSED SUPPLIERS

- A. Submit a list of suppliers who will provide materials, equipment or components principle to the Work.

- B. The submitted list should include:
 - 1. Name of supplier.
 - 2. Address.
 - 3. Equipment, material or component to be provided.
 - 4. Contact list for administrative and supervisory personnel.

1.10 MATERIAL SAFETY DATA SHEETS

- A. Submit MSDS to the Site on all products with chemical emissions and as called for in individual technical sections.

1.11 PAYMENT SCHEDULE

- A. Submit anticipated monthly payment schedule within 30 days after award of Contract, when requested by Engineer.
- B. Update whenever payment requests vary from the schedule by more than 10 percent.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

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SECTION 01 42 18

REFERENCE STANDARDS FOR INFRASTRUCTURE IMPROVEMENTS

PART 1 GENERAL

1.01 SUMMARY

- A. Quality Assurance.
- B. List of References.

1.02 QUALITY ASSURANCE

- A. For products or workmanship specified by Assoc., trade, or federal and state standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.
- B. Conform to reference standard by date of issue current on date of Contract Documents.
- C. Obtain copies of standards when required by Contract Documents.
- D. Maintain copy at jobsite during submittals, planning, and progress of the specific work, until Substantial Completion.
- E. Should specified reference standards conflict with Contract Documents, request clarification from Engineer before proceeding.
- F. The contractual relationship of the parties to the Contract shall not be altered from the Contract Documents by mention or inference otherwise in any reference document.

1.03 LIST OF NATIONAL REFERENCES

AABC	Associated Air Balance Council 1518 K Street NW Washington, DC 20005 202.737.0202 www.aabc.com	ADA	Americans with Disabilities Act US Dept. of Justice 950 Pennsylvania Avenue NW Civil Rights Division/Disability Rights Section - NYA Washington, DC 20530 800.514.0301 www.ada.gov
AASHTO	Am. Assoc. of State Hwy. & Transportation Officials 444 N. Capital Street NW, Ste. 249 Washington, DC 20001 202.624.5800 www.transportation.org	AGA	American Gas Assoc. 400 N. Capitol Street NW Washington, DC 20001 202.824.7000 www.aga.org
ABMA	American Bearing Manufacturers Association 2025 M Street, NW, Suite 800 Washington, DC 20036 202.367.1155	AGC	Associated General Contractors of America 2300 Wilson Boulevard., Ste. 400 Arlington, VA 22201 703.548.3118 www.agc.org
ACC	American Chemistry Council 700 Second Street NE Washington, DC 20002 202.249.7000 www.plastics.americanchemistry.com	AI	Asphalt Institute 2696 Research Park Drive Lexington, KY 40511-8480 859.288.4960 www.asphaltinstitute.org
ACEC	American Council of Engineering Companies 1015 15th Street, 8th Floor, NW Washington DC 20005-2605 202.347.7474 www.acec.org	AISI	American Iron & Steel Institute 1140 Connecticut Avenue NW, Ste. 705 Washington, DC 20036 202.452.7100 www.steel.org

ANSI	American National Standards Institute 1819 L Street NW, 6th Floor Washington, DC 20036 202.293.8020 www.ansi.org	EIMA	EIFS Industry Members Assoc. 513 West Broad Street, Ste. 210 Falls Church, VA 22046-3257 800.294.3462 www.eima.com
ARRA	Asphalt Recycling & Reclaiming Assoc. #3 Church Circle – PMB 250 Annapolis, MD 21401 410.267.0023 www.arra.org	EJCDC®	Engineers' Joint Contract Documents Committee® See ACEC, AGC, ASCE, and NSPE www.ejcdc.org
ASCE	American Society of Civil Engineers 1801 Alexander Bell Drive Reston, VA 20191-4400 800.548.2723 www.asce.org	EPA	U.S. Environmental Protection Agency Ariel Rios Building 1200 Pennsylvania Ave. NW Washington, DC 20004 202.272.0167 www.epa.gov
ASTM	American Society for Testing and Materials 100 Barr Harbor Drive West Conshohocken, PA 19428-2959 610.832.9500 www.astm.org	FEMA	Federal Emergency Management Assoc. 500 C Street SW Washington, DC 20472 800.621.3362 www.fema.gov
AWMA	Air & Waste Management Assoc. One Gateway Center, 3rd Floor 420 Fort Duquesne Blvd. Pittsburgh, PA 15222-1435 412.232.3444 www.awma.org	FMG	FM Global (Factory Mutual System) 270 Central Avenue, PO Box 7500 Johnston, RI 02919 401.275.3000 www.fmgglobal.com
AWWA	American Water Works Assoc. 6666 W. Quincy Avenue Denver, CO 80235 800.926.7337 www.awwa.org	Green Seal	Green Seal 1001 Connecticut Avenue NW, Ste. 827 Washington, DC 20036-5525 202.872.6400 www.greenseal.org
CDA	Copper Development Assoc. 260 Madison Avenue New York, NY 10016 212.251.7200 www.copper.org	Green-e	Green-e Program Center for Resource Solutions 1012 Torney Avenue, Second Floor PO Box 29512 San Francisco, CA 94129 415.561.2100 www.green-e.org
CPI	Concrete Paver Institute, a division of NCMA See ICPI	Green Guard	Greenguard Environmental Institute 2211 Newmarket Parkway, Ste. 110 Marietta, GA 30067 800.427.9681 www.greenguard.org
CLFMI	Chain Link Fence Manufacturers Institute 10015 Old Columbia Rd, Ste. B-215 Columbia, MD 21046 410.290.6267 www.chainlinkinfo.org	GRI	Geosynthetic Research Institute See GSI
CMRA	Construction Materials Recycling Assoc. 1001 I Street, PO Box 40125 Sacramento, CA 95812-4025 916.341.4027 www.calrecycle.ca.gov/RCP	GSI	Geosynthetic Institute 475 Kedron Avenue Folsom, PA 19033-1208 610.522.8440 www.geosynthetic-institute.org
CRSI	Concrete Reinforcing Steel Institute 933 North Plum Grove Road Schaumburg, IL 60173-4758 847.517.1200 www.crsi.org	ICEA	Insulated Cable Engineers Association, Inc. P.O. Box 1568 Carrollton, GA 30112 www.icea.net
CSI	Construction Specifications Institute 110 South Union Street, Ste. 100 Alexandria VA 22314 800.689.2900 www.csinet.org	ICPI	Interlocking Concrete Pavement Institute 13921 Park Center Road, Ste. 270 Herndon VA 20171 703.657.6900 www.icpi.org
DOE	U.S. Department of Energy 1000 Independence Ave. SW Washington DC 20585 202.586.5000 www.energy.gov	IMI	International Masonry Institute 42 East Street Annapolis, MD 21401 410.280.1305 www.imiweb.org
DOT	U.S. Department of Transportation 1200 New Jersey Ave, SE Washington, DC 20590 202.366.4000 www.dot.gov	IPBA	International Pipe Bursting Assoc. Division of NASSCO 410.486.3500 www.nassco.org/about_nassco/an_div_ipba.html
EEOC	Equal Employment Opportunity Commission 131 M Street NE Washington, DC 20507 800.669.4000 www.eeoc.gov	LEED	Leadership in Energy and Environmental Design See USGBC

MIA	Masonry Institute of America 22815 Frampton Avenue Torrance, CA 90501-5034 800.221.4000 www.masonryinstitute.org	NSSGA	National Stone, Sand & Gravel Assoc. 1605 King Street Alexandria, VA 22314 703.525.8788 www.nssga.org
MSS	Manufacturers Standardization Society of the Valve and Fitting Industry 127 Park St NE Vienna, VA 22180-4602 703.281.6613 www.mss-hq.com	OSHA	U. S. Occupational Safety and Health Administration 200 Constitution Avenue NW Washington, DC 20210 800.321.6742 www.osha.gov
MUTCD	Manual on Uniform Traffic Control Devices www.mutcd.fhwa.dot.gov	PCA	Portland Cement Assoc. 5420 Old Orchard Road Skokie, IL 60077 847.966.6200 www.cement.org
NACE	National Assoc. of Corrosion Engineers 1440 S. Creek Drive Houston, TX 77084-4906 281.228.6200 www.nace.org	PCI	Precast/Prestressed Concrete Institute 200 W. Adams Street, #2100 Chicago, IL 60606 312.786.0300 www.pci.org
NCMA	National Concrete Masonry Assoc. 13750 Sunrise Valley Drive Herndon, VA 20171-4662 703.713.1900 www.ncma.org	PCI Midwest	952.806.9997 www.midwestprecast.com
NEC	National Electric Code See NFPA	PPI	Plastics Pipe Institute 105 Decker Court, Ste. 825 Irving TX, 75062 469.499.1044 www.plasticpipe.org
NEBB	National Environmental Balancing Bureau 8575 Grovemont Circle Gaithersburg, MD 20877 301.977.3698 www.nebb.org	SSPC	Society for Protective Coatings 40 24th Street, 6th Floor Pittsburgh, PA 15222-4656 877.281.7772 www.sspc.org
NEMA	National Electrical Manufacturers Assoc. 1300 N. 17th Street., Ste. 1752 Rosslyn, VA 22209 703.841.3200 www.nema.org	TMS	The Masonry Society 105 South Sunset Street, Ste. Q Longmont, Colorado, 80501-6172 303.939.9700 www.masonrysociety.org
NFPA	National Fire Protection Assoc. 1 Batterymarch Park Quincy, MA 02169-7471 617.770.3000 www.nfpa.org	TPI	Turfgrass Producers International 2 East Main Street East Dundee, IL 60118 800.405.8873 www.turfgrasssod.org
NIOSH	National Institute for Occupational Safety and Health Centers for Disease Control and Prevention 1600 Clifton Road Atlanta, GA 30333 800.232.4636 www.cdc.gov/niosh	UL	Underwriters' Laboratories, Inc. 2600 N.W. Lake Rd. Camas, WA 98607-8542 877.854.3577 www.ul.com
NPCA	National Precast Concrete Assoc. 1320 City Center Drive, Suite 200 Carmel, IN 46032 800.366.7731 www.precast.org	USACE	U.S. Army Corps of Engineers Publication Department 2803 52nd Avenue Hyattsville, MD 20781-1102 301.394.0081 www.usace.army.mil
NPDES	National Pollutant Discharge Elimination System www.epa.gov	USGBC	U.S. Green Building Council 2101 L Street, Ste. 500 Washington DC 20037 800.795.1747 www.usgbc.org
NSF	NSF International 789 N. Dixboro Road, PO Box 130140 Ann Arbor, MI 48113-0140 800.673.6275 www.nsf.org	WQA	Water Quality Assoc. 4151 Naperville Road Lisle, IL 60532-3696 630.505.0160 www.wqa.org
NSPE	National Society of Professional Engineers 1420 King Street Alexandria, VA 22314-2794 703.684.2800 www.nspe.org		
NSWMA	National Solid Wastes Management Assoc. 4301 Connecticut Avenue NW, Ste. 300 Washington, DC 20008 800.424.2869 www.environmentalistseveryday.org/about-nswma-solid-waste-management		

1.04 LIST OF STATE REFERENCES

WISCONSIN

WDNR Wisconsin Department of Natural Resources
101 S. Webster, PO Box 7921
Madison, WI 53707
608.266.2621 www.dnr.wi.gov

WisDOT Wisconsin Department of Transportation
4802 Sheboygan Avenue, PO Box 7916
Madison, WI 53707
www.dot.state.wi.us

WEDC Wisconsin Economic Development Corporation
PO Box 7962
Madison, WI 53707
www.wedc.org

WMUTCD WI Manual on Uniform Traffic Control Devices
Division of Transportation
4802 Sheboygan Avenue
Madison, WI 53707
608.266.0150 www.dot.Wisconsin.gov

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

SECTION 01 42 19

REFERENCE STANDARDS FOR BUILDING CONSTRUCTION

PART 1 GENERAL

1.01 SUMMARY

- A. Quality Assurance.
- B. List of References.

1.02 QUALITY ASSURANCE

- A. For products or workmanship specified by Assoc., trade, or federal and state standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.
- B. Conform to reference standard by date of issue current on date of Contract Documents.
- C. Obtain copies of standards when required by Contract Documents.
- D. Maintain copy at jobsite during submittals, planning, and progress of the specific work, until Substantial Completion.
- E. Should specified reference standards conflict with Contract Documents, request clarification from Engineer before proceeding.
- F. The contractual relationship of the parties to the Contract shall not be altered from the Contract Documents by mention or inference otherwise in any reference document.

1.03 LIST OF NATIONAL REFERENCES

AA	Aluminum Assoc. 1525 Wilson Boulevard, Ste. 600 Arlington, VA 22209 703.358.2960 www.aluminum.org	ACC	American Chemistry Council 700 Second Street NE Washington, DC 20002 202.249.7000 www.plastics.americanchemistry.com
AABC	Associated Air Balance Council 1518 K Street NW Washington, DC 20005 202.737.0202 www.aabc.com	ACEC	American Council of Engineering Companies 1015 15th Street, 8th Floor, NW Washington DC 20005-2605 202.347.7474 www.acec.org
AAMA	American Architectural Manufacturer's Assoc. 1827 Walden Office Square, Ste. 550 Schaumburg, IL 60173-4268 847.303.5664 www.aamanet.org	ACIL	American Council of Independent Laboratories 1875 I Street, NW, Ste. 500 Washington, DC 20006 202.887.5872 www.acil.org
AASHTO	Am. Assoc. of State Hwy. & Transportation Officials 444 N. Capital Street NW, Ste. 249 Washington, DC 20001 202.624.5800 www.transportation.org	ACS	American Ceramic Society 600 N. Cleveland Avenue, Ste. 210 Westerville, OH 43082 866.721.3322 www.acers.org
AATCC	American Assoc. of Textile Chemists and Colorists 1 Davis Drive, PO Box 12215 Research Triangle Park, NC 27709-2215 919.549.8141 www.aatcc.org	ADA	Americans with Disabilities Act US Dept. of Justice 950 Pennsylvania Avenue NW Civil Rights Division/Disability Rights Section - NYA Washington, DC 20530 800.514.0301 www.ada.gov
ACAC	American Council for Accredited Certification PO Box 1000 Yarnell, AZ 85362 888.808.8381 www.acac.org		

AGA	American Gas Assoc. 400 N. Capitol Street NW Washington, DC 20001 202.824.7000 www.aga.org	ARMA	Asphalt Roofing Manufacturers Assoc. Public Information Department 750 National Press Building 529 14th Street NW Washington, DC 20045 202.207.0917 www.asphaltroofing.org
AGC	Associated General Contractors of America 2300 Wilson Boulevard., Ste. 400 Arlington, VA 22201 703.548.3118 www.agc.org	ARRA	Asphalt Recycling & Reclaiming Assoc. #3 Church Circle – PMB 250 Annapolis, MD 21401 410.267.0023 www.arra.org
AGMA	American Gear Manufacturers Assoc. 1001 N. Fairfax Street, Ste. 500 Alexandria, VA 22314-1587 703.684.0211 www.agma.org	ASA	Acoustical Society of America Suite 1NO1 2 Huntington Quadrangle 516.576.2360 www.acousticalsociety.org
AHMA	American Hardware Manufacturers 801 N. Plaza Drive Schaumburg, IL 60173-4977 847.605.1025 www.ahma.org	ASC	Adhesive and Sealant Council 7101 Wisconsin Avenue, Ste. 990 Bethesda, Maryland 20814 301.986.9700 www.ascouncil.org
AHRI	Air-Conditioning, Heating, and Refrigeration Institute 2111 Wilson Boulevard, Ste. 500 Arlington, VA 22201 703.524.8800 www.ahrinet.org	ASCE	American Society of Civil Engineers 1801 Alexander Bell Drive Reston, VA 20191-4400 800.548.2723 www.asce.org
AI	Asphalt Institute 2696 Research Park Drive Lexington, KY 40511-8480 859.288.4960 www.asphaltinstitute.org	ASHRAE	American Society of Heating, Refrigerating & Air Conditioning Engineering 1791 Tullie Circle NE Atlanta, GA 30329-2305 800.527.4723 www.ashrae.org
AIA	American Institute of Architects 1735 New York Avenue NW Washington, DC 20006-5292 800.242.3837 www.aia.org	ASI	Australian Steel Institute Level 13, 99 Mount Street North Sidney NSW 2060 www.steel.org.au
AISI	American Iron & Steel Institute 1140 Connecticut Avenue NW, Ste. 705 Washington, DC 20036 202.452.7100 www.steel.org	ASID	American Society of Interior Designers 608 Massachusetts Avenue NE Washington DC 20002-6006 202.546.3480 www.asid.org
AITC	American Institute of Timber Construction 7012 S. Revere Parkway, Ste. 140 Centennial, CO 80112 303.792.9559 www.aitc-glulam.org	ASLA	American Society of Landscape Architects 636 Eye Street NW Washington DC 20001-3736 202.898.2444 www.asla.org
ALSC	American Lumber Standards Committee PO Box 210 Germantown, MD 20875-0210 301.972.1700 www.alsc.org	ASME	American Society of Mechanical Engineers 22 Law Drive, PO Box 2300 Fairfield, NJ 07007-2300 800.843.2763 www.asme.org
AMCA	Air Movement & Control Assoc. 30 W. University Drive Arlington Heights, IL 60004 847.394.0150 www.amca.org	ASTM	American Society for Testing and Materials 100 Barr Harbor Drive West Conshohocken, PA 19428-2959 610.832.9500 www.astm.org
ANSI	American National Standards Institute 1819 L Street NW, 6th Floor Washington, DC 20036 202.293.8020 www.ansi.org	ATHENA	Athena Sustainable Materials Institute 119 Ross Avenue, Ste. 100 Ottawa, Ontario, Canada K1Y 0N6 613.729.9996 www.athenasmi.org
APA	APA - The Engineered Wood Assoc. 7011 S. 19th Street Tacoma, WA 98466-5333 253.565.6600 www.apawood.org	AWI	Architectural Woodwork Institute 46179 Westlake Drive, Ste. 120 Potomac Falls, VA 20165-5874 571.323.3636 www.awinet.org
API	American Petroleum Institute 1220 L Street NW Washington, DC 20005-4070 202.682.8000 www.api.org	AWMA	Air & Waste Management Assoc. One Gateway Center, 3rd Floor 420 Fort Duquesne Blvd. Pittsburgh, PA 15222-1435 412.232.3444 www.awma.org

AWPA	American Wood Protection Assoc. 100 Chase Park South, Ste. 116 Birmingham, AL 35244-1851 205.733.4077 www.awpa.com	CPI	Concrete Paver Institute, a division of NCMA See ICPI
AWPC	American Wind Power Center 1701 Canyon Lake Drive Lubbock, TX 79403 806.747.8734 www.windmill.com	CISCA	Ceilings & Interiors Systems Construction Assoc. 405 Illinois Avenue, 2B St Charles IL 60174 630.584.1919 www.cisca.org
AWS	American Welding Society 550 NW LeJeune Road Miami, FL 33126 800.443.9353 www.aws.org	CLFMI	Chain Link Fence Manufacturers Institute 10015 Old Columbia Rd, Ste. B-215 Columbia, MD 21046 410.290.6267 www.chainlinkinfo.org
AWWA	American Water Works Assoc. 6666 W. Quincy Avenue Denver, CO 80235 800.926.7337 www.awwa.org	CMRA	Construction Materials Recycling Assoc. 1001 I Street, PO Box 40125 Sacramento, CA 95812-4025 916.341.4027 www.calrecycle.ca.gov/RCP
BFRL	Building and Fire Research Laboratory See NIST	CPSC	Consumer Product Safety Commission 4330 E-W Highway Bethesda, MD 20814-4408 800.638.2772 www.cpsc.gov
BHMA	Builders Hardware Manufacturers Assoc. 355 Lexington Avenue, 15th Floor New York, NY 10017 212.297.2122 www.buildershardware.com	CRA	California Redwood Assoc. 818 Grayson Road, Suite 201 Pleasant Hill, CA 94523 888.225.7339 www.calredwood.org
BIA	Brick Industry Assoc. 1850 Centennial Park Drive, Ste. 301 Reston, VA 20191 703.620.0010 www.gobrick.com	CRI	Carpet and Rug Institute 730 College Drive, PO Box 2048 Dalton, GA 30722-2048 706.278.3176 www.carpet-rug.org
BIFMA	Business and Institutional Furniture Manufacturer's Assoc. 678 Front Avenue NW, Ste. 150 Grand Rapids, MI 49504-5368 616.285.3963 www.bifma.com	CRRA	Cool Roof Rating Council 1610 Harrison Street Oakland, CA 94612 866.465.2523 www.coolroofs.org
BMRA	Building Material Reuse Association PO Box 47776 Chicago, IL 60647 773.340.2672 www.bmra.org	CRSI	Concrete Reinforcing Steel Institute 933 North Plum Grove Road Schaumburg, IL 60173-4758 847.517.1200 www.crsi.org
Building Green	BuildingGreen, LLC 122 Birge Street, Ste. 300 Brattleboro, VT 05301 802.257.7300 www.buildinggreen.com	CSBA	California Straw Buildings Assoc. PO B 1293 Angels Camp, CA 95222 209.785.7077 www.strawbuilding.org
CDA	Copper Development Assoc. 260 Madison Avenue New York, NY 10016 212.251.7200 www.copper.org	CSI	Construction Specifications Institute 110 South Union Street, Ste. 100 Alexandria VA 22314 800.689.2900 www.csinet.org
CFPA	Chlorine Free Products Assoc. 19 N. Main Street Algonquin, IL 60102 847.658.6104 www.chlorinefreeproducts.org	CSSB	Cedar Shingle and Shake Bureau PO Box 1178 Sumas, WA 98295-1178 604.820.7700 www.cedarbureau.org
CGA	Canadian Gas Assoc. 350 Sparks Street, Ste. 809 Ottawa, Ontario K1R 7S8 613.748.0057 www.cga.ca	DHI	Door and Hardware Institute 14150 Newbrook Drive, Ste. 200 Chantilly, VA 20151-2232 703.222.2010 www.dhi.org
CGA	Compressed Gas Assoc. 14501 George Carter Way, Ste. 103 Chantilly, VA 20151 703.788.2700 www.cganet.com	DOE	U.S. Department of Energy 1000 Independence Ave. SW Washington DC 20585 202.586.5000 www.energy.gov
CI	Chlorine Institute, Inc. 1300 Wilson Boulevard, Ste. 525 Arlington, VA 22209 703.894.4140 www.chlorineinstitute.org	DOT	U.S. Department of Transportation 1200 New Jersey Ave, SE Washington, DC 20590 202.366.4000 www.dot.gov

EEOC	Equal Employment Opportunity Commission 131 M Street NE Washington, DC 20507 800.669.4000 www.eeoc.gov	GSA	U.S. GENERAL SERVICES ADMINISTRATION 1800 F Street, NW Washington, DC 20405 Ph: 202.501.0800 Internet: www.GSA.gov Obtain documents from: Acquisition Streamlining and Standardization Information System (ASSIST) Department of Defense Single Stock Point (DODSSP) Document Automation and Production Service (DAPS) Building 4/D 700 Robbins Avenue Philadelphia, PA 19111-5094 Ph: 215.697.6396 - for account/password issues Internet: http://assist.daps.dla.mil/online/start/ ; account registration required
EIMA	EIFS Industry Members Assoc. 513 West Broad Street, Ste. 210 Falls Church, VA 22046-3257 800.294.3462 www.eima.com		
EJCDC®	Engineers' Joint Contract Documents Committee® See ACEC, AGC, ASCE, and NSPE www.ejcdc.org		
EJMA	Expansion Joint Manufacturers Assoc. 25 N. Broadway Tarrytown, NY 10591 914.332.0040 www.ejma.org		
EPA	U.S. Environmental Protection Agency Ariel Rios Building 1200 Pennsylvania Ave. NW Washington, DC 20004 202.272.0167 www.epa.gov	GSI	Geosynthetic Institute 475 Kedron Avenue Folsom, PA 19033-1208 610.522.8440 www.geosynthetic-institute.org
FEMA	Federal Emergency Management Assoc. 500 C Street SW Washington, DC 20472 800.621.3362 www.fema.gov	HHS	Department of Health and Human Services 200 Independence Ave. SW Washington DC 20201 877.696.6775 www.hhs.gov
FMG	FM Global (Factory Mutual System) 270 Central Avenue, PO Box 7500 Johnston, RI 02919 401.275.3000 www.fmgglobal.com	HI	Hydraulic Institute 6 Campus Drive, First Floor North Parsippany NJ, 07054-4406 973.267.9700 www.pumps.org
FSCUS	Forest Stewardship Council-US 212 Third Avenue North, Ste. 504 Minneapolis, MN 55401 612.353.4511 www.fscus.org	HPVA	Hardwood Plywood & Veneer Assoc. 1825 Michael Faraday Drive Reston, Virginia 20190 703.435.2900 www.hpva.org
GA	Gypsum Assoc. 6525 Belcrest Road, Ste. 480 Hyattsville, MD 20782 301.277.8686 www.gypsum.org	HUD	U.S. Dept. of Housing & Urban Development 451 7th Street SW Washington, DC 20410 202.708.1112 www.hud.gov
GANA	Glass Assoc. of North America 800 SW Jackson Street, Ste. 1500 Topeka, KS 66612-1200 785.271.0208 www.glasswebsite.com	IBC	International Building Code See ICC
Green Seal	Green Seal 1001 Connecticut Avenue NW, Ste. 827 Washington, DC 20036-5525 202.872.6400 www.greenseal.org	ICBO	International Conference of Building Officials See ICC
Green-e	Green-e Program Center for Resource Solutions 1012 Torney Avenue, Second Floor PO Box 29512 San Francisco, CA 94129 415.561.2100 www.green-e.org	ICC	International Code Council 500 New Jersey Avenue NW, 6th Floor Washington, DC 20001 888.422.7233 www.iccsafe.org
Green Guard	Greenguard Environmental Institute 2211 Newmarket Parkway, Ste. 110 Marietta, GA 30067 800.427.9681 www.greenguard.org	ICPI	Interlocking Concrete Pavement Institute 13921 Park Center Road, Ste. 270 Herndon VA 20171 703.657.6900 www.icpi.org
GRI	Geosynthetic Research Institute See GSI	IEEE	Institute of Electrical and Electronics Engineers 445 Hoes Lane Piscataway, NJ 08854-4141 732.981.0060 www.ieee.org
		IGCC	Insulating Glass Certification Council PO Box 730 Sackets Harbor, NY 13685 315.646.2234 www.igcc.org
		IGMA	Insulating Glass Manufacturers Assoc. 27 N. Wacker Drive, Ste. 365 Chicago, IL 60606-2800 613.233.1510 www.igmaonline.org

IMI	International Masonry Institute 42 East Street Annapolis, MD 21401 410.280.1305 www.imiweb.org	NACE	National Assoc. of Corrosion Engineers 1440 S. Creek Drive Houston, TX 77084-4906 281.228.6200 www.nace.org
IPBA	International Pipe Bursting Assoc. Division of NASSCO 410.486.3500 www.nassco.org/about_nassco/an_div_ipba.html	NCAA	National Collegiate Athletic Assoc. 700 W. Washington Street, PO Box 6222 Indianapolis, IN 46206-6222 317.917.6222 www.ncaa.org
KCMA	Kitchen Cabinet Manufacturers Assoc. 1899 Preston White Drive Reston, VA 20191-5435 703.264.1690 www.kcma.org	NCMA	National Concrete Masonry Assoc. 13750 Sunrise Valley Drive Herndon, VA 20171-4662 703.713.1900 www.ncma.org
LEED	Leadership in Energy and Environmental Design See USGBC	NCRP	National Council on Radiation Protection 7910 Woodmont Avenue, Ste. 400 Bethesda, MD 20814-3095 301.657.2652 www.ncrp.org
MBMA	Metal Building Manufacturers Assoc. 1300 Sumner Avenue Cleveland, OH 44115-2851 216.241.7333 www.mbma.com	NEBB	National Environmental Balancing Bureau 8575 Grovemont Circle Gaithersburg, MD 20877 301.977.3698 www.nebb.org
MFMA	Maple Flooring Manufacturers Assoc., Inc. 111 Deer Lake Road, Ste. 100 Deerfield, IL 60015 888.480.9138 www.maplefloor.org	NEC	National Electric Code See NFPA
MHIA	Material Handling Industry of America 8720 Red Oak Boulevard, Ste. 201 Charlotte, NC 28217-3992 704.676.1190 www.mhia.org	NECA	National Electrical Contractors Assoc. 3 Bethesda Metro Center, Ste. 1100 Bethesda, MD 20814 301.657.3110 www.necanet.org
MIA	Masonry Institute of America 22815 Frampton Avenue Torrance, CA 90501-5034 800.221.4000 www.masonryinstitute.org	NEMA	National Electrical Manufacturers Assoc. 1300 N. 17th Street, Ste. 1752 Rosslyn, VA 22209 703.841.3200 www.nema.org
MIL	Military Specifications DODSSP (Dept. of Defense) Bldg. 4, Section D 700 Robbins Avenue Philadelphia, PA 19111-5098 215.697.2179 www.dsp.dla.mil	NFPA	National Fire Protection Assoc. 1 Batterymarch Park Quincy, MA 02169-7471 617.770.3000 www.nfpa.org
MPI	Master Painters Institute 2800 Ingleton Avenue Burnaby, B.C.Canada V5C 6G7 888.674.8937 www.mpi.net www.paintinfo.com	NFSA	National Federation of State High School Assoc. PO Box 690 Indianapolis, IN 46206 317.972.6900 www.nfhs.org
MSHA	Mine Safety and Health Administration 1100 Wilson Blvd., 21st Floor Arlington, VA 22209-3939 202.693.9400 www.msha.gov	NHLA	National Hardwood Lumber Assoc. PO Box 34518 Memphis, TN 38184-0518 901.377.1818 www.nhla.com
MSS	Manufacturers Standardization Society of the Valve and Fitting Industry 127 Park St NE Vienna, VA 22180-4602 703.281.6613 www.mss-hq.com	NIBS	National Institute of Building Sciences 1090 Vermont Avenue NW, Ste. 700 Washington DC 20005-4905 202.289.7800 www.nibs.org
MUTCD	Manual on Uniform Traffic Control Devices www.mutcd.fhwa.dot.gov	NIJ	National Institute of Justice 810 Seventh Street NW Washington, DC 20531 202.307.2942 www.ojp.usdoj.gov
NAAMM	National Assoc. of Architectural Metal Manufacturers 800 Roosevelt Rd. Bldg. C, Suite 312 Glen Ellyn, IL 60137 630.942.6591 www.naamm.org	NIST	NIST - Building and Fire Research Laboratory 100 Bureau Drive, Stop 1070 Gaithersburg, MD 20899-1070 301.975.6478 www.fire.nist.gov

NIOSH	National Institute for Occupational Safety and Health Centers for Disease Control and Prevention 1600 Clifton Road Atlanta, GA 30333 800.232.4636 www.cdc.gov/niosh	NWWDA	National Wood Window and Door Assoc. See WDMA
NLC	National League of Cities 1301 Pennsylvania Avenue NW, Ste. 550 Washington, DC 20004 202.626.3100 www.nlc.org	OSHA	U. S. Occupational Safety and Health Administration 200 Constitution Avenue NW Washington, DC 20210 800.321.6742 www.osha.gov
NLGA	National Lumber Grades Authority 105 - 13401 108th Avenue Surrey BC V3T 5T3 604.584.2393 www.nlga.org	PCA	Portland Cement Assoc. 5420 Old Orchard Road Skokie, IL 60077 847.966.6200 www.cement.org
NPCA	National Precast Concrete Assoc. 1320 City Center Drive, Suite 200 Carmel, IN 46032 800.366.7731 www.precast.org	PCI	Precast/Prestressed Concrete Institute 200 W. Adams Street, #2100 Chicago, IL 60606 312.786.0300 www.pci.org
NPDES	National Pollutant Discharge Elimination System www.epa.gov	PCI Midwest	952.806.9997 www.midwestprecast.com
NPIC	National Pesticide Information Center Oregon State University 333 Weniger Hall Corvallis, OR 97331-6502 800.858.7378 www.npic.orst.edu	PDCA	Painting and Decorating Contractors of America 1801 Park 270 Drive, Ste. 220 St. Louis, MO 63146 800.332.7322 www.pdca.org
NRCA	National Roofing Contractors Assoc. 10255 W. Higgins Road Ste. 600 Rosemont, IL 60018-5607 847.299.9070 www.nrca.net	PEI	Porcelain Enamel Institute, Inc. P. O. Box 920220, Norcross, GA 30010 PO Box 920220 Norcross, GA 30010 770.676.9366 www.porcelainenamel.com
NSF	NSF International 789 N. Dixboro Road, PO Box 130140 Ann Arbor, MI 48113-0140 800.673.6275 www.nsf.org	PPI	Plastics Pipe Institute 105 Decker Court, Ste. 825 Irving TX, 75062 469.499.1044 www.plasticpipe.org
NSPE	National Society of Professional Engineers 1420 King Street Alexandria, VA 22314-2794 703.684.2800 www.nspe.org	SBIC	Sustainable Buildings Industry Council 1090 Vermont Avenue NW, Ste. 700 Washington, DC 20005 202.289.7800 www.sbicouncil.org
NSWMA	National Solid Wastes Management Assoc. 4301 Connecticut Avenue NW, Ste. 300 Washington, DC 20008 800.424.2869 www.environmentalistseveryday.org/about-nswma-solid-waste-management	RCI	Roof Consultants Institute 1500 Sunday Drive, Ste. 204 Raleigh, NC 27607 800.828.1902 www.rci-online.org
NSSGA	National Stone, Sand & Gravel Assoc. 1605 King Street Alexandria, VA 22314 703.525.8788 www.nssga.org	RFCI	Resilient Floor Covering Institute 115 Broad Street, Ste. 201 La Grange GA 30240 706.882.3833 www.rfci.com
NTMA	National Terrazzo & Mosaic Assoc. 138 West Lower Crabapple, PO Box 2605 Fredericksburg, TX 78624 800.323.9736 www.ntma.com	RMA	Rubber Manufacturers Assoc. 1400 K Street NW, Ste. 900 Washington, DC 20005 202.682.4800 www.rma.org
NVLAP	National Voluntary Laboratory Accreditation Program 100 Bureau Drive, Stop 1070 Gaithersburg, MD 20899-1070 301.975.6478 www.nist.gov/nvlap	RPA	Radiant Professional Alliance 18927 Hickory Creek Drive, Ste. 140 Mokena, IL 60448 708.995.3003 www.radiantprofessionalsalliance.org
NWFA	National Wood Flooring Association 111 Chesterfield Industrial Boulevard Chesterfield, MO 63005 800.422.4556 www.nwfa.org	SDI	Steel Deck Institute PO Box 25 Fox River Grove, IL 60021 847.458.4647 www.sdi.org

SDI	Steel Door Institute 30200 Detroit Road Cleveland, OH 44145-1967 440.899.0010 www.steeldoor.org	UL	Underwriters' Laboratories, Inc. 2600 N.W. Lake Rd. Camas, WA 98607-8542 877.854.3577 www.ul.com
SIA	Security Industry Assoc. 635 Slaters Lane, Ste. 110 Alexandria, VA 22314 703.683.2075 www.siaonline.org	USACE	U.S. Army Corps of Engineers Publication Department 2803 52nd Avenue Hyattsville, MD 20781-1102 301.394.0081 www.usace.army.mil
SIGMA	Sealed Insulating Glass Manufacturers Assoc. See IGMA	USGBC	U.S. Green Building Council 2101 L Street, Ste. 500 Washington DC 20037 800.795.1747 www.usgbc.org
SJI	Steel Joist Institute 234 W. Cheves Street Florence, SC 29501 843.407.4091 www.steeljoist.org	VSI	Vinyl Siding Institute, Inc. National Housing Center 1201 15th Street NW, Ste. 220 Washington, DC 20005 202.587.5100 www.vinylsiding.org
SMACNA	Sheet Metal & Air Conditioning Contractors' National Assoc. 4201 Lafayette Center Drive Chantilly, VA 20150-1209 703.803.2980 www.smacna.org	WCLIB	West Coast Lumber Inspection Bureau PO Box 23145 Portland, OR 97281 503.639.0651 www.wclib.org
SPRI	Single Ply Roofing Industry 411 Waverley Oaks Road, Ste. 331B Waltham, MA 02453 781.647.7026 www.spri.org	WCSC	Window Covering Safety Council 355 Lexington Avenue, Ste. 1500 New York NY 10017 212.297.2100 www.windowcoverings.org
SSMA	Steel Stud Manufacturer's Assoc. 35 East Wacker Drive, Ste. 850 Chicago, IL 60601-2106 312.224.2570 www.ssma.com	WDMA	Window & Door Manufacturer's Assoc. 401 N. Michigan Avenue, Ste. 2200 Chicago, IL 60611 312.321.6802 www.wdma.org
SSPC	Steel Structures Painting Council 40 24th Street, 6th Floor Pittsburgh, PA 15222-4656 877.281.7772 www.sspc.org	WHI	Warnock Hersey Institute (several locations - now Intertek Testing Service) 7250 Hudson Boulevard, Ste. 100 St. Paul, MN 55128 651.730.1188 www.intertek.com
SSPC	Society for Protective Coatings 40 24th Street, 6th Floor Pittsburgh, PA 15222-4656 877.281.7772 www.sspc.org	WQA	Water Quality Assoc. 4151 Naperville Road Lisle, IL 60532-3696 630.505.0160 www.wqa.org
TCNA	Tile Council of North America, Inc. 100 Clemson Research Boulevard Anderson, SC 29625 864.646.8453 www.tileusa.com	WWPA	Western Wood Products Assoc. 522 SW 5th Avenue, Ste. 500 Portland, OR 97204-2122 503.224.3930 www2.wwpa.org
TIA/EIA	Telecommunications Industry Assoc./ Electronic Industries Alliance 2500 Wilson Boulevard, Ste. 300 Arlington, VA 22201 TIA: 703.907.7700 www.tiaonline.org EIA: 703.907.7500 www.eia.org		
TMS	The Masonry Society 105 South Sunset Street, Ste. Q Longmont, Colorado, 80501-6172 303.939.9700 www.masonrysociety.org		
TPI	Turfgrass Producers International 2 East Main Street East Dundee, IL 60118 800.405.8873 www.turfgrassod.org		
UBMA	Used Building Materials Assoc. See BMRA		

1.04 LIST OF STATE REFERENCES

WISCONSIN

WDNR	Wisconsin Department of Natural Resources 101 S. Webster, PO Box 7921 Madison, WI 53707 608.266.2621 www.dnr.wi.gov
WisDOT	Wisconsin Department of Transportation 4802 Sheboygan Avenue, PO Box 7916 Madison, WI 53707 www.dot.state.wi.us
WEDC	Wisconsin Economic Development Corporation PO Box 7962 Madison, WI 53707 www.wedc.org

WMUTCD WI Manual on Uniform Traffic Control Devices
Division of Transportation
4802 Sheboygan Avenue
Madison, WI 53707
608.266.0150 www.dot.Wisconsin.gov

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

SECTION 01 45 29

TESTING LABORATORY SERVICES

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Selection and Payment
 - 2. Quality Assurance
 - 3. Contractor Submittals
 - 4. Laboratory Responsibilities
 - 5. Laboratory Reports
 - 6. Limits on Testing Laboratory Authority
 - 7. Contractor Responsibilities
 - 8. Retesting
- B. Related Sections:
 - 1. Section 01 33 00 - Submittal Procedures: Manufacturer's certificates
 - 2. Section 01 75 00 - Starting and Adjusting: Testing, adjusting, and balancing of systems
 - 3. Section 01 77 00 - Closeout Procedures: Project Record Documents
- C. Individual Specification Sections: Inspections and tests required, and standards for testing.

1.02 REFERENCES

- A. ANSI/ASTM:
 - 1. D3740 - Practice for Evaluation of Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction
 - 2. E329 - Recommended Practice for Inspection and Testing Agencies for Concrete, Steel, and Bituminous Materials as Used in Construction

1.03 SELECTION AND PAYMENT

- A. Owner will employ and pay for services of an independent testing laboratory CGC, Inc. of Madison to perform geotechnical and material testing.
- B. Employment of testing laboratory shall in no way relieve Contractor of obligation to perform work in accordance with requirements of Contract Documents.

1.04 QUALITY ASSURANCE

- A. Comply with requirements of ANSI/ASTM D3740 and ANSI/ ASTM E329.
- B. Laboratory: Authorized to operate in state in which Project is located.
- C. Laboratory Staff: Maintain a full time registered Engineer specialist on staff to review services.
- D. Testing Equipment: Calibrated at reasonable intervals with devices of an accuracy traceable to either National Bureau of Standards (NBS) Standards or accepted values of natural physical constants.

1.05 CONTRACTOR SUBMITTALS

- A. Prior to start of Work, submit testing laboratory name, address, and telephone number, and names of full time registered Engineer specialist and responsible officer.

- B. Submit copy of report of laboratory facilities inspection made by Materials Reference Laboratory of National Bureau of Standards (NBS) during most recent tour of inspection, with memorandum of remedies of any deficiencies reported by the inspection.

1.06 LABORATORY RESPONSIBILITIES

- A. Test samples of mixes submitted by Contractor.
- B. Provide qualified personnel at site. Cooperate with Engineer and Contractor in performance of services.
- C. Perform specified inspection, sampling, and testing of Products in accordance with specified standards.
- D. Ascertain compliance of materials and mixes with requirements of Contract Documents.
- E. Promptly notify Engineer and Contractor of observed irregularities or non-conformance of Work or Products.
- F. Perform additional inspections and tests required by Engineer.
- G. Attend preconstruction conferences and progress meetings.

1.07 LABORATORY REPORTS

- A. After each inspection and test, promptly submit two copies of laboratory report to Engineer, and to Contractor.
- B. Include:
 - 1. Date issued.
 - 2. Project title and number.
 - 3. Name of inspector.
 - 4. Date and time of sampling or inspection.
 - 5. Identification of product and Specifications Section.
 - 6. Location in the Project.
 - 7. Type of inspection or test.
 - 8. Date of test.
 - 9. Results of tests.
 - 10. Conformance with Contract Documents.
- C. When requested by Engineer, provide interpretation of test results.

1.08 LIMITS ON TESTING LABORATORY AUTHORITY

- A. Laboratory may not release, revoke, alter, or enlarge on requirements of Contract Documents.
- B. Laboratory may not approve or accept any portion of the Work.
- C. Laboratory may not assume any duties of Contractor.
- D. Laboratory has no authority to stop the Work.

1.09 CONTRACTOR RESPONSIBILITIES

- A. Deliver to laboratory at designated location, adequate samples of materials proposed to be used which require testing, along with proposed mix designs.
- B. Cooperate with laboratory personnel, and provide access to the Work and to manufacturer's facilities.

- C. Provide incidental labor and facilities to provide access to Work to be tested, to obtain and handle samples at the site or at source of products to be tested, to facilitate tests and inspections, storage and curing of test samples.
- D. Notify Engineer and laboratory 24 hours prior to expected time for operations requiring inspection and testing services.
- E. Employ services of a separate qualified testing laboratory. Arrange with laboratory and pay for additional samples and tests required by Contractor beyond specified requirements.

1.10 RETESTING

- A. Where results of quality control services prove unsatisfactory and do not indicate compliance of related work with requirements of the contract documents, retests are responsibility of Contractor, regardless of whether the original test was Contractor's responsibility. Retesting will be at the rate of 2 retests for each failed test. Retest of work revised or replaced by Contractor is Contractor's responsibility. Retesting costs invoiced to the Owner will be deducted from Contract amount by Supplemental Agreement.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

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SECTION 01 51 00

TEMPORARY UTILITIES

PART 1 GENERAL

1.01 SUMMARY

- A. Temporary utility services and facilities including, but not limited to:
 - 1. Construction water.
 - 2. Electric power service.
 - 3. Lighting.
 - 4. Telephone services.
 - 5. Heat.
- B. Related Requirements:
 - 1. Section 01 57 00 - Temporary Controls
 - 2. Section 01 52 19 - Temporary Sanitary Facilities

1.02 PRICE AND PAYMENT PROCEDURES

- A. Temporary Utilities are incidental to the installation of proposed applicable permanent utility improvements and include:
 - 1. Devices required by Section 01 57 00.
 - 2. Costs associated with required tests and inspections.

1.03 REFERENCES

- A. ANSI - A10 Series Safety Requirements Standards
- B. AWWA - C651 Disinfecting Water Mains
- C. FM Global
- D. NECA - NJG-6 - Temporary Job Utilities and Services
- E. NEMA
- F. NFPA:
 - 1. 70 - National Electrical Code
 - 2. 241 - Safeguarding Construction, Alteration, and Demolition Operations
- G. Underwriter's Laboratory (UL)

1.04 COORDINATION

- A. Contractor shall coordinate tests and inspections required by state and local health departments and AWWA C651.
- B. Utility interruptions required for tie-ins:
 - 1. Determine requirements, time constraints, etc. for installing temporary service to the Site, or to make connections to existing service.
 - a. Shall be requested by Contractor in writing to Engineer.
 - b. Shall not commence until Contractor has received written response from Engineer.
 - c. Engineer reserves the right to restrict the time and duration of interruption.
 - 2. Arrange with utility companies for service interruption, where necessary, to make connections for temporary services.

1.05 QUALITY ASSURANCE

- A. Comply with requirements of local laws and regulations governing construction and local industry standards, in the installation and maintenance of temporary utilities and related services.
- B. Comply with requirements of NECA NJG-6, NFPA 241, ANSI A10, AWWA C651 Series Standards.
- C. Comply with applicable NEMA, NECA, and UL standards and governing regulations for materials and layout of temporary electric service.
- D. Where local laws and regulations conflict with the requirements of NEMA, NFPA, ANSI, AWWA, or NECA, comply with the most stringent requirements.

PART 2 PRODUCTS

2.01 MATERIALS AND EQUIPMENT

- A. Provide all required materials and equipment for temporary utilities, services, and facilities.
- B. Used materials and equipment may be used, if acceptable to Engineer.
- C. Provide only materials and equipment that are suitable for intended use and comply with appropriate standards.

2.02 UTILITIES

- A. Where local utility company provides only a portion of temporary utility, provide remainder with matching, compatible materials and equipment. Comply with utility company's recommendations and requirements.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Provide each temporary service and facility ready for use at each location when service or facility is first needed.
- B. Locate temporary utilities where they will serve Project and result in minimum interference with performance of the Work.
- C. Maintain, relocate, modify, and extend utilities as required during course of Work.
- D. Use qualified tradepersons for installation of temporary utilities.

3.02 CONSTRUCTION WATER

- A. Contractor will pay for water used for construction purposes.
- B. Secure water necessary for construction and testing and pay service connection charges.
- C. Install water service and distribution piping of sizes and pressures adequate for construction purposes.
- D. Where available supply of potable water is inadequate, provide non-potable water for purposes other than drinking and washing.

- E. Where non-potable water is used, provide warning signs on the discharge end of each length of hose and at the shut-off nozzles.
- F. Where shut-off nozzles are used at water hose discharge, provide heavy-duty abrasion-resistant hoses with a pressure rating greater than the maximum pressure of the water distribution system.
- G. Trades needing a larger source of water are responsible for the source and distribution.
- H. Exercise control over usage to conserve water.
- I. Sterilize temporary water piping for potable water prior to use.
- J. Maintain distribution system to avoid damage to existing or new construction.
- K. Avoid damage to permanent plumbing at source of temporary water.

3.03 ELECTRIC POWER SERVICE

- A. Provide a weatherproof, grounded temporary electric power service and distribution system of sufficient size, capacity, and power characteristics to accommodate performance of Work.
- B. Contractor shall pay for electricity used for construction purposes.
 - 1. Electrical service shall be provided and installed by Contractor.
 - 2. Any Trade requiring power with different characteristics than provided shall arrange and pay for access to such power.
- C. When permanent power and lighting systems are in operation, they may be used for construction purposes.
- D. Whenever an overhead floor or roof deck has been installed, install temporary lighting adequate to provide sufficient illumination for safe work and traffic conditions in area of Work.
- E. Install service and grounding in compliance with NFPA 70. Include necessary meters, transformers, overload protected disconnect, and main distribution switch gear.
- F. Connect temporary service to local electric power company main as directed by electric company officials.
- G. Install temporary service with an automatic ground-fault interrupter feature, activated from circuits of the system.
- H. Install circuits of adequate size and proper characteristics for each use.
 - 1. Run wiring overhead and rise vertically where wiring will be least exposed to damage from construction operations.
 - 2. Install rigid steel conduit or equivalent raceways for wiring that must be exposed on grade, floors, decks, or other areas of possible damage or abuse.
- I. Provide identification/warning signs at power outlets that are other than 110 to 120 volt power.
- J. Provide polarized outlets for plug-in type outlets, to prevent insertion of 110 to 120 volt plugs into higher voltage outlets.
- K. Provide receptacle outlets equipped with ground-fault circuit interrupters, reset button and pilot light, for plug-in connection of power tools and equipment.
- L. Use only grounded extension cords.
 - 1. Use "hard-service" cords where exposed to abrasion and traffic.
 - 2. Use single lengths or waterproof connectors to connect separate lengths of electric cords.

3.04 LIGHTING

- A. Install local switching of temporary lighting, spaced to allow lighting to be turned off in patterns to conserve energy and retain light suitable for work-in-progress, access traffic, security check, and Project lock-up.
- B. Provide not less than one 200-watt incandescent lamp per 1,000 square feet of floor area, uniformly distributed, for general construction lighting, or equivalent illumination of a similar nature.
 - 1. In corridors and similar traffic areas, provide not less than one 100-watt incandescent lamp every 50 feet.
 - 2. In stairways and at ladder runs, locate not less than one 100-watt incandescent lamp for illuminating each landing and flight.
- C. Install and operate temporary lighting that will fulfill security and protection requirements, without the necessity of operating entire temporary lighting system.
- D. Provide general service incandescent lamps of wattage required for adequate illumination.
- E. Protect lamps with guard cages or tempered glass enclosures.

3.05 TELEPHONE SERVICES

- A. Contractor shall maintain and pay for telephone (and fax machine) on Site for use of Contractors, Engineers, Architect, and others who have legitimate need for telephone communication in pursuit of Work of this Project.
- B. Arrange for local telephone company to install temporary service. Install telephone on a separate line for each temporary office and first aid station.
- C. At each telephone location post a list of important telephone numbers, including:
 - 1. Local police and fire departments.
 - 2. Doctor.
 - 3. Ambulance service.
 - 4. Contractor's offices.
 - 5. Engineer's offices.
 - 6. Subcontractor's offices.
- D. Long distance calls are to be by credit card.
- E. Provide high speed internet access if available in area.

3.06 HEAT

- A. Provide temporary heat for performance of the Work, curing or drying of recently installed work, or protection of work-in-place from adverse effects of elements.
- B. Provide temporary heating units, tested and labeled by UL, FM, or other recognized trade association related to the fuel being consumed.
- C. Select units known to be safe and without deleterious effect upon work-in-place or being installed.
 - 1. Except where conditions make it necessary to use another system, and where use of the permanent heating system is available and authorized by Engineer, provide properly vented self-contained liquid propane gas or fuel oil heaters with individual space thermostatic controls for temporary heat.
- D. Coordinate ventilation requirements to produce indicated ambient condition required, to prevent accumulations of dust, fumes, vapors or gases, and to minimize consumption of fuel or energy.
- E. Coordinate use of existing facilities with Owner.

- F. Temporary heating and ventilation required by Work under Contract shall be provided and paid by Contractor requiring same.
- G. Extend and supplement with temporary units as required to maintain specified conditions for construction operations, and to protect materials and finishes from damage due to temperature or humidity.
- H. After Enclosure:
 - 1. Owner will not allow use of permanent heating system for temporary heat.
- I. Maintain a minimum temperature of 50 degrees in permanently enclosed portions of the structures and areas where finished Work has been installed.

3.07 OPERATION, TERMINATION, AND REMOVAL

- A. Enforce strict discipline in use of temporary services and facilities at the Site.
 - 1. Limit availability of temporary services and facilities to essential and intended uses to minimize waste and abuse.
 - 2. Do not permit temporary installations to be abused or endangered.
 - 3. Do not allow hazardous, dangerous, or unsanitary conditions to develop or persist on Site.
- B. Operate temporary services and facilities in a safe and efficient manner.
 - 1. Do not overload temporary services or facilities.
 - 2. Protect from damage by freezing temperatures and similar elements.
 - 3. Prevent water-filled piping from freezing by use of ground covers, insulation, draining, or by temporary heating.
 - 4. Maintain distinct markers for underground lines.
 - 5. Protect from damage during excavation operations.
- C. Unless Engineer requests that it be maintained for a longer period of time, remove each temporary service and facility promptly when no longer needed, when it has been replaced by the authorized use of a permanent facility, or no later than Substantial Completion.
- D. Complete or restore permanent Work which may have been delayed because of interference with temporary service or facility.
- E. Repair damaged Work, clean exposed surfaces, and replace Work which cannot be satisfactorily repaired.
- F. Materials and facilities that constitute temporary services and facilities are, and will remain, the property of Contractor.
- G. At Substantial Completion, clean and renovate permanent services and facilities that have been used to provide temporary services and facilities during construction, including but not limited to:
 - 1. Replace air filters and clean inside of ductwork and housings.
 - 2. Replace significantly worn parts and parts that have been subject to unusual operating conditions.
 - 3. Replace lighting system lamps that are burned out or noticeably dimmed.

END OF SECTION

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SECTION 01 51 36
TEMPORARY WATER

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Availability of Water for Construction.

1.02 DESCRIPTION

- A. Water is available from the City of Madison.
- B. City will establish rates and conditions.
- C. Water shall be obtained from approved city hydrant.
- D. Piping shall be the responsibility of the Contractor.
- E. Keep water use to minimum and consistent with needs.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

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SECTION 01 52 13

FIELD OFFICE

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes furnishing and maintaining field office for use by Contractor, subcontractors, and Engineer during construction operations.
- B. Related Sections:
 - 1. Section 01 11 00 - Summary of Work
 - 2. Section 01 51 00 - Temporary Utilities
 - 3. Section 01 71 13 - Mobilization
- C. Basis of Payment: Incidental to Mobilization.
- D. Field office is optional.

1.02 DESCRIPTION

- A. Basic Requirements:
 - 1. Portable or mobile buildings, or buildings constructed with floors raised above ground, securely fixed to foundations, with steps and landings at entrance doors.
 - 2. Minimum 8-foot wide and 7-foot ceiling height.
 - 3. Minimum 120 square feet of usable space.
 - 4. Weatherproof and insulated.
 - 5. Finished interior walls.
 - 6. Heating and air conditioning system: See Section 01 51 00.
 - 7. Telephone service: See Section 01 51 00.
 - 8. Electrical service: See Section 01 51 00.
 - 9. Lighting: 50-foot C at desktop height and exterior lighting at entrance doors.
 - 10. Internet access: See Section 01 51 00.
- B. Furnishings:
 - 1. Desk and chair.
 - 2. Flat surface large enough to examine Construction Documents.
 - 3. Drawing rack.
 - 4. Conference table and chairs to seat at least 6 persons.
 - 5. Telephone.
 - 6. Answering machine.
 - 7. Wastebasket.
 - 8. Potable water supply.
 - 9. Fire extinguisher.
 - 10. Six adjustable-band protective helmets for visitors.
 - 11. One 10-inch outdoor weather thermometer.

1.03 LOCATION

- A. Locate to provide convenient access to construction Site and as provided on Drawings or determined in field by Engineer.
- B. Subject to Owner's approval.
- C. Existing facilities shall not be used for field offices.

1.04 SCHEDULE

- A. Provide facility and services upon commencement of construction or within 10 days after date fixed in Notice to Proceed.
- B. Remove building, utilities, and foundation upon completion and acceptance of Work. Restore area.

1.05 MAINTENANCE

- A. Maintain, clean, and repair field office and services to ensure proper working order throughout the duration of construction operations.
- B. Maintain approach walks free of mud, water, and snow.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

SECTION 01 52 19

TEMPORARY SANITARY FACILITIES

PART 1 GENERAL

1.01 SUMMARY

- A. Provide temporary closet or privy.
- B. Maintain throughout Project duration.
- C. Type and location subject to Engineer's approval.
- D. Remove upon completion of Project.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

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SECTION 01 57 00

TEMPORARY CONTROLS

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Drainage control.
 - 2. Dust control.
 - 3. Erosion and sediment control.
 - 4. Noise control.
 - 5. Pollution control.
 - 6. Barriers.
 - 7. Protection:
 - a. Shoring and bracing.
 - b. Enclosures.
 - c. Installed work.
 - d. Security.
 - e. Fire protection.
 - 8. Site cleaning.
- B. Related Sections:
 - 1. Section 01 11 00 - Summary of Work
 - 2. Section 01 52 13 - Field Office
 - 3. Section 01 57 19 - Air, Land, and Water Pollution
 - 4. Section 01 58 13 - Project Signs
 - 5. Section 02 41 19 - Selective Demolition
 - 6. Section 31 11 00 - Clearing and Grubbing
 - 7. Section 31 22 20 - Earthwork for Building Sites
 - 8. Section 31 23 10 - Excavation and Embankment
 - 9. Section 31 25 10 - Temporary Erosion Control

1.02 QUALITY ASSURANCE

- A. Regulatory Requirements: As a minimum, comply with local, state, and federal requirements.

1.03 DRAINAGE CONTROL

- A. Reference: See 31 23 10.
- B. Maintain excavations free of water.
 - 1. Grade Site to drain.
 - 2. Provide, operate, and maintain pumping equipment.
 - 3. Protect Site from puddling or running water.

1.04 DUST CONTROL

- A. Reference: See Section 31 25 10.
- B. Execute Work by methods to minimize raising dust from construction operations.
- C. Provide positive means to prevent airborne dust from dispersing into atmosphere.

1.05 EROSION AND SEDIMENT CONTROL

- A. Reference: See Section 31 25 10.
- B. Prevent erosion and sedimentation:
 - 1. Plan and execute construction by methods to control surface drainage from cuts and fills, from borrow and waste disposal areas.
 - 2. Minimize amount of bare soil exposed at one time.
 - 3. Provide temporary measures such as berms, dikes, and drains, to prevent water flow.
 - 4. Use selective placement at construction fill and waste areas to avoid erosive surface silts or clays.
 - 5. Periodically inspect earthwork to detect evidence of erosion and sedimentation.
 - 6. Promptly apply corrective measures.

1.06 NOISE CONTROL

- A. Comply with local noise ordinances.
- B. Avoid use of tools or equipment that produce harmful noise.
- C. Restrict use of noise-making tools and equipment to hours of use that will minimize noise complaints from persons or businesses near Site.
- D. Provide noise suppression barriers or equipment used to perform the Work.

1.07 POLLUTION CONTROL

- A. Reference: See Section 01 57 19.
- B. Provide methods, means, and facilities to prevent contamination of soil, water, and atmosphere from discharge of noxious, toxic substances, and pollutants produced by construction operations.

1.08 BARRIERS

- A. Provide barriers as required to:
 - 1. Prevent public entry to construction areas.
 - 2. Protect existing facilities, designated plantings and trees, and adjacent properties from damage from construction activities.
- B. Construction:
 - 1. Type: Commercial grade chain link fence.
 - 2. Height: 7-foot.
 - 3. Gates: Equip with vehicular and pedestrian gates with locks.
- C. Access: Provide barricades and covered walkways as required for public rights-of-way, for public access to, and emergency egress from existing buildings.

1.09 PROTECTION

- A. Shoring and Bracing:
 - 1. Reference: See Section 31 40 00.
 - 2. Provide temporary shoring, bracing, and protection as required for installation and protection of Work.
 - 3. Ensure adequacy of such items.
 - 4. Repair or replace damaged Work occasioned by inadequate temporary supports.
 - 5. Leave temporary shoring and bracing in place until permanent construction is complete to point where installed Work is properly supported.

- B. Installed Work:
 - 1. Provide temporary protection for installed products; control traffic in immediate area to minimize damage.
 - 2. Provide protective coverings at walls, projections, jambs sills, and soffits of openings; protect finished floors and stairs from traffic, movement of heavy objects.
 - 3. Prohibit traffic and storage on waterproofed and roofed surfaces or on lawn and landscaped areas.

- C. Security:
 - 1. Provide security program and facilities to protect Work, existing facilities, and Owner's operations from unauthorized entry, vandalism, and theft.
 - 2. Provide doors in enclosures with self-closing hardware and locks.
 - 3. Provide temporary locks for doors installed in Work.

- D. Fire Protection:
 - 1. Fire extinguishers shall be non-freeze type such as A-B-C rated dry chemical of not less than 10-pound capacity.
 - 2. Provide and maintain in working order during entire construction period, a minimum of 1 fire extinguisher in construction area and 1 in field office.
 - 3. Contractors who maintain enclosed sheds on the premises shall provide and maintain, in an accessible location, a minimum of 1 non-freezing type extinguisher in each shed.
 - 4. Each Contractor using open flame (i.e., welding or soldering) shall have a 10-pound minimum extinguisher within closest practical distance.

1.10 SITE CLEANING

- A. Keep Site neat, clean, free of debris.
- B. Prevent papers, cardboard or other debris from blowing around Site or onto adjacent property.
- C. Contractor shall provide and pay for dumpsters for collection of trash.
- D. Control accumulation of waste materials and rubbish. Collect and dispose of all trash from the Site at regular intervals.
- E. Separate and recycle applicable materials.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

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SECTION 01 57 12
EROSION CONTROL

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes prevention and control of soil erosion and siltation and the resultant turbidity of streams, lakes, and impoundments.
- B. Related Sections:
 - 1. Section 31 22 10 - Site Grading
 - 2. Section 31 23 10 - Excavation and Embankment
 - 3. Section 31 23 33 - Trench Excavation and Backfill
 - 4. Section 31 25 10 - Temporary Erosion Control
 - 5. Section 32 92 12 – Turf Establishment
 - 6. Section 33 05 50 - Surface Facility Restoration
 - 7. Section 33 41 00 - Storm Sewer Systems
- C. Basis of Payment:
 - 1. All expenses shall be borne by the Contractor with no direct compensation.
 - 2. Failure to comply with established erosion control measures will result in withholding of progress payments by the Owner.

1.02 SUBMITTALS

- A. Proposed schedule for accomplishment of Work within, adjacent to, or affecting surface water.
- B. Erosion control schedule.
- C. Submit within 30 days of Notice of Award and prior to the Preconstruction Conference.

1.03 QUALITY ASSURANCE

- A. Obtain all necessary permits from the responsible regulatory agencies for temporary erosion control measures not shown on the Drawings.
- B. "Wisconsin Site Best Management Handbook" by the WDNR Bureau of Wastewater Management will be the basis for all erosion control on this Project.

1.04 REFERENCES

- A. WisDOT 628 - Erosion Control

1.05 SEQUENCING AND SCHEDULING

- A. Construct drainage facilities and turf establishment concurrently with earthwork operation.
- B. Complete construction and finishing operation on a drainage area basis to minimize erosion.
- C. Incorporate erosion control measures at the earliest practical time during construction.
- D. Install erosion control measures as directed prior to the disturbance of in-place ground cover in critical areas that are tributary to public waters.

1.06 MAINTENANCE

- A. Maintain all erosion control facilities to provide proper function throughout the Project.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.01 CONSTRUCTION REQUIREMENTS

- A. Shape exposed soil areas to permit runoff with minimal erosion.
- B. Install safeguards to prevent water pollution from haul roads, work platforms or other temporary construction facilities.
- C. Restore all plant, equipment or other supplementary operation sites to prevent siltation and erosion.
- D. Repair any offsite damage resulting from failure to install or maintain erosion control measures.

END OF SECTION

SECTION 01 57 19

AIR, LAND, AND WATER POLLUTION

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes general requirements for the control of pollution from construction sites and related activities.
- B. Related Sections:
 - 1. Section 01 57 12 - Erosion Control
 - 2. Section 31 25 10 - Temporary Erosion Control
- C. Unit Prices:
 - 1. All activities required by or relating to this section will be considered incidental.
 - 2. No direct payment will be made.
 - 3. No additional compensation or time extension will be granted due to actions brought against the Contractor for failure to comply with pollution control requirements.

1.02 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. Conduct all operations to prevent, control and abate the pollution of air, land and water in accordance with the rules, regulations and standards adopted and established by the following agencies:
 - a. Wisconsin Department of Natural Resources
 - b. U.S. Army Corps of Engineers

1.03 SCHEDULING

- A. Schedule and conduct all operations to minimize soil erosion and prevent siltation and the resultant turbidity of public waters.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.01 PREPARATION

- A. Review all local conditions and regulations pertaining to air and land pollution prior to commencing operations.

3.02 PROTECTION OF WATERS

- A. Prevent pollution of flowing or impounded waters from particulate or liquid matter that may be harmful to fish and wildlife or detrimental to public use.
- B. Remove sediment from aggregate wash operations by filtration or settlement prior to discharge into public waters.
- C. Do not discharge wash water or waste from concrete mixing operations into live streams.

3.03 SPECIAL REQUIREMENTS

- A. Provide temporary bridging where stream crossings are necessary.
- B. Remove temporary bridging as soon as crossings are no longer necessary.

END OF SECTION

SECTION 01 60 00

PRODUCT REQUIREMENTS

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Administrative and procedural requirements governing:
 - a. Products.
 - b. Delivery, storage and handling.
 - 2. The following is not included in this section: Product Substitution Procedures (Section 01 25 13).

1.02 PRODUCT DEFINITIONS

- A. Products:
 - 1. Unless indicated otherwise, the term "products" represents new material, machinery, components, equipment, fixtures, and systems forming the Work.
 - 2. Does not include machinery and equipment used for preparation, fabrication, conveying, or erection of the Work.
- B. Named Products: Items identified by manufacturer's product name, including make or model designation, indicated in the manufacturer's published product literature, that is current as of the date of the Contract Documents.
- C. Materials: Products that are substantially shaped, cut, worked, mixed, finished, refined, or otherwise fabricated, processed, or installed as part of the Work.
- D. Equipment: A product with operational parts, whether motorized or manually operated, that requires service connections such as wiring or piping.

1.03 PRODUCT QUALITY ASSURANCE

- A. Source Limitations: To the fullest extent possible, provide products of the same kind, from a single source.
- B. Limited Quantities:
 - 1. When specified products are available only from sources that do not or cannot produce a quantity adequate to complete Project requirements in a timely manner, consult with Engineer for a determination of the most important product qualities before proceeding.
 - 2. Qualities may include attributes relating to:
 - a. Visual appearance.
 - b. Strength.
 - c. Durability.
 - d. Compatibility.
 - 3. When a determination has been made, select products from sources that possess these qualities to the fullest extent possible.

1.04 PRODUCT REQUIREMENTS

- A. Minimum Requirements: Comply with specifications and referenced standards.
- B. Product Provision: Provide products complete with all accessories, trim, finish, safety guards, and other devices and details needed for a complete installation and for the intended use and effect.

- C. Components: Items required to be supplied in quantity within a specification section shall be the same and shall be interchangeable.
- D. Compatibility of Options: When Contractor is given the option of selecting between 2 or more products for use on the Project, the product selected shall be compatible with products previously selected, even if previously selected products were also options.
- E. Existing Products: Do not use materials and equipment removed from existing premises, except as specifically required or permitted by Contract Documents.
- F. Nameplates:
 - 1. Except for required labels and operating data, do not attach or imprint manufacturer's nameplates or trademarks on exposed surfaces of products that will be exposed to view in occupied spaces or on the exterior.
 - 2. Labels: Locate required product labels and stamps on concealed surfaces or, where required for observation after installation, on an accessible surface that is not conspicuous.
 - 3. Equipment Nameplates:
 - a. Provide permanent nameplate on each item of service-connected or power-operated equipment.
 - b. Locate on an easily accessible surface that is inconspicuous in occupied spaces.
 - c. Provide the following information and other essential operating data on nameplate:
 - 1) Name of product and manufacturer.
 - 2) Model and serial number.
 - 3) Capacity.
 - 4) Speed.
 - 5) Ratings.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. General Requirements:
 - 1. Deliver, store and handle products in accordance with the manufacturer's recommendations.
 - 2. Schedule and coordinate the delivery of materials to ensure personnel and equipment will be available at the Site.
 - 3. Sequence deliveries to avoid delays but minimize on-site storage.
 - 4. Prevent damage, deterioration, soiling, and loss, including theft.
 - 5. Repair or replace damaged materials at no additional cost to Owner.
- B. Packing and Shipping: Deliver products to the jobsite in manufacturer's sealed containers bearing the manufacturer's name and brand, and appropriate UL labels for fire hazard and fire resistance classification.
- C. Acceptance at Site:
 - 1. Promptly inspect shipments to ensure that:
 - a. Products comply with requirements.
 - b. Quantities are correct.
 - c. Products are undamaged.
 - 2. Replace damaged or defective materials.
- D. Storage and Protection:
 - 1. Store with manufacturer's seals and labels intact and legible.
 - 2. Store sensitive products in weather-tight, climate-controlled enclosures.
 - 3. Cover products subject to deterioration with impervious sheet covering, providing ventilation to avoid condensation.
 - 4. For exterior storage of fabricated products, place on sloped supports, above ground.
 - 5. Store loose granular materials on solid flat surfaces in a well-drained area. Prevent mixing with foreign matter.
 - 6. Provide off-site storage and protection when Site does not permit on-site storage or protection.
 - 7. Protect stored materials from damage by adjacent work, falling debris, or equipment.

8. Arrange storage of products to permit access for inspection. Periodically inspect to assure products are undamaged and are maintained under required conditions.

1.06 PRODUCT SELECTION

- A. Product selection is governed by the Contract Documents, and governing regulations by previous project experience.
- B. Proprietary Specification Requirements: Where only a single product or manufacturer is named, provide the product indicated. No substitutions will be permitted.
- C. Semi-Proprietary Specification Requirements:
 1. Where 2 or more products or manufacturers are named, provide 1 of the products indicated. No substitutions will be permitted.
 2. Where products or manufacturers are specified by name, accompanied by the term "or equal," or "or approved equal", comply with Section 01 25 13 or other Contract Document provisions concerning "substitutions" to obtain approval for use of an unnamed product.
 3. Contractors and suppliers will be expected to provide the specified product unless prior approval is received from Engineer's office in sufficient time to notify Bidders through addendum.
- D. Descriptive Specification Requirements: Where specifications describe a product or assembly, listing exact characteristics required, with or without use of a brand or trade name, provide a product or assembly that provides the characteristics and otherwise complies with Contract requirements.
- E. Performance Specification Requirements:
 1. Where specifications require compliance with performance requirements, provide products that comply with these requirements, and are recommended by the manufacturer for the application indicated.
 2. Manufacturer's recommendations may be contained in published product literature, or by the manufacturer's certification of performance.
 3. General overall performance of a product is implied where the product is specified for a specific application.
- F. Compliance with Standards, Codes and Regulations: Where the specifications only require compliance with an imposed code, standard or regulation, select a product that complies with applicable standards, codes and regulations.
- G. Visual Matching:
 1. Where specifications require matching an established sample, Engineer's decision will be final on whether a proposed product matches satisfactorily.
 2. Where no product available within the specified category matches satisfactorily but complies with other specified requirements, comply with provisions of the Contract Documents concerning "substitutions" for selection of a matching product, or for noncompliance with specified requirements.
- H. Visual Selection: Where specified product requirements include the phrase "...as selected from manufacturer's standard colors, patterns, textures..." or a similar phrase, select a product and manufacturer that comply with other specified requirements. Engineer will select the color, pattern and texture from the product line selected.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.01 CLEANING AND PROTECTION

- A. Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

END OF SECTION

SECTION 01 71 13
MOBILIZATION (WisDOT 619)

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Preparatory work and operations.
 - 2. Movement of personnel, equipment, supplies and incidentals to the Site.
 - 3. Establishment of Contractor offices and facilities.

- B. Related Sections:
 - 1. Section 01 52 13 - Field Office
 - 2. Section 01 52 19 - Temporary Sanitary Facilities

- C. Basis of Payment:
 - 1. If the Lump Sum Bid amount for Mobilization exceeds 5 percent of the total Base Bid amount, the Owner will withhold the amount in excess of 5 percent until Substantial Completion of the Project.

1.02 REFERENCES

- A. WisDOT 619 - Mobilization

1.03 PERFORMANCE REQUIREMENTS

- A. Submittal of information listed under Article 1.04.
- B. Installation of temporary sanitary facilities.
- C. Installation of Project signs.
- D. Erection of a field office (optional).
- E. Commencement of Work.
- F. Installation of construction tracking pad.

1.04 SUBMITTALS

- A. Approved Project Schedule
- B. Shop Drawing Schedule
- C. List of Proposed Subcontractors
- D. List of Proposed Suppliers
- E. Material and Procedural Submittals, as required

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

SECTION 01 73 29

CUTTING AND PATCHING

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Procedures for administration of cutting and patching of existing structures and buildings.
 - a. Submittals.
 - b. Quality assurance.
 - 2. Materials.
 - 3. Examination: Site conditions.
 - 4. Preparation:
 - a. Temporary Support.
 - b. Protection.
 - 5. Construction:
 - a. Special techniques.
 - b. Interface with others.
 - 6. Cleaning.
- B. Related Sections:
 - 1. Section 01 33 00 - Submittal Procedures
 - 2. Individual Specification Sections inferred by Cutting and Patching required.

1.02 SUBMITTALS

- A. Refer to Section 01 33 00.
- B. Schedules:
 - 1. Initial Schedule:
 - a. 5 days prior to proposed start of work, submit to Engineer 6 copies of schedule of work involving cutting or patching.
 - 2. Utility Schedule:
 - a. Include with initial schedule the following utility information:
 - 1) Which utilities will be disturbed or affected, including those that will be relocated or temporarily out-of-service.
 - 2) Length of time service will be disrupted.
 - 3. Revised Schedules: Submit 6 copies of updated schedules not less than once per week.
- C. Structural Elements: Where cutting and patching involves addition to reinforcement to structural elements, submit 6 copies of Shop Drawings including all details and structural calculations showing how reinforcement is integrated with the original structure.

1.03 QUALITY ASSURANCE

- A. Qualifications:
 - 1. Personnel: Employ skilled workers.
- B. Regulatory Requirements:
 - 1. Structural Work Limitations:
 - a. Do not cut and patch structural elements in manner to reduce load-carrying capacity or load-deflection ratio. Obtain acceptance of cutting and patching proposal before cutting and patching following structural elements:
 - 1) Foundation construction.
 - 2) Bearing walls.

- 3) Structural concrete.
 - 4) Structural steel.
 - 5) Lintels.
 - 6) Structural decking.
 - 7) Miscellaneous structural metals.
 - 8) Equipment supports.
- b. Operational and Safety Limitations:
- 1) Do not cut and patch operating elements or safety related components in manner to reduce their capacity to perform as intended, or result in increased maintenance or decreased operational life and safety. Obtain acceptance of cutting and patching proposal before cutting operating elements or safety related systems.
 - 2) Visual Requirements:
 - a) Do not cut and patch construction exposed on exterior or in occupied spaces in manner to, in Engineer's opinion, reduce structure's/building's aesthetic qualities, or result in visual evidence of cutting and patching. Remove and replace work cut and patched in visually unsatisfactory manner. If possible, retain project contractors to patch following categories of exposed work, otherwise engage other recognized experienced, specialized firms including, but not limited to:
 - (1) Special concrete finishes.
 - (2) Masonry.
 - (3) Stucco and plaster.
 - (4) Acoustical ceilings.
 - (5) Ceramic tile.
 - (6) Flooring.
 - (7) Roofing.
- C. Preinstallation Meetings: Before proceeding, meet at Site with parties involved in cutting and patching, including mechanical and electrical trades. Review areas of potential interference and conflict. Coordinate procedures, resolve potential conflicts before proceeding.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Identical to existing materials. If not available or not usable where exposed surfaces are involved, match existing adjacent surfaces to fullest extent possible with regard to visual effect. Use materials whose installed performance equals or surpasses that of existing materials.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Site Conditions: Before cutting existing surfaces, examine surfaces to be cut and patched and conditions under which cutting and patching is to be performed. If unsafe or unsatisfactory conditions are encountered, correct before proceeding.

3.02 PREPARATION

- A. Temporary Support: Provide temporary support of work to be cut.
- B. Protection:
1. Prevent damage to existing construction. Protect portions of project that might be exposed during work from adverse weather conditions.
 2. Avoid interference with use of or free passage to adjoining areas.
 3. Take necessary precautions to avoid cutting existing pipe, conduit, ductwork.

3.03 CONSTRUCTION

A. Special Techniques:

1. Cutting:

a. General:

- 1) Use methods least likely to damage elements to be retained or adjoining construction. Cut holes and slots neatly to size required with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
- 2) Equipment:
 - a) Hand or small power tools designed for sawing or grinding. For concrete and masonry, use cutting machine such as carborundum saw or diamond core drill.
- 3) Existing finished surfaces: Avoid marring; cut or drill from exposed or finished side into concealed surfaces.
- 4) Excavating and Backfilling: Comply with requirements of applicable Sections of Division 31.
- 5) Utility services:
 - a) Where services are shown or required to be removed, relocated or abandoned, bypass before cutting.
 - b) Cut off pipe or conduit in walls or partitions to be removed.
 - c) Cap, valve or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture, other foreign matter after by-passing and cutting.

b. Patching:

- 1) Seams: Durable, invisible as possible.
- 2) Exposed finishes:
 - a) Restore, extend finish restoration into retained adjoining construction in manner to eliminate evidence of patching and refinishing.
 - b) Where finished areas extend into others, patch and repair floor and wall surfaces in new space to provide even surface of uniform color and appearance. Remove existing floor and all coverings, replace with new materials, if necessary to achieve uniform color and appearance.
 - c) Where patching occurs in smooth painted surface, extend final paint coat over entire unbroken area containing patch, after patched area has received primer and second coat.
 - d) Patch, repair, rehang existing ceilings as necessary to provide even plane surface of uniform appearance.

- B. Interface with Others: Cut to provide for installation of other components or performance of the reconstruction activities and subsequent fitting and patching required to restore surfaces to original condition.

3.04 CLEANING

- A. Thoroughly clean areas, spaces where cutting and patching is performed or used as access. Remove completely paint, mortar, oils, putty, similar items. Thoroughly clean piping, conduit, similar features before painting or other finishing is applied. Restore damaged pipe covering to original condition.

END OF SECTION

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SECTION 01 74 20

CONSTRUCTION WASTE MANAGEMENT

PART 1 GENERAL

1.01 SUMMARY

- A. Administrative and procedural requirements for salvaging, recycling, and disposing of nonhazardous demolition and construction waste.

1.02 PERFORMANCE GOALS AND REQUIREMENTS

- A. Salvage/Recycle Requirements: Owner's goal is to salvage and recycle as much nonhazardous demolition and construction waste as possible including the following materials:

- 1. Demolition Waste:
 - a. Asphaltic concrete paving.
 - b. Concrete.
 - c. Concrete reinforcing steel.
 - d. Brick.
 - e. Concrete masonry units.
 - f. Wood studs and joints.
 - g. Plywood and oriented strand board.
 - h. Wood paneling and trim.
 - i. Structural and miscellaneous steel.
 - j. Rough hardware.
 - k. Roofing.
 - l. Insulation.
 - m. Doors, frame, and hardware.
 - n. Windows and glazing.
 - o. Metal studs.
 - p. Gypsum board.
 - q. Acoustical tile and panels.
 - r. Demountable partitions.
 - s. Equipment.
 - t. Cabinets.
 - u. Plumbing fixtures.
 - v. Piping.
 - w. Supports and hangers.
 - x. Valves.
 - y. Sprinklers.
 - z. Mechanical equipment.
 - aa. Refrigerants.
 - bb. Electrical conduit.
 - cc. Copper wiring.
 - dd. Lighting fixtures.
 - ee. Lamps and ballasts.
 - ff. Electrical devices.
 - gg. Switchgear and panelboards.
 - hh. Transformers.
- 2. Construction Waste:
 - a. Site-clearing waste.
 - b. Masonry and CMU.
 - c. Lumber.
 - d. Wood sheet materials.
 - e. Wood trim.
 - f. Metals.

- g. Roofing.
- h. Insulation.
- i. Gypsum board.
- j. Piping.
- k. Electrical conduit.
- l. Packaging:
 - 1) Encourage manufacturers to ship their product using reusable, recyclable, returnable, or recycled content packaging.
 - 2) Salvage or recycle 100 percent of the following uncontaminated packaging materials:
 - a) Paper.
 - b) Cardboard.
 - c) Boxes.
 - d) Plastic sheet and film.
 - e) Polystyrene packaging.
 - f) Wood crates.
 - g) Plastic pails.

1.03 SUBMITTALS

- A. Records of Donations: Indicate receipt and acceptance of salvageable waste donated to individuals and organizations, and whether organization is tax exempt.
- B. Records of Sales: Indicate receipt and acceptance of salvageable waste sold to individuals and organizations and whether organization is tax exempt.
- C. Recycling and Processing Facility Records: Indicate receipt and acceptance of recyclable waste by recycling and processing facilities licensed to accept them, including manifests, weight tickets, receipts, and invoices.
- D. Landfill and Incinerator Disposal Records: Indicate receipt and acceptance of waste by landfills and incinerator facilities licensed to accept them, including manifests, weight tickets, receipts, and invoices.
- E. Statement of Refrigerant Recovery:
 - 1. Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant was recovered and was performed according to EPA regulations.
 - 2. Include name and address of technician and date refrigerant was recovered.

1.04 QUALITY ASSURANCE

- A. Qualifications:
 - 1. Refrigerant Recovery Technician: Certified by EPA-approved certification program.
- B. Regulatory Requirements: Comply with hauling and disposal regulations of authorities having jurisdiction.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.01 PLAN IMPLEMENTATION

- A. Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during the entire duration of the Contract.

- B. Training: Train workers, subcontractors, and suppliers on proper waste management procedures, as appropriate for the Work occurring at Site.
- C. Site Access and Temporary Controls:
 - 1. Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
 - 2. Designate and label specific areas on Site necessary for separating materials that are to be salvaged, recycled, reused, donated, and sold.

3.02 SALVAGING DEMOLITION WASTE

- A. Salvaged Items for Reuse in the Work:
 - 1. Clean salvaged items.
 - 2. Pack or crate items after cleaning and identify contents.
 - 3. Store items in a secure area until installation.
 - 4. Protect items from damage during transport and storage.
 - 5. Install salvaged items to comply with installation requirements for new materials and equipment.
 - 6. Provide connections, supports, and miscellaneous materials necessary to make items functional for use indicated.
- B. Salvaged Items for Sale or Donation: Not permitted on site.
- C. Salvaged Items for Owner's Use:
 - 1. Clean salvaged items.
 - 2. Pack or crate items after cleaning. Identify contents of containers.
 - 3. Store items in secure area until delivery to Owner.
 - 4. Transport items to storage area designated by Owner.
 - 5. Protect items from damage during transport and storage.
- D. Doors and Hardware:
 - 1. Brace open end of door frames.
 - 2. Except for removing door closers, leave door hardware attached to doors.

3.03 RECYCLING DEMOLITION AND CONSTRUCTION WASTE, GENERAL

- A. Recycle paper and beverage containers used by on-site workers.
- B. Recycling Incentives: Revenues, savings, rebates, tax credits, and other incentives received for recycling waste materials shall accrue to Owner.
- C. Procedures:
 - 1. Separate recyclable waste from other waste materials, trash, and debris.
 - 2. Separate recyclable waste by type at Site to the maximum extent practical.
 - 3. Provide appropriately marked containers or bins for controlling recyclable waste until they are removed from Site.
 - 4. Include list of acceptable and unacceptable materials at each container and bin.
 - 5. Inspect containers and bins for contamination and remove contaminated materials if found.
 - 6. Stockpile processed materials on-site without intermixing with other materials.
 - a. Place, grade, and shape stockpiles to drain surface water.
 - b. Cover to prevent windblown dust.
 - 7. Stockpile materials away from construction area. Do not store within drip line of remaining trees.
 - 8. Store components off the ground and protect from the weather.
 - 9. Remove recyclable waste off Owner's property and transport to recycling receiver or processor.

3.04 RECYCLING DEMOLITION WASTE

- A. Asphaltic Concrete Paving: Break up and transport paving to asphalt-recycling facility.

- B. Concrete: Remove reinforcement and other metals from concrete and sort with other metals.
 1. Transport off-site for crushing or pulverizing.
 2. Pulverize concrete to maximum 4-inch size.
- C. Masonry: Remove metal reinforcement, anchors, and ties from masonry and sort with other metals.
 1. Pulverize masonry to maximum 4-inch size.
 2. Clean and stack undamaged, whole masonry units on wood pallets.
- D. Wood Materials:
 1. Sort and stack members according to size, type, and length.
 2. Separate lumber, engineered wood products, panel products, and treated wood materials.
- E. Metals: Separate by type.
 1. Structural Steel: Stack members according to size, type of member, and length.
 2. Remove and dispose of bolts, nuts, washers, and other rough hardware.
- F. Asphalt Shingle Roofing:
 1. Separate organic and glass-fiber asphalt shingles and felts.
 2. Remove and dispose of nails, staples, and accessories.
- G. Gypsum Board:
 1. Stack large clean pieces on wood pallets and store in a dry location.
 2. Remove edge trim and sort with other metals. Remove and dispose of fasteners.
- H. Equipment:
 1. Drain tanks, piping, and fixtures. Seal openings with caps or plugs.
 2. Protect equipment from exposure to weather.
- I. Plumbing Fixtures: Separate by type and size.
- J. Piping:
 1. Reduce piping to straight lengths and store by type and size.
 2. Separate supports, hangers, valves, sprinklers, and other components by type and size.
- K. Lighting Fixtures: Separate lamps by type and protect from breakage.
- L. Electrical Devices: Separate switches, receptacles, switchgear, transformers, meters, panelboards, circuit breakers, and other devices by type.
- M. Conduit: Reduce conduit to straight lengths and store by type and size.

3.05 RECYCLING CONSTRUCTION WASTE

- A. Packaging:
 1. Cardboard and Boxes: Break down packaging into flat sheets and bundle and store in a dry location.
 2. Polystyrene Packaging: Separate and bag materials.
 3. Pallets:
 - a. As much as possible, require deliveries using pallets to remove pallets from Site.
 - b. For pallets that remain on-site, break down pallets into component wood pieces and comply with requirements for recycling wood.
 4. Crates: Break down crates into component wood pieces and comply with requirements for recycling wood.
- B. Site-Clearing Wastes: Chip brush, branches, and trees at landfill facility.
- C. Wood Materials:
 1. Clean Cut-offs of Lumber: Grind or chip into small pieces.

2. Clean Sawdust: Bag sawdust that does not contain painted or treated wood.
- D. Gypsum Board:
1. Stack large clean pieces on wood pallets and store in a dry location.
 2. Grind scraps of clean gypsum board using small mobile chipper or hammer mill.
 3. Screen out paper after grinding.
 4. Comply with requirements in for use of clean ground gypsum board as inorganic soil amendment.

3.06 DISPOSAL OF WASTE

- A. Reuse or return packaging material to suppliers or manufacturers as much as possible.
- B. Except for items or materials to be salvaged, recycled, or otherwise reused, remove waste materials from Site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.
1. Do not allow waste materials that are to be disposed of accumulate on-site.
 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
- C. Burning: No burning allowed.
- D. Disposal: Transport waste materials off Owner's property and legally dispose of them.

END OF SECTION

SECTION 01 75 00

STARTING AND ADJUSTING

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Starting systems.
 - 2. Testing, adjusting, and balancing.
 - 3. Demonstration and instructions.

- B. Related Sections:
 - 1. Section 01 21 00 - Allowances
 - 2. Section 01 33 00 - Submittal Procedures
 - 3. Section 01 77 00 - Closeout Procedures
 - 4. Section 01 78 23 - Operation and Maintenance Data
 - 5. Individual Technical Sections

1.02 STARTING SYSTEMS

- A. Coordinate schedule for start-up of various equipment systems.

- B. Verify that tests, meter readings, and specified electrical characteristics agree with those required by the equipment or system manufacturer.

- C. Verify wiring and support components for equipment are complete and tested.

- D. When specified in individual specification sections, require manufacturer to provide authorized representative to be present at site to inspect, check and approve equipment or system installation prior to start-up, and to supervise placing equipment or system in operation.

- E. Submit a written report in accordance with Section 01 33 00 that equipment or system has been properly installed and is functioning correctly.

1.03 TESTING, ADJUSTING, AND BALANCING

- A. Contractor will appoint, employ, and pay for services of an independent firm to perform testing, adjusting and balancing.

- B. Reports will be submitted by the independent firm to Engineer indicating:
 - 1. Observations and results of tests.
 - 2. Compliance or non-compliance with manufacturer's requirements and with the requirements of the Contract Documents.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.01 DEMONSTRATION AND INSTRUCTIONS

- A. A manufacturer's representative who is knowledgeable about the project shall meet with Owner's personnel prior to date of final inspection to provide instruction in proper operation and maintenance:
 - 1. Utilize operation and maintenance manuals as basis for instructions.
 - 2. Review contents of manual with Owners' personnel in detail to explain all aspects of operation and maintenance.
 - 3. Include a detailed review of the following items:
 - a. Maintenance manuals.
 - b. Record documents.
 - c. Spare parts and materials.
 - d. Tools.
 - e. Lubricants.
 - f. Fuels.
 - g. Identification systems.
 - h. Control sequences.
 - i. Hazards.
 - j. Cleaning.
 - k. Warranties.
 - l. Maintenance agreements and similar continuing commitments.
 - 4. Manufacturer's representative shall demonstrate the following procedures to Owner's personnel prior to date of final inspection:
 - a. Startup.
 - b. Shutdown.
 - c. Emergency operations.
 - d. Noise and vibration adjustments.
 - e. Safety procedures.
 - f. Economy and efficiency adjustments.
 - g. Effective energy utilization.
 - h. Troubleshooting.
 - i. Maintenance.
- B. Prepare and insert additional data in operations and maintenance manuals if need for additional data becomes apparent during instructions.
- C. Provide a digital recording of above procedures.

END OF SECTION

SECTION 01 77 00

CLOSEOUT PROCEDURES

PART 1 GENERAL

1.01 SUMMARY

- A. Administrative and procedural requirements for contract closeout, including:
 - 1. Submittals.
 - 2. Inspection procedures.
 - 3. Warranties.
 - 4. Record document submittals.
 - 5. Final cleaning.
- B. Related Sections:
 - 1. Section 01 78 23 - Operation and Maintenance Data
 - 2. Specific requirements for individual units of work are included in appropriate technical sections

1.02 SUBSTANTIAL COMPLETION

- A. Complete the following before requesting Engineer's inspection for certification of Substantial Completion for each phase of work. List items that are incomplete in request.
 - 1. Prepare a list of items to be completed and corrected (punch list), the value of items on the list, and reasons why the Work is not complete.
 - 2. Obtain, submit releases enabling Owner unrestricted use of the Work and access to services and utilities.
 - 3. Regulatory requirements:
 - a. Where required, obtain occupancy permits, operating certificates, similar releases.
 - 4. Bonding and insurance:
 - a. Consent of Surety to Reduction In or Partial Release of Retainage.
 - b. Advise Owner of pending insurance change-over-requirements.
- B. Inspection Procedures:
 - 1. When prerequisites are complete, submit request in writing to Engineer stating that all requirements are satisfied, and requesting inspection.
 - 2. Upon receipt of Contractor's request for inspection, Engineer will either proceed with inspection or advise Contractor of unfilled prerequisites.
 - 3. Following initial inspection, Engineer will either prepare Certificate of Substantial Completion, or advise Contractor of work which must be performed before certificate will be issued. Engineer will repeat inspection when requested and when assured that work has been substantially completed.
 - 4. Results of completed inspection will form the basis of requirements for Final Acceptance.

1.03 FINAL ACCEPTANCE

- A. Before requesting final inspection for determining date of Final Completion, complete the following:
 - 1. Submittals:
 - a. Lien Waivers (from all subcontractors and suppliers).
 - b. Certificate of Substantial Completion (AIA G704) - 5 copies.
 - c. Contractor's Affidavit of Payment of Debts and Claims (AIA G706).
 - d. Contractor's Affidavit of Release of Liens (AIA G706A).
 - e. Consent of Surety (if Performance Bond provided).
 - 1) To Partial Release of Retainage (AIA G707A).
 - 2) To Final Payment (AIA G707).
 - f. Assurance that unsettled claims will be settled.
 - g. Proof that fees and similar obligations have been paid.
 - h. Evidence of final, continuing insurance coverage complying with insurance requirements.

- i. Certified copy of Engineer's final punch list of itemized work to be completed or corrected, stating that each item has been completed or otherwise resolved for acceptance and has been endorsed and dated by Engineer.
 - 2. Warranties: Submit specific warranties, workmanship/maintenance bonds, maintenance agreements, final certifications, similar documents.
 - 3. Maintenance:
 - a. Materials (each type and color):
 - 1) Masonry.
 - 2) Tile.
 - 3) Paint.
 - b. Maintenance manuals: See Section 01 78 23
 - 1) Organize operating, maintenance data into suitable sets of manageable size.
 - 2) Bind into individual heavy-duty 2-inch, 3-ring vinyl-covered binders with pocket folders, each set of data, marked with appropriate identification on both front and spine of each binder.
 - 3) Include:
 - a) Emergency instructions.
 - b) Spare parts listing.
 - c) Copies of warranties.
 - d) Wiring diagrams.
 - e) Recommended "turnaround" cycles.
 - f) Inspection procedures.
 - g) Shop Drawings and Product Data.
 - 4. Miscellaneous Record Submittals:
 - a. Refer to other sections of specifications for requirements of miscellaneous record keeping and submittals in connection with actual performance of work.
 - b. Complete miscellaneous records, place in good order, properly identified and bound or filed, ready for continued use and reference.
 - 5. Records:
 - a. Test/adjust/balance records.
 - b. Startup performance reports.
 - c. Inspection Reports:
 - 1) Alarm tests.
 - 2) Fire sprinkler test.
 - 3) Meter readings.
- B. Record Drawings: Submit to Engineer a set of record prints marked to show "as-built" conditions for work of contract.
- C. Adjusting:
 - 1. Repair and restore marred exposed finishes.
 - 2. Touch up of painting of marred surfaces.
 - 3. Complete final cleaning requirements.
- D. Final Payment Request:
 - 1. Include certificates of insurance for products and completed operations where required.
 - 2. Updated final statement, accounting for final additional changes to Contract Sum.
 - 3. Final liquidated damages settlement statement, acceptable to Owner.
- E. Re-inspection Procedure:
 - 1. Engineer will re-inspect work upon receipt of notice that work, including punch list items resulting from earlier inspections, has been completed, except for items whose completion has been delayed because of circumstances that are acceptable to Engineer.
 - 2. Engineer will either prepare a certificate of final acceptance, or will advise Contractor of work that is incomplete or of obligations that have not been fulfilled but are required for final acceptance.
 - 3. If necessary, re-inspection procedure will be repeated.

1.04 TRANSFER OF SITE TO OWNER

- A. Deliver tools, spare parts, extra materials and similar items to location designated by Owner. Label with manufacturer's name and model number where applicable.
- B. Change door locks to Owner's access. Advise Owner's personnel of changeover in security provisions.
- C. Advise Owner of changeover in heat and other utilities.
- D. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.

1.05 OPERATING AND MAINTENANCE INSTRUCTIONS/DEMONSTRATIONS

- A. Arrange for each installer of operating equipment and other work requiring regular or continuing maintenance, to meet at Site with Owner's personnel to provide necessary basic instruction in proper operation and maintenance of entire work. Where installers are not experienced in required procedures, include instruction by manufacturer's representatives.
- B. Provide detailed review of following items:
 - 1. Maintenance manuals.
 - 2. Record documents.
 - 3. Spare parts and materials.
 - 4. Tools.
 - 5. Lubricants.
 - 6. Fuels.
 - 7. Identification systems.
 - 8. Control sequences.
 - 9. Hazards.
 - 10. Cleaning materials and procedures.
 - 11. Warranties, bonds, maintenance agreements similar continuing commitments.
- C. As part of this instruction for operating equipment, demonstrate following procedures:
 - 1. Start-up.
 - 2. Shut-down.
 - 3. Emergency operations.
 - 4. Noise and vibration adjustments.
 - 5. Safety procedures.
 - 6. Economy and efficiency adjustments.
 - 7. Effective energy utilization.
- D. Provide a video tape of above procedures.

PART 2 PRODUCTS

2.01 CLEANING AGENTS

- A. Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned.
- B. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

PART 3 EXECUTION

3.01 FINAL CLEANING

- A. Provide final cleaning, following manufacturer's written instructions.
- B. Conduct cleaning and waste-removal operations to comply with local laws and ordinances, and federal and local environmental and antipollution regulations.
- C. Employ experienced workers or professional cleaners for final cleaning.
- D. Comply with safety standards for cleaning.
 - 1. Do not burn waste materials.
 - 2. Do not bury debris or excess materials on Owner's property.
 - 3. Do not discharge volatile, harmful, or dangerous materials into drainage systems.
 - 4. Remove waste materials from Site and dispose of lawfully.
- E. Clean Site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
- F. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program.
 - 1. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
 - 2. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
 - 3. Remove tools, construction equipment, machinery, and surplus material from Site.
 - 4. Remove snow and ice to provide safe access to building.
 - 5. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
 - 6. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
 - 7. Sweep concrete floors broom clean in unoccupied spaces.
 - 8. Vacuum carpet and similar soft surfaces, removing debris and excess nap; shampoo if visible soil or stains remain.
 - 9. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials. Polish mirrors and glass, taking care not to scratch surfaces.
 - 10. Remove labels that are not permanent.
 - 11. Wipe surfaces of mechanical and electrical equipment, elevator equipment, and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
 - 12. Replace parts subject to unusual operating conditions.
 - 13. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
 - 14. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
 - 15. Clean ducts, blowers, and coils if units were operated without filters during construction.
 - 16. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency. Replace burned-out bulbs, and those noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.

END OF SECTION

SECTION 01 78 23

OPERATION AND MAINTENANCE DATA

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes administrative and procedural requirements for operation and maintenance data:
 - 1. Submittals.
- B. Related Sections:
 - 1. Section 01 33 00 - Submittal Procedures
 - 2. Section 01 75 00 - Starting and Adjusting
 - 3. Section 01 77 00 - Closeout Procedures
 - 4. Individual Technical Sections

1.02 SUBMITTALS

- A. Refer to Section 01 33 00.
- B. Form and Format:
 - 1. Organize operation, maintenance data for equipment prepared in the form of an instruction manual of manageable size.
 - 2. Provide complete electronic copy divided into subsections and bookmarked.
 - 3. Bind into individual heavy-duty, 2-inch, 3-ring vinyl-covered binders with pocket folders, each set of data, marked with appropriate identification on both front and spine of each binder.
 - 4. Text shall be manufacturer's printed data or typewritten data on 20-pound paper; page size 8-1/2-inch by 11-inch. Computer generated data shall be by letter quality printers or laser printers.
 - 5. Clearly mark each sheet of product data to specify products, component parts, and data applicable to installation; delete inapplicable information.
 - 6. Drawings and photographs shall have reinforced, punched binder tabs. Bind in with text, folding larger drawings to size of text pages.
- C. Submittal Schedule:
 - 1. Submit 2 individually bound copies of preliminary draft of contents no later than 45 calendar days after approval of Shop Drawings.
 - 2. Submit 6 individually bound copies of completed data in final form not later than 7 calendar days prior to first instruction of Owner personnel.
 - 3. If instruction of Owner personnel is not required, submit completed data no later than 14 calendar days prior to final inspection.
 - 4. Submit 6 copies of additional requested data no later than 21 calendar days following instruction of Owner personnel.

1.03 QUALITY ASSURANCE

- A. Preparation of Project-specific data shall be by personnel trained and experienced in maintenance and operation of described products, equipment, systems, materials, or finishes.
- B. Photocopies: Drawings shall be legible and suitable for photocopying. All materials shall be reproducible. On material that contains data on several types/sizes/models of equipment, the specific type/size/model provided shall be clearly highlighted.

1.04 CONTENTS

- A. Table of Contents: Include with each volume, with each product or system description identified.

- B. Directory:
 - 1. List names, addresses and telephone numbers of:
 - a. Engineer.
 - b. Contractor.
 - c. Manufacturers and suppliers, including local source of supplies and replacement parts.

- C. Data to be Included:
 - 1. Assembly, installation, alignment, inspection procedures.
 - 2. Critical tolerances.
 - 3. Startup procedures.
 - 4. Complete parts listing.
 - 5. Spare parts listing.
 - 6. Emergency instructions.
 - 7. Fabrication drawings.
 - 8. Copies of warranties.
 - 9. Recommended "turn-around" cycles.
 - 10. Inspection procedures.
 - 11. Shop Drawings and Product Data.
 - 12. Fixture lamping schedule.

- D. Data for Equipment and Systems:
 - 1. Provide manufacturer's printed operation and maintenance instructions.
 - 2. Provide sequence of operation and as-installed control diagrams by controls manufacturer.
 - 3. Provide composite wiring diagrams for supervisory control systems. Include wiring diagrams showing connections between equipment wiring, electrical wiring, and supervisory control system wiring.
 - 4. For equipment, include description of unit and component parts. Give function, normal operation characteristics and limiting conditions. Include performance curves, with engineering data and tests, and complete nomenclature and commercial number of replacement parts.
 - 5. For panelboard circuit directories, indicate electrical service characteristics, controls, and communications. Include as-installed color coded wiring diagrams.
 - 6. Provide manufacturer's printed operation and maintenance instructions, including start-up, break-in, and normal operation instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and any special operation instructions.
 - 7. For maintenance and preventative maintenance procedures include routine procedures; guide for "trouble-shooting;" and alignment, adjusting, balancing, and checking instructions.
 - 8. Provide servicing and lubrication schedule, and list of lubricants required.
 - 9. Provide manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance. Include recommended items and quantities to be stocked as spare parts.

- E. Data for Materials and Finishes:
 - 1. For building products, applied materials, and finishes, include manufacturer's product data with catalog number, size, composition, and color and texture designations.
 - 2. List instructions for care, maintenance, and preventative maintenance; include manufacturer's recommendations for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.
 - 3. For moisture-protection and weather exposed products, include manufacturer's product data listing applicable reference standards, chemical composition, and details of installation. Provide recommendations for inspections, maintenance, and repair.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

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SECTION 01 78 37

PRODUCT WARRANTIES

PART 1 GENERAL

1.01 SUMMARY

- A. Requirements include administrative and procedural requirements for:
 - 1. Warranties
 - 2. Warranty submittals
- B. Related Sections:
 - 1. Section 01 33 00 - Submittal Procedures
 - 2. Section 01 77 00 - Closeout Procedures
 - 3. Individual Technical Sections

1.02 DEFINITIONS

- A. Standard Product Warranties: Preprinted written warranties published by individual manufacturers for particular products and are specifically endorsed by the manufacturer to Owner.
- B. Special Warranties: Written warranties required by, or incorporated in the Contract Documents, either to extend time limits provided by standard warranties or to provide greater rights for Owner.

1.03 WARRANTY REQUIREMENTS

- A. Separate Prime Contracts:
 - 1. Each prime Contractor is responsible for warranties related to its own contract. Each Contractor shall warrant their work for labor and material for 1-year minimum. This warranty shall include material purchased directly by Owner and installed by Contractor. Warranty requirements noted in individual sections may exceed this 1-year minimum; if it does, the warranty shall apply for the stipulated time for both material and labor.
- B. Related Damages and Losses: When correcting warranted Work that has failed, remove and replace other Work that has been damaged as a result of such failure or that must be removed and replaced to provide access for correction of warranted Work.
- C. Replacement Cost: Upon determination that Work covered by a warranty has failed, replace or rebuild the Work to an acceptable condition complying with requirements of Contract Documents. Contractor is responsible for the cost of replacing or rebuilding defective Work regardless of whether Owner has benefited from use of the Work through a portion of its anticipated useful service life.
- D. Reinstatement of Warranty: When Work covered by a warranty has failed and been corrected by replacement or rebuilding, reinstate the warranty by written endorsement. The reinstated warranty shall be equal to the original warranty with an equitable adjustment for depreciation.
- E. Disclaimers and Limitations: Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of warranty on the Work that incorporates the products.
- F. Owner's Recourse: Written warranties made to Owner are in addition to implied warranties, and shall not limit the duties, obligations, rights and remedies otherwise available under the law, nor shall warranty periods be interpreted as limitations on time in which Owner can enforce such other duties, obligations, rights or remedies.
 - 1. Rejection of Warranties: Owner reserves the right to reject warranties and to limit selections to products with warranties not in conflict with requirements of the Contract Documents.

- G. Right of Refusal: Owner reserves the right to refuse to accept Work for the Project where a special warranty, certification, or similar commitment is required on such Work or part of the Work, until evidence is presented that entities required to countersign such commitments are willing to do so.

1.04 SUBMITTALS

- A. Warranty Commencement:
 - 1. Submit duplicate, notarized copies of written warranties to Engineer prior to the date certified for Substantial Completion. Engineer's Certificate of Substantial Completion shall be the commencement date for warranties.
 - 2. When a designated portion of the Work is completed and occupied or used by Owner, by separate agreement with Contractor during the construction period, submit properly executed warranties to Engineer within 15 days of completion of that designated portion of the Work.
 - 3. For items of Work delayed beyond the date of Substantial Completion, provide updated submittal within 10 days of acceptance by Owner, listing date of acceptance as start of warranty period.
- B. Special Warranty:
 - 1. When a special warranty is required to be executed by Contractor, or Contractor and a subcontractor, supplier or manufacturer, prepare a written document that contains appropriate terms and identification, ready for execution by the required parties. Submit a draft to Owner through Engineer for approval prior to final execution.
 - a. Execute and assemble documents from subcontractors, suppliers, and manufacturers.
 - b. Refer to individual sections of Divisions 2 through 46 for specific content requirements, and particular requirements for submittal of special warranties.
- C. Form of Submittal:
 - 1. At final completion compile 2 copies of each required warranty and bond properly executed by Contractor, subcontractor, supplier, or manufacturer.
 - 2. Organize the warranty documents into an orderly sequence based on the Table of Contents of the Project Manual.
 - 3. Bind warranties and bonds in heavy-duty, commercial quality, durable 3-ring vinyl covered loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-inch by 11-inch paper. Also provide electronic copy of warranties divided into subsections and bookmarked.
 - a. Identify each binder on the front and the spine with the typed or printed title "Warranties and Bonds," the project title or name, and the name of Contractor.
 - b. When operating and maintenance manuals are required for warranted construction, provide additional copies of each required warranty, as necessary, for inclusion in each required manual.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

SECTION 01 91 58
FACILITY START-UP

PART 1 - GENERAL

1.01 SUMMARY

- A. This Section describes the Contractor's general equipment requirements for facility start-up.
- B. Related Sections:
 - 1. Section 01 60 00 – Product Requirements
 - 2. Section 01 75 00 – Starting and Adjusting

1.02 SUBMITTALS

- A. Submit a detailed plan and schedule for start-up of the facility at least thirty (30) days prior to the scheduled start-up of the facility.

PART 2 - PRODUCTS

No products are required in this Section.

PART 3 - EXECUTION

3.1 CONTRACTOR'S REQUIREMENTS

- A. In addition to the services required to comply with Sections 01 60 00 and 01 75 00 provide the services of a qualified and experienced factory employed field service engineer from each equipment manufacturer:
 - 1. Confirm that equipment has been installed in accordance with the manufacturer's recommended procedures.
 - 2. Confirm that equipment is operational and ready for start-up.
 - 3. Make necessary repairs, corrections, and/or modifications prior to the scheduled start-up.
- B. Coordinate efforts of various equipment field service engineers with construction activities including painting and facility disinfection.
 - 1. Complete painting of equipment containing process water prior to disinfection.
 - 2. Successfully complete facility disinfection prior to start-up in accordance with appropriate provisions of AWWA C-653.
- C. Perform the above services at least two weeks prior to the scheduled start-up.

- D. Perform the facility start-up procedures in the presence of the Owner and Engineer.
- E. Operate the facility without problems for a period of fourteen (14) consecutive days prior to Owner's acceptance of the facility.

END OF SECTION

SECTION 024119 - SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Demolition and removal of selected portions of building or structure.
2. Demolition and removal of selected site elements.

B. Related Requirements:

1. Section 017300 "Execution" for cutting and patching procedures.
2. Section 013516 "Alteration Project Procedures" for general protection and work procedures for alteration projects.
3. Section 311000 "Site Clearing" for site clearing and removal of above- and below-grade improvements not part of selective demolition.

1.2 DEFINITIONS

- A. Remove: Detach items from existing construction and dispose of them off-site unless indicated to be salvaged or reinstalled.
- B. Remove and Reinstall: Detach items from existing construction, in a manner to prevent damage, prepare for reuse, and reinstall where indicated.
- C. Existing to Remain: Leave existing items that are not to be removed and that are not otherwise indicated to be salvaged or reinstalled.
- D. Dismantle: To remove by disassembling or detaching an item from a surface, using gentle methods and equipment to prevent damage to the item and surfaces; disposing of items unless indicated to be salvaged or reinstalled.

1.3 MATERIALS OWNERSHIP

- A. Unless otherwise indicated, demolition waste becomes property of Contractor.
- B. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to Owner that may be uncovered during demolition remain the property of Owner.
 1. Carefully salvage in a manner to prevent damage and promptly return to Owner.

1.4 FIELD CONDITIONS

- A. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
- B. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.
- C. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.
 - 1. Hazardous materials will be removed by Owner before start of the Work.
 - 2. If suspected hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.
- D. Storage or sale of removed items or materials on-site is not permitted.
- E. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.
 - 1. Maintain fire-protection facilities in service during selective demolition operations.

1.5 COORDINATION

- A. Arrange selective demolition schedule so as not to interfere with Owner's operations.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- B. Standards: Comply with ASSE A10.6 and NFPA 241.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that utilities have been disconnected and capped before starting selective demolition operations.
- B. Review Project Record Documents of existing construction or other existing condition and hazardous material information provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in Project Record Documents.

- C. Perform an engineering survey of condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective building demolition operations.
 - 1. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.
- D. Survey of Existing Conditions: Record existing conditions by use of measured drawings.
 - 1. Inventory and record the condition of items to be removed and salvaged. Provide photographs or video of conditions that might be misconstrued as damage caused by salvage operations.

3.2 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

- A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.
- B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off utility services and mechanical/electrical systems serving areas to be selectively demolished.
 - 1. Arrange to shut off utilities with utility companies.
 - 2. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
 - 3. Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC systems, equipment, and components indicated on Drawings to be removed.

3.3 PROTECTION

- A. Temporary Protection: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
 - 1. Provide protection to ensure safe passage of people around selective demolition area.
 - 2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
 - 3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
 - 4. Cover and protect equipment that has not been removed.
 - 5. Comply with requirements for temporary enclosures, dust control, heating, and cooling specified in Section 015000 "Temporary Facilities and Controls."
- B. Temporary Shoring: Design, provide, and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.
 - 1. Strengthen or add new supports when required during progress of selective demolition.

- C. Remove temporary barricades and protections where hazards no longer exist.

3.4 SELECTIVE DEMOLITION, GENERAL

- A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:
 - 1. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping. Temporarily cover openings to remain.
 - 2. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
 - 3. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.
 - 4. Maintain fire watch during and for at least 2 hours after flame-cutting operations.
 - 5. Maintain adequate ventilation when using cutting torches.
 - 6. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
 - 7. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
 - 8. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
 - 9. Dispose of demolished items and materials promptly.
- B. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
- C. Removed and Reinstalled Items:
 - 1. Clean and repair items to functional condition adequate for intended reuse.
 - 2. Pack or crate items after cleaning and repairing. Identify contents of containers.
 - 3. Protect items from damage during transport and storage.
 - 4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.
- D. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.

3.5 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

- A. Concrete: Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals using power-driven saw, and then remove concrete between saw cuts.

- B. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, and then remove masonry between saw cuts.
- C. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, and then break up and remove.

3.6 DISPOSAL OF DEMOLISHED MATERIALS

- A. Remove demolition waste materials from Project site and dispose of them in an EPA-approved construction and demolition waste landfill acceptable to authorities having jurisdiction.
 - 1. Do not allow demolished materials to accumulate on-site.
 - 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
- B. Burning: Do not burn demolished materials.

3.7 CLEANING

- A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

End of section

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SECTION 02 41 33

REMOVING PAVEMENT AND MISCELLANEOUS STRUCTURES (WisDOT 204)

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Removal and disposal of:
 - a. Curb and Gutter.
 - 2. Salvaging of designated materials.
 - 3. Backfilling of resulting depressions.
- B. Related Sections:
 - 1. Section 31 23 10 - Excavation and Embankment

1.02 REFERENCES

- A. WisDOT 204 - Removing or Abandoning Miscellaneous Structures

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.01 PREPARATION

- A. Sawing Pavement:
 - 1. Saw concrete pavement along removal lines to a depth 1/3 of the pavement thickness.
 - 2. Saw bituminous pavement along removal lines through entire pavement thickness.
 - 3. Produce a neat, square edge prior to restoration.
- B. Protect all in place structures and facilities not designated for removal.

3.02 REMOVAL OPERATIONS

- A. Remove only structures and facilities that have been so marked by Engineer.
- B. Complete all removal operations prior to adjacent new construction.
- C. Remove materials designated for salvage in a manner that will not result in damage.
- D. Completely remove structures that are designated for removal.
- E. Whenever possible, remove concrete to an existing joint.

3.03 DISPOSAL OF MATERIALS AND DEBRIS

- A. Stockpile all materials designated for salvage at locations approved by Engineer.
- B. Dispose of all materials not designated for salvage in accordance with all applicable laws and ordinances.

- C. Submit written request to Engineer for burning operations.
- D. All surplus excavated materials shall become the property of Contractor for disposal.

3.04 BACKFILLING DEPRESSIONS

- A. Backfill all depressions resulting from removals in accordance with Section 31 23 10.

END OF SECTION

SECTION 02 82 20

REGULATED ASBESTOS REMOVAL

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Asbestos removal.
 - 2. Competent person.
 - 3. Notice of intent.
 - 4. Air monitoring and sampling.
 - 5. Transportation and disposal of asbestos containing materials (ACM).

1.02 REFERENCES

- A. Asbestos Investigation Report is included in this Project Manual as Document: KPH Asbestos Inspection Report, Unit Well 12, 801 South Whitney Way, Madison, Wisconsin.
- B. Compressed Gas Association
- C. EPA - National Emission Standard for Asbestos 40 CFR 61, Subpart M
- D. OSHA - Asbestos Construction Industry Standard 29 CFR 1926.1101

1.03 DEFINITIONS

- A. Abatement Contractor: Contractor accredited by the state to remove regulated and nonregulated ACM.
- B. Asbestos-Containing Material (ACM): Any material or mixture of material that contains greater than 1 percent of asbestos fibers.
- C. Friable: Material that may be crumbled, pulverized, or reduced to powder by hand pressure when dry.
- D. Category I Nonfriable ACM: Asbestos containing gaskets, packings, resilient floor covering, and asphalt roofing products containing greater than 1 percent asbestos as determined by polarized light microscopy (PLM).
- E. Category II Nonfriable ACM: Any nonfriable material, excluding Category I nonfriable ACM, containing greater than 1 percent asbestos as determined by the PLM.
- F. Regulated Asbestos Containing Material (RACM):
 - 1. Friable asbestos material.
 - 2. Category I nonfriable ACM that has become friable.
 - 3. Category I nonfriable ACM that will be or has been subjected to sanding, grinding, cutting, or abrading.
 - 4. Category II nonfriable ACM that has a high probability of becoming or has become crumbled, pulverized, or reduced to powder by the forces expected to act on the material in the course of demolition or renovation operations.
- G. Class I Asbestos Work: Activities involving the removal of thermal systems insulation (TSI) and surfacing ACM or RACM.
- H. Class II Asbestos Work: Activities involving the removal of ACM that is not TSI or surfacing material.

1.04 EXISTING CONDITIONS

- A. Regulated ACM is present in the following locations: Refer to the Asbestos Investigation Report included in this Project Manual.

1.05 SUBMITTALS

- A. Submit the following prior to commencing asbestos abatement in areas where regulated ACM is to be removed prior to demolition:
 - 1. Submit an asbestos project plan and a project design report to the appropriate regulatory agencies and Owner. The asbestos project plan must contain information provided in the Wisconsin Administrative Code NR 447.
 - 2. Copy of "Notification of Asbestos-Related Work" that was submitted to applicable regulatory agencies.
 - 3. Copy of state license of waste hauler.
 - 4. Name of disposal facility where ACM will be disposed including contact person.
 - 5. Documentation that all employees or agents who may be exposed to airborne asbestos in excess of action level have been medically cleared and are physically capable of working while wearing a respirator.
 - 6. Documentation that all employees working in a regulated area are certified as an "Authorized Person" per OSHA 29 CFR 1926.1101.
 - 7. Written emergency plan.
- B. Review of abatement Contractor's Project design report by Owner in no manner or form implies endorsement, acceptance, or use of the plan or that the design report meets the requirements of the applicable regulatory agencies.
- C. Submit prior to completion of Project and final payment:
 - 1. Manifest documents for disposal of ACM.
 - 2. Daily record of activities.

1.06 COMPETENT PERSON

- A. Provide a "Competent Person," as defined in OSHA 29 CFR 1926.1101 during all Class II asbestos removal activities.
 - 1. Be onsite at all times during Class II asbestos removal activities.
 - 2. Conduct required personal air sampling and monitoring and will determine if work is conducted in accordance with generally accepted practices.
- B. The Competent Person or Owner have the authority to stop Work at any time if necessary and must do so if applicable rules and regulations are violated.
- C. Stoppage of Work shall continue until conditions have been corrected and corrective steps have been taken to the satisfaction of the Competent Person and Owner.
- D. Standby time required to resolve violations shall be at Contractor's expense.

1.07 NOTICE OF INTENT

- A. Abatement Contractor is responsible for filing a "Notification of Asbestos-Related Work" form with all of the parties named hereinafter, prior to commencement of any work involving ACM abatement.
 - 1. Asbestos Coordinator
 - 2. Asbestos Unit
 - 3. Owner and Owner's representative.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Disposal containers shall be in conformance with OSHA Requirement 29 CFR 1926.1101 (k) (8).
- B. Stick-on labels for disposal containers shall be in conformance with EPA, OSHA, and DOT requirements.

2.02 EQUIPMENT

- A. Abatement Contractor shall be responsible for supplying equipment to maintain proper ventilation. Negative pressure ventilation units shall be equipped with HEPA filtration and operated in accordance with ANSI Z9.2-19 and EPA guidance document EPA 560/5-83-002 Guidance for Controlling Friable Asbestos-Containing Material in Buildings Appendix F.
- B. Abatement Contractor is responsible for supplying safety equipment to their employees to complete the abatement project in accordance with OSHA and state Department of Health regulations.

PART 3 EXECUTION

3.01 GENERAL

- A. Asbestos-containing material must be removed by a Wisconsin Certified asbestos abatement contractor.
- B. Remove and dispose of all ACM associated with the asbestos removal project. Locations of known ACM are identified in the Asbestos Inspection Report. Work shall conform to all current local, state, and federal regulations.
- C. Prior to commencing work, abatement Contractor shall post appropriate warning signs at all approaches to a regulated area.
- D. The abatement Contractor must use wet methods to remove all ACM. Dry removal will not be acceptable.
- E. A 5-chambered decontamination enclosure system shall be provided at each location where authorized personnel will enter or exit a regulated area. The decontamination enclosure system shall meet or exceed the requirements of OSHA 29 CFR 1926.1101 and Wisconsin Administrative Code NR 447.
- F. Authorized personnel shall enter the regulated area only through the decontamination enclosure system.

3.02 MONITORING AND SAMPLING

- A. Retain an independent air monitoring firm to collect and analyze air samples required for clearance air sampling and analysis.
- B. Provide monitoring and sampling of air within the regulated area as required by state Department of Health rules.
- C. Area air samples and clearance air samples will be analyzed by phase contrast microscopy in accordance with NIOSH Method 7400.
- D. Asbestos removal activities will cease if the clearance standard (0.01 f/cc) is exceeded outside the Work area. An alternative clearance standard may be established prior to beginning the Project. A minimum of 5 air samples must be collected to establish an alternative clearance standard.

- E. Costs for additional clearance sampling and analysis beyond the initial clearance sampling and analysis shall be borne by abatement Contractor. Final clearance shall be determined by Owner's representative and will be based on visual inspections and results of clearance air sample analyses.

3.03 TRANSPORTATION AND DISPOSAL

- A. The ACM disposal location shall be prearranged and approved by Owner prior to transportation of any and all ACM from the Site.
- B. Properly sealed and labeled containers of ACM shall be removed and transported directly to the prearranged disposal location, which must be an authorized site in accordance with regulatory requirements of the EPA and Wisconsin Administrative Code NR 447. Use of intermediate storage locations will not be acceptable.
- C. Containers of ACM that have been removed from the regulated area shall be loaded directly into an enclosed truck for transportation.
- D. Excess water used in asbestos abatement shall be filtered down to 5 micrometers prior to discharge to city sewer.

3.04 COMPLETION OF ABATEMENT

- A. Following asbestos abatement, procedures for visual inspection, lockdown, removal of containment walls and floors, clearance air sampling, and removal of critical barriers must be followed in accordance with Wisconsin Administrative Code NR 447.
- B. An adequate coating of encapsulating agent shall be applied to all surfaces within the work area to seal in non-visible residue or unabated exposed ACM.

END OF SECTION



ASBESTOS INSPECTION REPORT

Job Site:

**Unit Well 12
801 South Whitney Way
Madison, Wisconsin**

For:

**Madison Water Utility
Attn: Dan Rodefeld
110 S. Paterson St.
Madison, WI 53703**

KPH Project No.: 14-200-475

A handwritten signature in black ink, appearing to read "Dean Jacobsen", written over a horizontal line.

Dean Jacobsen
Asbestos Inspector No. 14370

Prepared by:

KPH Environmental
1237 West Bruce Street
Milwaukee, Wisconsin 53204

December 2014

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I. INTRODUCTION

KPH Environmental Corp., (KPH) was retained by the Madison Water Utility to conduct an inspection for possible asbestos containing materials in the Unit Well 12 buildings located at 801 South Whitney Way, Madison.

Dan Rodefeld, of the Madison Water Utility, authorized KPH to conduct a building inspection and to analyze samples collected during the inspection. The inspection of the Unit Well 12 buildings located at 801 South Whitney Way, Madison, Wisconsin, was conducted on December 1, 2014. The inspection was conducted by Dean Jacobsen, Wisconsin Asbestos Inspector License No. AII – 14370. Additional information on the inspection and results are contained in the following sections.

II. BUILDING SURVEY

A. Methods

This asbestos inspection included a visual determination as to the extent of visible and accessible suspect materials in the building, sampling and documentation of these suspect materials, and quantification of observable and accessible positive materials existing within the spaces.

Bulk sampling involves inspecting all or part of a building (depending on the project scope) and identifying suspect asbestos containing materials. According to the USEPA, this includes all materials except wood, metal, and glass. After suspect materials are identified, the inspector divides the building into homogeneous areas. Homogeneous areas contain materials that are alike in color, composition, age of installation, and any other aspect. If any differences are identified during the inspection, a separate homogeneous area is established. The inspector then uses USEPA sampling protocols to collect bulk samples based upon the type of material and quantity of material in the homogeneous area. Bulk samples are placed into resealable containers and sent to a laboratory certified under the National Voluntary Laboratory Accreditation program (NVLAP) for analysis. Destructive sampling was not conducted where it would have adversely impacted suspect asbestos containing materials, such as plaster, to avoid building contamination.

The results of the survey integrated with the Polarized Light Microscopy with Dispersion Staining (PLM/DS) analysis of bulk samples taken are outlined in this document.

B. List of Suspect Asbestos Containing Materials

The following types of suspect materials were inspected to determine if asbestos containing materials were present within the building as required by US EPA NESHAP regulation 40 CFR 61 Subpart M and NR 447 of the Wisconsin Administrative Code:

- Flue packing
- Caulk
- Ceramic tile
- Plaster
- Pipe insulation
- Fittings
- Transite panels
- Stone mortar
- Flashing

A listing of specific homogeneous materials and homogeneous material codes are in the Samples and Results section following the results table.

III. THE LABORATORY

Samples were analyzed at Amerisci of Midlothian, Virginia, a National Voluntary Laboratory Accreditation Program lab, for total asbestos content by volume using EPA Method 600/M4/82/020, 600/R-93/116. Analysis is performed by using the bulk samples for visual observation and slide preparation(s) for microscopical examination and identification. The slides are analyzed for asbestos (chrysotile, amosite, crocidolite, anthophyllite, and actinolite/tremolite), fibrous non asbestos constituents (mineral wool, paper, etc.), and nonfibrous constituents. Asbestos is identified by refractive indices (obtained by using dispersion staining), morphology, color, pleochroism, birefringence, extinction characteristics, and signs of elongation. The same characteristics are used to identify the non asbestos constituents.

The microscopist visually estimates relative amounts of each constituent using a stereoscope if necessary. The test results are based on a visual determination of relative volume of the bulk sample components. The results are valid only for the item tested. Where the first sample of a homogeneous material contained more than 1% asbestos, the subsequent samples of that material were not analyzed. A point count analysis is performed for samples where the polarized light microscopy result is close to 1%. The point count is a more accurate fiber counting method and takes precedence over polarized light microscopy result.

Current regulations state asbestos containing materials (ACM) means material containing more than 1% asbestos as determined using the method specified in Appendix E, Subpart E, 40 CFR Part 763 Section I, Polarized Light Microscopy. Bold values indicate that the material contains more than 1% asbestos.

Refer to 29 CFR 1926.1101 (Construction) for specific OSHA asbestos safety requirements.

IV. FINDINGS AND OBSERVATIONS

The following are the laboratory results:

Sample #	Location and Description	Results	Homogeneous Code
1-801	East room – pipe insulation cover	Negative	TFI
2-801a	East room – pipe insulation fitting cover	Negative	TFF
2-801b	East room – pipe insulation fitting	Positive 5% Chrysotile	TFF
3-801	East room – on west wall at flue – flue packing	Negative	TFP
4-801	West room – at east wall motor cabinet – brown caulk	Negative	MCLKn
5-801	West room – at east wall motor cabinet – gray caulk	Negative	MCLKy
6-801a	West room – west wall – green ceramic tile	Negative	MCTMg
6-801b	West room – west wall – under ceramic tile – mortar	Negative	MCTMg
6-801c	West room – west wall – grout	Negative	MCTMg
7-801a	West room – north wall – green ceramic tile	Negative	MCTMg
7-801b	West room – north wall – under ceramic tile – mortar	Negative	MCTMg
7-801c	West room – north wall – grout	Negative	MCTMg
8-801a	West room – south wall – green ceramic tile	Negative	MCTMg
8-801b	West room – south wall – under ceramic tile – mortar	Negative	MCTMg
8-801c	West room – south wall – grout	Negative	MCTMg
9-801a	West room – floor – red and orange ceramic tile	Negative	MCTMro
9-801b	West room – floor – grout	Negative	MCTMro
10-801a	West room – floor – red and orange ceramic tile	Negative	MCTMro
10-801b	West room – floor – grout	Negative	MCTMro
11-801a	East room – floor – red and orange ceramic tile	Negative	MCTMro
11-801b	East room – floor – grout	Negative	MCTMro
12-801a	East room – east wall – plaster skim coat	Negative	SPI
12-801b	East room – east wall – plaster base coat	Negative	SPI
13-801a	West room – east wall – plaster skim coat	Negative	SPI
13-801b	West room – east wall – plaster base coat	Negative	SPI
14-801a	West room – west wall – plaster skim coat	Negative	SPI
14-801b	West room – west wall – plaster base coat	Negative	SPI
15-801	West room – on pipes – foam insulation	Negative	MFI
16-801	West room – in south electrical panel in left door – gray transite panel	Positive 12% Chrysotile	MTP
17-801	West room – in south electrical panel on left side – black transite panel	Positive 20% Chrysotile	MTP2
18-801	Exterior – on doors and newer windows – gray caulk #2	Negative	MCLKy2
19-801	Exterior – walls – stone mortar	Negative	MSM
20-801	Exterior – on 2 old west side windows – dark gray caulk	Positive 5% Chrysotile	MCLKydark
21-801	Exterior – roof – at chimney – black flashing	Negative	MRF

Homogeneous Material Codes

MCLKn	Brown Caulk
MCLKy	Gray Caulk
MCLKy2	Gray Caulk #2
MCLKydark	Dark Gray Caulk
MCTMg	Green Ceramic Tile
MCTMro	Red & Orange Ceramic Tile

Homogeneous Material Codes

MFI	Foam Insulation
MTP	Gray Transite Panel
MTP2	Black Transite Panel
MSM	Stone Mortar
MRF	Tar Flashing
TFI	Wrap on Fiberglass Pipe Insulation
TFF	Pipe Insulation Fitting
TFP	Flue Packing

Note#1: Federal, state, and local inspection and sampling guidelines were followed.

Note#2: Random sampling methods were used in general accordance with the U. S. Environmental Protection Agency National Emission Standards for Hazardous Air Pollutants guidelines (40 CFR 61 Subpart M).

Note#3: Any materials that are discovered during demolition that are not listed above are to be assumed to be asbestos containing.

Note#4: The following universal wastes were identified: 12 fluorescent light fixture ballasts and 24 fluorescent light bulbs.

V. SUMMARY OF RESULTS

Four (4) of the materials sampled contain greater than 1% asbestos: pie insulation fittings in the east and west rooms, gray and black transite panels the south side electrical cabinet, and caulk on 2 west windows.

Material	Homogeneous Code	Location	Approximate Quantity
Pipe Insulation Fittings	TFF	East & West Rooms	4 Fittings < 5" Diameter
Gray Transite Panel	MTP	West Room South Electrical Panel in Left Door	1 Sq. Ft., ¼ In. Thick
Black Transite Panel	MTP2	West Room South Electrical Panel on Left Side	8 Sq. Ft., 1 In. Thick
Dark Gray Caulk	MCLKydark	Exterior 2 Old West Side Windows	24 Ln. Ft.

The pipe insulation fittings are a friable material and must be removed by a Wisconsin certified asbestos abatement contractor prior to building demolition. The transite panels and caulk are category II non-friable materials and also must be removed by a Wisconsin certified asbestos abatement contractor prior to building demolition.

VI. EXCLUSIONS

No visible or accessible areas or material were excluded from this scope of work.

This report represents the condition of the building and its visible/accessible suspect asbestos containing materials at the date and the times of the onsite inspection. Hidden materials or

those materials that could be present at the point of inspection, over and above those stated in the inspection report, are the responsibility of the building owner and the renovation contractor.

VII. LIMITATIONS

The care and skill given to our procedures insures the most reliable test results possible. KPH utilized Amerisci Richmond for our Polarized Light Microscopy, as specified by the client. The findings and conclusions of KPH represent our professional opinions extrapolated from limited data. Significant limited data is gathered during the course of the preliminary asbestos specific site assessment. No other warranty is expressed or implied. Prior to any abatement or renovation activities, it is recommended that KPH be provided the opportunity to review such plans in order that the inspection and assessments contained herein are properly interpreted and implemented.

This report and the information contained herein are prepared for the sole and exclusive use and possession of the Madison Water Utility. No other person or entity may rely on this report or any information contained herein. Any dissemination of the Report or any information contained herein is strictly prohibited without prior written authorization from KPH Environmental Corp.

VIII. LABORATORY RESULTS



PLM Bulk Asbestos Report

KPH Construction Corp
Attn: Dean Jacobsen
1237 W Bruce Street

Milwaukee, WI 53204

Date Received 12/03/14 **AmeriSci Job #** 114121095
Date Examined 12/05/14 **P.O. #**
Page 1 of 7
RE: 14-200-475; Madison Water Utility; 801 S Whitney Way, WI

Client No. / HGA	Lab No.	Asbestos Present	Total % Asbestos
1-801 Location:	114121095-01	No	NAD (by CVES) by Gordon T. Saleeby on 12/05/14
Analyst Description: Blue/White, Heterogeneous, Non-Fibrous, Bulk Material			
Asbestos Types:			
Other Material: Cellulose 35 %, Non-fibrous 65 %			
2-801 Location:	114121095-02.1	No	NAD (by CVES) by Gordon T. Saleeby on 12/05/14
Analyst Description: Blue/White, Heterogeneous, Non-Fibrous, Wrap			
Asbestos Types:			
Other Material: Cellulose 35 %			
2-801 Location:	114121095-02.2	Yes	5 % (by CVES) by Gordon T. Saleeby on 12/05/14
Analyst Description: Gray, Heterogeneous, Non-Fibrous, Mud			
Asbestos Types: Chrysotile 5.0 %			
Other Material: Animal hair 5 %, Non-fibrous 90 %			
3-801 Location:	114121095-03	No	NAD (by CVES) by Gordon T. Saleeby on 12/05/14
Analyst Description: Lt. Gray, Heterogeneous, Non-Fibrous, Bulk Material			
Asbestos Types:			
Other Material: Wollastonite 15 %, Non-fibrous 85 %			
4-801 Location:	114121095-04	No	NAD (by CVES) by Gordon T. Saleeby on 12/05/14
Analyst Description: Brown, Heterogeneous, Non-Fibrous, Bulk Material			
Asbestos Types:			
Other Material: Non-fibrous 100 %			

Client Name: KPH Construction Corp

PLM Bulk Asbestos Report

14-200-475; Madison Water Utility; 801 S Whitney Way, WI

Client No. / HGA	Lab No.	Asbestos Present	Total % Asbestos
5-801 Location:	114121095-05	No	NAD (by CVES) by Gordon T. Saleeby on 12/05/14
Analyst Description: White/Gray, Heterogeneous, Non-Fibrous, Bulk Material			
Asbestos Types:			
Other Material: Non-fibrous 100 %			
6-801 1 Location:	114121095-06.1	No	NAD (by CVES) by Gordon T. Saleeby on 12/05/14
Analyst Description: Green, Heterogeneous, Non-Fibrous, Ceramic Tile			
Asbestos Types:			
Other Material: Non-fibrous 100 %			
6-801 1 Location:	114121095-06.2	No	NAD (by CVES) by Gordon T. Saleeby on 12/05/14
Analyst Description: Gray, Heterogeneous, Non-Fibrous, Thinset			
Asbestos Types:			
Other Material: Non-fibrous 100 %			
6-801 1 Location:	114121095-06.3	No	NAD (by CVES) by Gordon T. Saleeby on 12/05/14
Analyst Description: White, Heterogeneous, Non-Fibrous, Grout			
Asbestos Types:			
Other Material: Non-fibrous 100 %			
7-801 1 Location:	114121095-07.1	No	NAD (by CVES) by Gordon T. Saleeby on 12/05/14
Analyst Description: Green, Heterogeneous, Non-Fibrous, Ceramic Tile			
Asbestos Types:			
Other Material: Non-fibrous 100 %			
7-801 1 Location:	114121095-07.2	No	NAD (by CVES) by Gordon T. Saleeby on 12/05/14
Analyst Description: Gray, Heterogeneous, Non-Fibrous, Thinset			
Asbestos Types:			
Other Material: Non-fibrous 100 %			

Client Name: KPH Construction Corp

PLM Bulk Asbestos Report

14-200-475; Madison Water Utility; 801 S Whitney Way, WI

Client No. / HGA	Lab No.	Asbestos Present	Total % Asbestos
7-801 1 Location:	114121095-07.3	No	NAD (by CVES) by Gordon T. Saleeby on 12/05/14
Analyst Description: Off White, Heterogeneous, Non-Fibrous, Grout Asbestos Types: Other Material: Non-fibrous 100 %			
8-801 1 Location:	114121095-08.1	No	NAD (by CVES) by Gordon T. Saleeby on 12/05/14
Analyst Description: Green, Heterogeneous, Non-Fibrous, Ceramic Tile Asbestos Types: Other Material: Non-fibrous 100 %			
8-801 1 Location:	114121095-08.2	No	NAD (by CVES) by Gordon T. Saleeby on 12/05/14
Analyst Description: Gray, Heterogeneous, Non-Fibrous, Thinset Asbestos Types: Other Material: Non-fibrous 100 %			
8-801 1 Location:	114121095-08.3	No	NAD (by CVES) by Gordon T. Saleeby on 12/05/14
Analyst Description: Off White, Heterogeneous, Non-Fibrous, Grout Asbestos Types: Other Material: Non-fibrous 100 %			
9-801 Location:	114121095-09.1	No	NAD (by CVES) by Gordon T. Saleeby on 12/05/14
Analyst Description: Red, Heterogeneous, Non-Fibrous, Brick Asbestos Types: Other Material: Non-fibrous 100 %			
9-801 Location:	114121095-09.2	No	NAD (by CVES) by Gordon T. Saleeby on 12/05/14
Analyst Description: Black/Gray, Heterogeneous, Non-Fibrous, Mortar Asbestos Types: Other Material: Non-fibrous 100 %			

Client Name: KPH Construction Corp

PLM Bulk Asbestos Report

14-200-475; Madison Water Utility; 801 S Whitney Way, WI

Client No. / HGA	Lab No.	Asbestos Present	Total % Asbestos
10-801 Location:	114121095-10.1	No	NAD (by CVES) by Gordon T. Saleeby on 12/05/14
Analyst Description: Red, Heterogeneous, Non-Fibrous, Brick			
Asbestos Types:			
Other Material: Non-fibrous 100 %			
10-801 Location:	114121095-10.2	No	NAD (by CVES) by Gordon T. Saleeby on 12/05/14
Analyst Description: Gray, Heterogeneous, Non-Fibrous, Mortar			
Asbestos Types:			
Other Material: Non-fibrous 100 %			
11-801 Location:	114121095-11.1	No	NAD (by CVES) by Gordon T. Saleeby on 12/05/14
Analyst Description: Red, Heterogeneous, Non-Fibrous, Brick			
Asbestos Types:			
Other Material: Non-fibrous 100 %			
11-801 Location:	114121095-11.2	No	NAD (by CVES) by Gordon T. Saleeby on 12/05/14
Analyst Description: Gray, Heterogeneous, Non-Fibrous, Mortar			
Asbestos Types:			
Other Material: Non-fibrous 100 %			
12-801 Location:	114121095-12.1	No	NAD (by CVES) by Gordon T. Saleeby on 12/05/14
Analyst Description: White, Heterogeneous, Non-Fibrous, Skim Coat (Plaster)			
Asbestos Types:			
Other Material: Non-fibrous 100 %			
12-801 Location:	114121095-12.2	No	NAD (by CVES) by Gordon T. Saleeby on 12/05/14
Analyst Description: Lt. Gray, Heterogeneous, Non-Fibrous, Base Coat (Plaster)			
Asbestos Types:			
Other Material: Non-fibrous 100 %			

PLM Bulk Asbestos Report

14-200-475; Madison Water Utility; 801 S Whitney Way, WI

Client No. / HGA	Lab No.	Asbestos Present	Total % Asbestos
13-801 Location:	114121095-13.1	No	NAD (by CVES) by Gordon T. Saleeby on 12/05/14
Analyst Description: White, Heterogeneous, Non-Fibrous, Skim Coat (Plaster)			
Asbestos Types:			
Other Material: Non-fibrous 100 %			
13-801 Location:	114121095-13.2	No	NAD (by CVES) by Gordon T. Saleeby on 12/05/14
Analyst Description: Lt. Gray, Heterogeneous, Non-Fibrous, Base Coat (Plaster)			
Asbestos Types:			
Other Material: Non-fibrous 100 %			
14-801 Location:	114121095-14.1	No	NAD (by CVES) by Gordon T. Saleeby on 12/05/14
Analyst Description: White, Heterogeneous, Non-Fibrous, Skim Coat (Plaster)			
Asbestos Types:			
Other Material: Non-fibrous 100 %			
14-801 Location:	114121095-14.2	No	NAD (by CVES) by Gordon T. Saleeby on 12/05/14
Analyst Description: Lt. Gray, Heterogeneous, Non-Fibrous, Base Coat (Plaster)			
Asbestos Types:			
Other Material: Non-fibrous 100 %			
15-801 Location:	114121095-15	No	NAD (by CVES) by Gordon T. Saleeby on 12/05/14
Analyst Description: Blue/Black, Heterogeneous, Non-Fibrous, Bulk Material			
Asbestos Types:			
Other Material: Non-fibrous 100 %			
16-801 Location:	114121095-16	Yes	12 % (by CVES) by Gordon T. Saleeby on 12/05/14
Analyst Description: Gray, Heterogeneous, Non-Fibrous, Bulk Material			
Asbestos Types: Chrysotile 12.0 %			
Other Material: Non-fibrous 88 %			

Client Name: KPH Construction Corp

PLM Bulk Asbestos Report

14-200-475; Madison Water Utility; 801 S Whitney Way, WI

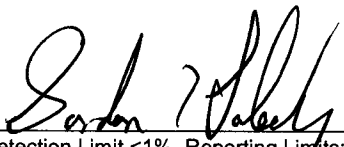
Client No. / HGA	Lab No.	Asbestos Present	Total % Asbestos
17-801 Location:	114121095-17	Yes	20 % (by CVES) by Gordon T. Saleeby on 12/05/14
Analyst Description: Black, Heterogeneous, Non-Fibrous, Bulk Material			
Asbestos Types: Chrysotile 20.0 %			
Other Material: Non-fibrous 80 %			
18-801 Location:	114121095-18	No	NAD (by CVES) by Gordon T. Saleeby on 12/05/14
Analyst Description: Lt. Gray, Heterogeneous, Non-Fibrous, Bulk Material			
Asbestos Types:			
Other Material: Non-fibrous 100 %			
19-801 Location:	114121095-19	No	NAD (by CVES) by Gordon T. Saleeby on 12/05/14
Analyst Description: Gray, Heterogeneous, Non-Fibrous, Bulk Material			
Asbestos Types:			
Other Material: Non-fibrous 100 %			
20-801 Location:	114121095-20	Yes	5 % (by CVES) by Gordon T. Saleeby on 12/05/14
Analyst Description: Tan/Gray, Heterogeneous, Non-Fibrous, Bulk Material			
Asbestos Types: Chrysotile 5.0 %			
Other Material: Non-fibrous 95 %			
21-801 Location:	114121095-21	No	NAD (by CVES) by Gordon T. Saleeby on 12/05/14
Analyst Description: Black, Heterogeneous, Non-Fibrous, Bulk Material			
Asbestos Types:			
Other Material: Cellulose 12 %, Non-fibrous 88 %			

PLM Bulk Asbestos Report

14-200-475; Madison Water Utility; 801 S Whitney Way, WI

Reporting Notes:

Analyzed by: Gordon T. Saleeby



Date

Dec 5, 2014

*NAD = no asbestos detected, Detection Limit <1%, Reporting Limits: CVES = 1%, 400 Pt Ct = 0.25%, 1000 Pt Ct = 0.1%; "Present" or NVA = "No Visible Asbestos" are observations made during a qualitative analysis; NA = not analyzed; NA/PS = not analyzed / positive stop; PLM Bulk Asbestos Analysis by EPA 600/M4-82-020 per 40 CFR 763 (NVLAP Lab Code 101904-0) and ELAP PLM Analysis Protocol 198.1 for New York friable samples which includes quantitation of any vermiculite observed (198.6 for NOB samples) or EPA 400 pt ct by EPA 600/M4-82-020 (NYSDOH ELAP Lab # 10984); CA ELAP Lab # 2508; Note: PLM is not consistently reliable in detecting asbestos in floor coverings and similar NOB materials. NAD or Trace results by PLM are inconclusive, TEM is currently the only method that can be used to determine if this material can be considered or treated as non-asbestos-containing in New York State (also see EPA Advisory for floor tile, FR 59, 146, 38970, 8/1/94). NIST Accreditation requirements mandate that this report must not be reproduced except in full without the approval of the laboratory. This PLM report relates ONLY to the items tested.

Reviewed By: _____

BULK CHAIN OF CUSTODY

AMERISCI RICHMOND
 13635 GENITO ROAD
 MIDLOTHIAN, VA 23112
 PHONE: (804) 476-5227
 FAX: (804) 763-1800



AMERISCI #: **114121095**

Relinquished By: Jan Date/Time: 12/2/14 1700

Received By: [Signature] Date/Time: _____

Relinquished By: _____ Date/Time: _____

Received By: SM Date/Time: _____

Project: Madison Water Utility Proj #: 14-200-475

Company: KPH Environmental Corp. Proj Mgr: _____

Street Address: 1237 West Bruce Street

City: Milwaukee State: WI Zip: 53204

Phone: 414-647-1530 Fax: 414-647-1540

Cell: _____ Fax: _____

E-mail: dean.jacobsen@kphenvironmental.com Verbal Results: X / N

Results to: Dean Jacobsen

Special Instructions or Comments: _____

Project State: WI

Analysis: X PLM; Positive Stop; TEM; NY ELAP PLM/TEM w/ NOB Prep.

ASTM Dust (Microvac) (Wipe); Qualitative; Other (describe in comments)

Turnaround Time: 5 Day Material Type: X Bulk Dust Water

Sampled By: Dean Jacobsen Date Sampled: 12/1/14

Lab ID	Field ID	Location	Sample Description (dust area)	Homogenous Area
	1-801			
	2-801			
	3-801			
	4-801			
	5-801			
	6-801			
	7-801			
	8-801			
	9-801			
	10-801			
	11-801			
	12-801			
	13-801			
	14-801			
	15-801			
	16-801			
	17-801			

Test Unt. > 12
 ↓

IX. KPH CERTIFICATION

Company Certificate

This certifies that

KPH ENVIRONMENTAL CORPORATION

1237 W BRUCE ST
MILWAUKEE WI 53204-1218

is certified under ch. DHS 159, Wis.Adm.Code as a

Asbestos Company - Primary

Certificate Issue Date: 06/11/2014
Expiration Date: 09/10/2016, 12:01 a.m.
Certification #: CAP-1432180

Wisconsin Department of Health Services
Division of Public Health
Bureau of Environmental and Occupational Health
Asbestos & Lead Section
PO Box 2659
Madison WI 53701-2659
Phone: (608) 261-6876



Shelley A Bruce
Shelley A Bruce,
Unit Supervisor



14-180

Cert. No.

Certificate of Completion

Dean T. Jacobsen

Has completed and satisfactorily passed an examination covering the contents of the course title listed below.

This training course complies with the requirements of TSCA Title II and is accredited by the State of Wisconsin Department of Health Services under ch. DHS 159 Wis. Adm. Code.



Course: Refresher Asbestos Inspector

S.A. Herbst & Associates

*1237 West Bruce Street * Milwaukee, WI 53204 * (414) 727-7900*

Class Location: 1237 W. Bruce Street, Milwaukee WI 53204

Kenneth A. Harenda II

Instructor/Trainer Name

A handwritten signature in blue ink, appearing to read 'D. Jacobsen', written over a horizontal line.

Signature

November 21, 2014

Examination Date

Course Date: 11/21/14

Certificate Issued: November 21, 2014

November 21, 2015

Expiration Date

SECTION 03 11 00
CONCRETE FORMING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Design, furnish, and install formwork with shoring, bracing and anchorage for cast-in-place concrete.

1.02 REFERENCES

- A. American Concrete Institute (ACI):
 - 1. CI 347 - Recommended Practice for Concrete Formwork

1.03 SUBMITTALS

- A. Submittals shall conform to Section 01 33 00 – Submittal Procedures.
- B. Submit Product Data for form ties.

1.04 QUALITY ASSURANCE

- A. The design, engineering, and proper construction of all formwork shall be the responsibility of the Contractor.
- B. Design formwork in accordance with ACI 347.

1.05 PRODUCT HANDLING

- A. Do not store forms or equipment on finished slabs.

PART 2 PRODUCTS

2.01 FORM MATERIAL

- A. Form Facing Material: Smooth faced, undamaged plywood or other panel type material approved by Engineer.
- B. The form facing material shall produce a smooth, hard, uniform texture on the concrete.
- C. The arrangement of the facing material shall be orderly and symmetrical with the number of seams kept to a minimum.
- D. Do not use facing material with raised grain, torn surfaces, worn edges, patches, dents, or other defects which will impair the texture of the concrete surface.
- E. Fiber Tube Forms: Continuous laminated fiber tube with exterior moisture protection and non-adhering interior surface similar to:
 - 1. "A-Coated Sonotube" as manufactured by Sonoco Products, Hartsville, South Carolina;
 - 2. "Quik-Tube" as manufactured by The Quikcrete Companies, Atlanta, Georgia;
 - 3. "CEME-TUBE" as manufactured by CEME-TUBE, LLC, Hudson, Wisconsin;
 - 4. or approved equal.

- F. Void Forms:
 - 1. Corrugated fiberboard forms impregnated with paraffin, as manufactured by firm regularly engaged in production of corrugated fiberboard forms.
 - 2. Design to safely support dead load of concrete and construction live loads for period of 2 weeks.
 - 3. Design to prevent leakage of concrete or backfill materials and treat to prevent loss of strength and softening of form material due to moisture absorption.
 - 4. Size as shown on Drawings.

2.02 FORM TIES

- A. Form Ties: Factory fabricated, adjustable length, removable or snap-off metal form ties designed to prevent form deflection and to prevent spalling concrete surfaces upon removal.
- B. The portion of the tie remaining in the concrete after removal of the tie shall be at least 1 inch from the surface of the concrete.
- C. Provide waterseals on all wall ties used in water containment structures and exterior walls.

2.03 FORM COATINGS

- A. Form Coatings or Release Agents: Commercially formulated chemical release agents containing no lubrication oil, conventional form oil, fuel oil, or kerosene. Containers shall have manufacturer's instructions for use printed thereon.
- B. The form coating shall not penetrate, stain, or leave a residual film on the concrete surface and shall not attract dirt or other deleterious material.

2.04 ACCESSORIES

- A. Chamfer Strips: 3/4-inch by 3/4-inch wood or plastic strips.
- B. Provide all anchorages, braces, and special forms required to construct cast-in-place concrete components shown on the Drawings.

PART 3 EXECUTION

3.01 GENERAL

- A. Establish a benchmark in an accessible location and use as a reference point for various construction levels.
- B. Verify lines, levels, and centers before proceeding with formwork.
- C. Insure that dimensions agree with the Drawings. Report any discrepancies to Engineer before proceeding with Work.

3.02 FORMWORK DESIGN

- A. The design, engineering, and construction of the formwork shall be the responsibility of the Contractor.
- B. Design formwork in accordance with ACI 347.
- C. Formwork shall be designed, erected, supported, braced, and maintained to safely support all vertical and lateral loads that might be applied until such loads can be supported by the concrete structure.
- D. Camber formwork to compensate for anticipated deflections in the formwork prior to hardening of the concrete.

- E. Provide positive means of adjustment of shores and struts.
 - 1. Take up all settlement during concrete placing operations.
 - 2. Securely brace forms against lateral deflections.

3.03 FORMWORK CONSTRUCTION

- A. Provide forms for all concrete work. Do not use earth cuts as forms for vertical surfaces.
- B. Construct forms to conform to slopes, lines, and dimensions shown on the Drawings.
- C. Forms shall be sufficiently tight to prevent loss of mortar from the concrete.
- D. Place chamfer strips at all exposed corners.
- E. Install all required openings, frames, pipe sleeves, cavities, slots, and other embedded items.
- F. Cut all holes in forms required for installation or embedment of concrete reinforcement bars and ties.
- G. Provide sharp clean corners at intersecting planes without visible edges or offsets. Back joints with extra studs or girts to maintain true, square corners.
- H. Provide temporary openings at the base of column forms and wall forms to facilitate cleaning and observation immediately before concrete is placed.
 - 1. Construct closures to ensure a tight fit flush with the adjoining surfaces.
- I. Provide runways for moving equipment.
 - 1. Provide runways with struts or legs and support directly on the formwork.
 - 2. Runways shall not rest on the reinforcing steel.
- J. Thoroughly clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris before concrete is placed.
- K. Install Void Forms:
 - 1. Protect from moisture before concrete placement. Store above ground level in dry location.
 - 2. Do not use forms subjected to water, moist soils, or damp storage unless test loaded.
 - 3. Install on surface providing uniform support. Conform to recommendations of manufacturer.
 - 4. Protect from crushing and penetration of form at reinforcing steel supports and at other supports.

3.04 TOLERANCES

- A. Construct formwork so that concrete surfaces will conform with the following tolerances:
 - 1. Variation from Plumb:
 - a. In any 10 feet of length: 1/4 inch.
 - b. Maximum for entire length: 1/2-inch.
 - 2. Variation from the Level or Specified Grade:
 - a. In any 10 feet of length: 1/4 inch.
 - b. Maximum for entire length: 1/2-inch.
 - 3. Variation of the Linear Building Lines from Established Position in Plan and Related Position of Columns, Walls, Grade Beams and Partitions:
 - a. In any 20 feet of length: 1/2-inch.
 - b. Maximum for entire length: 1 inch.
 - 4. Variation in the Sizes and Locations of Sleeves, Floor Openings, and Wall Openings: 1/4-inch plus or minus.
 - 5. Variation in Cross-sectional Dimensions of Columns and Beams and in the Thickness of Slabs and Walls:
 - a. Minus: 1/4-inch.
 - b. Plus: 1/2-inch.

6. Footings (tolerances apply to concrete dimensions only, not to positioning of reinforcing steel):
 - a. Variations in dimensions in plan:
 - 1) Minus: 1/2-inch.
 - 2) Plus: 1 inch.
 - b. Misplacement: 1 inch.
 - c. Thickness:
 - 1) Decrease in thickness: 1/2-inch.
 - 2) Increase in thickness: No limit
7. Variations in Steps:
 - a. In flight of stairs:
 - 1) Rise: 1/8 inch plus or minus.
 - 2) Tread: 1/4 inch plus or minus.
 - b. In consecutive steps:
 - 1) Rise: 1/16 inch plus or minus.
 - 2) Tread: 1/8 inch plus or minus.

3.05 FORM SURFACE PREPARATION

- A. Clean surfaces of forms and embedded material of all accumulated mortar or grout from previous concreting and of all other foreign material before concrete is placed.
- B. Before placing the reinforcing steel or the concrete, cover the surfaces of the forms with an acceptable coating material that will effectively prevent absorption of moisture, prevent bond with the concrete, and not stain the concrete surfaces.
- C. Do not allow form coating material to stand in puddles in the forms.
- D. Form coating material shall not come in contact with hardened concrete against which fresh concrete is to be placed.
- E. Spray form coating on all concrete form surfaces, including wood forms for wall openings, keyway strips, and chamfer strips. Apply coatings in accordance with manufacturer's instructions.

3.06 RE-USE OF FORMS

- A. Clean and repair surfaces of forms to be re-used.
- B. Do not use split, frayed, delaminated, or otherwise damaged form facing material.

3.07 FORM REMOVAL

- A. Formwork for columns, walls, sides of beams, and other parts not supporting the weight of the concrete may be removed as soon as the concrete has hardened sufficiently to resist damage from removal operations, but not less than 24 hours after completing concrete placement and finishing.
- B. Forms and shoring used to support the weight of concrete in beams, slabs, and other structural members shall not be removed in less than 10 days and not until the concrete has attained 3500 psi minimum compressive strength. Determine compressive strength by field-cured specimens.
- C. Once forms and shoring supporting beams, slabs, and other structural members have been removed, reshore concrete structural members at each level the same day such that all superimposed loads are uniformly distributed and transferred directly to the foundation through temporary supports.
 1. No construction or other live loads shall be permitted on the members, unless sufficient support is in place or concrete has attained full design strength and loads do not exceed the design maximum, as approved by Engineer.
- D. Contractor shall be responsible for all damage resulting from removal of forms or premature overloading of structural members.

- E. Loosen wood forms for wall openings as soon as possible without damage to the concrete.
- F. Time specified above represents cumulative time during which temperature of concrete is maintained above 50 degree F (10 degree C) and for concrete without set-controlling admixtures.
- G. Reduce removal time in half for high-early strength cement concrete.

END OF SECTION

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SECTION 03 20 00

CONCRETE REINFORCING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Furnish and install concrete reinforcement.

1.02 REFERENCES

- A. ACI:
 - 1. 117 - Standard Specifications for Tolerances for Concrete Construction and Materials
 - 2. 301 - Specifications for Structural Concrete for Buildings
 - 3. 315 - Details and Detailing of Concrete Reinforcement
- B. CRSI Manual of Standard Practice

1.03 SUBMITTALS

- A. Submit complete Shop Drawings and bar lists of all material to be furnished and installed under this Section.
 - 1. Show bar sizes, spacing, locations, and quantities of reinforcing and bending details.
- B. Provide Shop Drawings in accordance with ACI 315 and the CRSI Manual of Standard Practice.
 - 1. Show in detail the location, size, spacing, bends, and quantities of each and all reinforcing bars to be placed in the structure.
 - 2. Bars shall have unique identifying labels or marks for each size, length, bend configuration, etc.
- C. Submit Product Data on threaded dowel inserts.
- D. Submit mill certifications for concrete reinforcement at time of delivery.
- E. Submit certification for the epoxy coating at the time of delivery.
 - 1. Documentation of certification data shall come directly from the manufacturing plant quality control office.
 - 2. Certification data shall contain test data and measurements taken at times and locations approved by Engineer.
 - 3. Monitoring shall be done by personnel not directly involved in production and be sufficient for compliance with approved procedures.

1.04 QUALITY COMPLIANCE

- A. Comply with ACI 117, ACI 301, and ACI 315, except as modified in this Section.

1.05 PRODUCT HANDLING

- A. Deliver reinforcement to the Site bundled, tagged, and marked.
 - 1. Use metal tags indicating bar size, lengths, and other information corresponding to markings shown on placement Drawings.
- B. Store reinforcement at the Site in a manner to prevent damage from drainage and accumulation of dirt and excessive rust.
- C. Do not store reinforcement, supports, or equipment on finished slabs.
- D. Store metal bar supports in a weather-proof shelter.

- E. Repair coating damage due to shipping, handling, and placing with an epoxy paint or equivalent coating material approved by Engineer.
 - 1. Damaged areas shall not exceed 2 percent of the surface area per linear foot of each bar.
 - 2. Coating color fading will not be considered coating damage.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Reinforcing Bars: Deformed billet steel bars conforming to ASTM A615, Grade 60.
- B. Welded Wire Fabric: Steel wire spot welded at intersections conforming to ASTM A185. Use flat sheets only.
- C. Epoxy-Coated Reinforcing Steel: Conform to ASTM A775.

2.02 ACCESSORIES

- A. Bar Supports for Elevated Slabs, Walls, Columns, and Beams: All bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcement in place shall be plastic protected, conforming to CRSI Class 1 protection for bar supports.
- B. Ground Supported Reinforcing:
 - 1. All supports for ground supported reinforcement shall conform to CRSI Class 1 protection for bar supports.
 - 2. All supports shall be supplied with precast concrete blocks with a minimum bearing surface of 100 sq. inches to prevent the support from sinking.
- C. Tie Wire for Reinforcing Bars: Black annealed wire, 16 gage or heavier.
- D. Tie Wire for Epoxy-Coated Reinforcing Bars: 16 gage or heavier annealed wire epoxy-coated or other polymer approved by Engineer.
- E. Threaded Dowel Inserts: Manufactured of minimum Grade 60 steel and shall be capable of achieving 125 percent of specified yield strength of reinforcement steel for the bar size indicated.
- F. Mechanical Bar Splices:
 - 1. Manufactured of minimum Grade 60 steel.
 - 2. Shall achieve 125 percent of specified yield strength of reinforcement steel for the bar size indicated.
- G. Wire Supports for Epoxy-Coated Reinforcement: Supports shall be coated with dielectric material including epoxy or other polymer for a minimum of 2 inches from the point of contact with epoxy-coated reinforcement.

2.03 FABRICATION

- A. Shop fabricate reinforcing steel to required shapes and dimensions.
- B. Do not rebend or straighten reinforcing steel.
- C. Fabricate bars in accordance with the fabricating tolerances given in ACI 315.

2.04 FINISHES

- A. Epoxy coating shall be applied in a fusion bonded coating plant that has been granted "Certification" by CRSI (Concrete Reinforcing Steel Institute).

PART 3 EXECUTION

3.01 PLACING

- A. Place reinforcing steel in accordance with the Structural Drawings, approved Shop Drawings, and as specified herein.
- B. Reinforcing steel shall have the following concrete cover, unless specifically noted differently on the Drawings:
 - 1. Concrete cast against earth 3 inches.
 - 2. All other concrete 2 inches.
- C. Properly position reinforcing steel and wire it together at intersections and supports to ensure against displacement during concrete placing. Tie all reinforcing steel to wall forms.
- D. Support reinforcing steel for slabs on grade by placing the top of precast concrete blocks, flush with grade, at all locations where chairs are to be located. Place chairs or standees over concrete blocks.
- E. Wire dowels in place before placing concrete.
- F. Place and tie all reinforcing steel before concrete is placed.
- G. Do not bend reinforcing steel embedded in hardened or partially hardened concrete after placing.
- H. Place wall chairs at the top and bottom of all walls and not greater than 6 feet on center horizontally.
- I. 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.
- J. Support the reinforcing steel closest to the formed surface with chairs and bolsters. Support beam stirrups and column ties by chairs.
- K. After completing welds on epoxy-coated reinforcement, repair damaged coating in accordance with the requirements stated in Part 1 of this Section.
- L. Reinforcement used as supports with epoxy-coated reinforcement shall be epoxy coated.
- M. After field bending or straightening epoxy-coated reinforcing bars, repair coating damage in accordance with Part 1 of this Section.
- N. When epoxy-coated reinforcing bars are cut in the field, coat the ends of the bars with the same material used for repair of coating damage, and repair any coating damage in accordance with Part 1 of this Section.

3.02 SPLICES

- A. Provide reinforcement splices by lapping ends, placing bars in contact, and tightly wire tying. Provide lap splice lengths as shown on the Drawings.
- B. Provide splices only as shown on the Drawings or as authorized by Engineer.
- C. Provide threaded or other approved mechanical bar splices:
 - 1. Where shown on the Drawings.
 - 2. Elsewhere for the convenience of the Contractor at no additional cost to Owner if specifically requested of and approved by Engineer.

3.03 TOLERANCES

- A. Place bars to the tolerances specified in ACI 117.

END OF SECTION

SECTION 03 30 00

CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Furnish and install all cast-in-place concrete and accessories.
- B. Related Sections:
 - 1. Section 03 11 00 - Concrete Forming
 - 2. Section 03 20 00 - Concrete Reinforcing

1.02 REFERENCES

- A. ACI:
 - 1. 301 - Specifications for Structural Concrete for Buildings
 - 2. 305 - Hot Weather Concreting
 - 3. 306 - Cold Weather Concreting
 - 4. 309 - Recommended Practice for Consolidation of Concrete
 - 5. 350 - Environmental Engineering Concrete Structures
- B. ASTM:
 - 1. A36 - Carbon Structural Steel
 - 2. A307 - Carbon Steel Bolts and Studs

1.03 SUBMITTALS

- A. Submittals shall conform to Sections 01 33 00 and 01 45 00.
- B. Submit manufacturer's data for concrete admixtures, liquid curing material, floor joint filler, finishing compounds, bonding agents, and adhesive anchoring material.
- C. Submit concrete aggregate test reports and concrete mix designs at least 14 days prior to placement of concrete.
- D. Submit results of project field and laboratory concrete tests (slump, air content, and compressive strength).

1.04 QUALITY ASSURANCE

- A. Comply with ACI 301, except as modified in this Section.
- B. For concrete mix designs and aggregate testing associated with the concrete mix designs retain an independent testing laboratory/agency, approved by the Owner, to perform the work listed below. All costs for this testing shall be paid by owner:
 - 1. Test proposed aggregate.
 - 2. Design concrete mixes for each type of concrete specified.
 - 3. Test each type of concrete mixes proposed for slump, air content, temperature & compressive strength.
 - 4. Cast concrete cylinders for compressive strength tests.
 - 5. Test concrete cylinders for compressive strength.
- C. Coordinate production testing in accordance with Section 01 45 00:
 - 1. Test aggregate.
 - 2. Test each type of concrete mixes for slump, air content, temperature, and compressive strength.

3. Cast concrete cylinders for compressive strength tests.
 4. Test concrete cylinders for compressive strength.
- D. Aggregate Tests: Test aggregates for compliance with ASTM C33.
1. Submit aggregate test results in accordance with Section 1.03C.
- E. Concrete Mix Design:
1. Prepare mix designs for each type of concrete specified.
 2. Design concrete mixes in accordance with ACI 301.
- F. Concrete Strength Tests:
1. Mold and cure 4 specimens from each sample in accordance with ASTM C31. Any deviations from the requirements of ASTM C31 shall be recorded in the test report.
 2. Test specimens in accordance with ASTM C39. 2 specimens shall be tested at 28 days for acceptance and 1 shall be tested at 7 days for information. 1 specimen shall be tested at 56 days if desired by Engineer.
 3. Make at least 1 strength test for each 75 cu.yds. or fraction thereof of each mixture design of concrete placed in any 1 day.
 4. A copy of the test results shall be furnished to the Engineer as soon as available.
 5. Costs of concrete cylinder testing will be paid by Owner.
 6. Mold and field cure specimens as required in ASTM C31.
 7. The acceptance test results shall be the average strengths of the 2 specimens tested at 28 days.
 8. Failure on the concrete tested to meet the specified strength, in accordance with ASTM C42, will require a load test of test cores at Contractor's expense.
 9. Failure to meet strength requirements of the cores, shall constitute consideration for rejection by Engineer.
 10. The cost of all measures to make the work satisfactory shall be paid for by Contractor.
- G. Adjustment to Concrete Mixes: May be requested when characteristics of materials, job conditions, weather, test results, other circumstances warrant, at no additional cost to Owner, it meets the requirements of 3.01.A, and as accepted by Engineer.
- H. Concrete Slump Tests:
1. The testing agency shall determine slump of concrete from each truck in accordance with ASTM C143.
 2. If slump exceeds maximum allowed, remove batch from work and dispose of off Project Site.
 3. Slump shall be tested at end of conveying system.
 4. All costs of slump testing will be paid by Owner.
- I. Concrete Air Content Tests:
1. The testing agency shall determine air content of concrete from each truck in accordance with ASTM C231.
 2. If air content adjustments are allowed provided the maximum unloading time is not exceeded as specified in 3.01A. Otherwise remove batch from work and dispose of off Project Site.
 3. Air content shall be tested at end of conveying system.
 4. All costs of air content testing will be paid by Owner.
- J. Concrete Temperature:
1. The testing agency shall determine temperature of concrete from each truck in accordance with ASTM C31.
 2. The temperature shall be tested at end of conveying system.
 3. All costs of temperature testing will be paid by Owner.
- K. Leak Testing Watertight Structures:
1. Structures that shall be constructed watertight include the following:
 - a. SBR Structure.
 - b. Grit Structure.

2. Water-containing structures shall be accepted as watertight after they have successfully passed the following leakage test.
 - a. Tank and containment structures shall be filled and left standing as directed by the Engineer to allow for absorption (up to 2 days).
 - b. The tank and containment structures shall be filled and a 55-gallon PVC barrel shall be filled and left uncovered.
 - c. Both volumes of water shall be monitored for a period of 24 hours after absorption and stabilization has been established by the Engineer.
 - d. The leakage test will be considered successful if there is no visible leakage or visible dampness on the outside of the structure and/or the measured leakage after correcting for evaporation losses is equal to or less than 0.001 times the tank volume.
3. The Contractor shall be responsible for the cost of water used in any tests or retests.
4. Structures may not be backfilled until they have passed the leakage test.

L. Special Structural Testing and Inspection Program:

1. Special inspections are required in accordance with Section 01 45 00. The Testing Agency will conduct concrete slump tests, concrete air content tests, concrete temperature tests, and concrete strength test periodically as required per the Special Structural Testing and Inspection Program Summary Schedule.
2. Concrete floor slabs on grade less than 6 inches thick are exempt from Special Inspections requirements.

1.05 PRODUCT HANDLING

- A. Do not store forms, shores, reinforcing, equipment, or other material on finished slab surfaces.

PART 2 PRODUCTS

2.01 CONCRETE MATERIAL

- A. Cement: Conform to ASTM C150, Type I.
1. Alkali content less than or equal to 0.6 percent (expressed as Na₂O).
 2. Provide cement from one source of supply.
- B. Aggregate:
1. Coarse Aggregate: ASTM C33-5S
 - a. Provide from 1 source of supply.
 - b. For exterior exposed surfaces.
 2. Fine Aggregate: ASTM C33.
 - a. Provide from 1 source of supply.
 - b. For exterior exposed surfaces.
 3. Do not use fine or coarse aggregates containing spalling-causing deleterious substances.
 4. Local aggregates not complying with ASTM C33 but which have been shown by special test or actual service to produce concrete of adequate strength & durability may be used when approved by Engineer.
 5. Maximum Size:
 - a. 1/5 the narrowest dimension of concrete member; nor
 - b. 1/3 the depth of slab; nor
 - c. 3/4 the clear spacing between reinforcement bars; nor
 - d. 1-1/2 inches
 6. Gradation sizes 467, 57 or 67: ASTM C33, Table 2.
- C. Water: Clean, potable and free from deleterious amounts of oil, acid, alkali, or other foreign matter.

2.02 ADMIXTURES

- A. Air Entraining Admixture: ASTM C260.

- B. Water Reducing Admixture: ASTM C494, Type A.
- C. High Range Water-Reducing Admixtures (Superplasticizer): ASTM C494, Type F and contain no chlorides.
- D. Retarding Admixtures: ASTM C494, Types B and D.
- E. Set-Accelerating Admixtures: ASTM C494, Type C. No chloride containing admixtures will be allowed.
- F. Xypex. Use in all liquid-holding structures. Base on manufacturer's suggested dosing rates.
- G. Cortec MCI. Use in all concrete subject to de-icing salts. Base on manufacturer's suggested dosing rates.
- H. Viscosity Modifying Admixture: Demonstrate compatibility with other admixtures.
- I. Pozzolans:
 - 1. Fly Ash: ASTM C618, Class C or F. Loss on ignition shall be limited to 3 percent maximum.
 - 2. Ground Granulated Blast-Furnace Slag: ASTM C989, Grade 100 or 120.
 - 3. Silica Fume: ASTM C1240, 6 percent maximum.

2.03 MISCELLANEOUS MATERIAL

- A. Burlap-Polyethylene Sheet: Burlap weighing not less than 10 ounces per linear yard, 40 inches wide impregnated on 1 side with white opaque polyethylene 0.006 inch thick. Sheeting shall conform to ASTM C171.
- B. Liquid Curing Compound: ASTM C309, Type 1-D, Class B clear or translucent with fugitive dye. Do not apply to floor slabs.
- C. Expansion Joint Material: Bituminous fiber type conforming to ASTM D1751 with bituminous or paraffin binder.
- D. PVC Waterstops:
 - 1. Serrated type with centerbulb.
 - 2. Material: Virgin PVC.
 - 3. Minimum Thickness: 3/16-inch.
 - 4. Greenstreak Plastic Products Company, specification grade, or approved equal.
 - 5. Install 4-inch width for construction joints located flush with slab or wall.
 - a. Centerbulb diameter: 3/4-inch minimum.
 - 6. Install 6-inch width for all other construction joints, unless otherwise noted.
 - a. Centerbulb diameter: 15/16-inch minimum.
 - 7. Water Stop Joints: Manufacturer's standard prefabricated joints at intersection points and corners.
- E. Hydrophylic Waterstops:
 - 1. Rubber Concrete Joint: Volclay Akwastop in accordance with manufacturers recommendations, or approved equal.
 - 2. Bentonite RX 101: Colloid Environmental Technologies Company, installed per manufacturer's specification with approved bonding agent.
- F. Interior Joint Filler: 1 part, self leveling, polymer reinforced joint filler.
 - 1. Everjoint manufactured by L&M Construction Chemicals, Inc., or approved equal.
- G. Exterior Joint Sealant: 2 parts, self leveling, polyurethane sealant.
 - 1. Sonolastic SL2 manufactured by Sonneborn, or approved equal.
- H. Bonding Agent: Acryl 60 manufactured by Thoro System Products, or approved equal.

- I. Drilled-In Anchors:
 - 1. Cartridge Injection Adhesive Anchors: Threaded steel rod, inserts, or reinforcing dowels, complete with nuts, washers, polymer or hybrid mortar adhesive two component injected epoxy system, and manufacturer's preparation and installation instructions. Type and size indicated on Drawings.
 - a. As indicated on the Drawings, provide stainless steel anchors. Stainless steel anchors shall be AISI Type 304 or Type 316 (where allowed) stainless steel provided with stainless steel nuts & washers or matching alloy group and minimum proof stress equal or greater than specified minimum full-size tensile strength of externally threaded fastener. All nuts shall conform to ASTM F594 unless otherwise specified. Avoid installing stainless steel anchors in contact with galvanically dissimilar metals.
 - b. Reinforcing dowels shall be ASTM A615, Grade 60.
 - c. Acceptable adhesive anchor manufacturers are:
 - 1) Hilti HAS threaded rods, HIT-TZ rods, or reinforcing dowels with HIT HY-200/ HIT ICE Adhesive Anchorage System for anchorage to concrete or grouted masonry, ICC ER-5193, ICC ESR-1562.
 - 2) Hilti HAS threaded rods or reinforcing dowels with RE 500 Injection Adhesive Anchoring System for anchorage to concrete, ICC ESR-1682.
 - 3) Red Head threaded rods or reinforcing dowels with Red Head Adhesive Anchoring System C6 or G5 Adhesive.
 - 4) Threaded rods or reinforcing dowels with Simpson Stong-Tie Epoxy Tie Adhesive.
 - 5) Threaded rods or reinforcing dowels with Sonneborn Epogel Adhesive.
 - d. Or approved equal.
- J. Epoxy Injection: Sika 35, Hi-Mod, LV or equal with Sikadur 31 Paste Epoxy or equal to be installed as manufacturer's recommendations.
- K. Plastic Coated Manhole Rungs: Copolymer Polypropylene Plastic in accordance with ASTM C-478 and ASTM A-615 as manufactured by M.A Industries, Inc., or approved equal.
- L. Dovetail Anchor Slot: 18 gage stainless steel.
- M. Vapor Barrier: ASTM E1745, Class A, minimum 15 mils thick polyethylene film, water vapor transmission of 0.00 or perm level of 0.01.

2.04 CONCRETE MIX PROPORTIONS

- A. All concrete mix proportions are shown in Table 2.1 at the end of the Section in addition to the requirements listed below:
 - 1. 515 lb/yd³ minimum cementitious material content for concrete.

PART 3 EXECUTION

3.01 CONCRETE PRODUCTION

- A. Ready-mixed concrete: Comply with ASTM C94.
 - 1. Air Temperature between 85 degrees F (30 degrees C) and 90 degrees F (32 degrees C): Reduce mixing and delivery time to 75 minutes.
 - 2. Air Temperature above 90 degrees F (32 degrees C): Reduce mixing and delivery time to 60 minutes.
 - 3. Batch Ticket: Provide for each batch discharged and used in work, indicating project identification name and number date, mix type, mix time, quantity and amount of water introduced and available.
- B. Mix concrete only in quantities for immediate use. Concrete which has set shall be discarded and shall not be retempered.
- C. Do not add water at the Site without the approval of Engineer.

- D. Add superplasticizer and mix concrete in accordance with manufacturer specification.

3.02 PLACING WATERSTOP

- A. Place waterstop material at all construction joints, unless shown otherwise and confirmed by Engineer.
- B. Center waterstop in the joint and between each layer of reinforcing steel with each half embedded in concrete. Secure waterstop by hog-tying waterstop to protection bar (refer to Drawings) at 12 inches on center prior to placing concrete.
- C. Thoroughly and systematically vibrate concrete around the waterstop to ensure positive contact between concrete and waterstop. When concrete is being placed, take care not to deflect waterstop out of proper position.
- D. Use prefabricated waterstop fittings or follow proper field splicing procedures for all connections and splices.
 - 1. Miter all intersecting connections at 45 degrees.
 - 2. Use a thermostatically controlled heating iron to heat both ends of waterstop to be connected, then butt splice pieces to be joined with full contact.
- E. Follow manufacturer's recommendations for proper preparation and installation of waterstop material.

3.03 EMBEDDED ITEMS

- A. Place all sleeves, inserts, anchors, and embedded items required for adjoining work or for its support prior to placing concrete.
- B. Position all embedded items accurately and supported against displacement.
- C. Temporarily fill voids in sleeves, inserts, and anchor slots with readily removable material to prevent the entry of concrete into the voids.
- D. General - Construction Joints:
 - 1. Locate joints as indicated on Contract Drawings or as shown on approved shop drawings.
 - 2. Contractor to submit pour sequence and plan to engineer prior to pouring concrete.
 - 3. In general, locate joints near the middle of the spans of slabs, beams & girders unless a beam intersects a girder at this point, in which case, offset joint in girder a distance equal to twice the width of the beam.
 - 4. Locate joints in walls and columns at underside of floors, slabs, beams, or girders, and at tops of foundations or floor slabs, unless shown otherwise.
 - a. At Contractor's option, beam pockets may be formed into concrete walls. Size pockets to allow reinforcing to be placed as detailed on Drawings.
 - 5. Place beams, girders, column capitals, and drop panels at same time as slabs.
 - 6. Place corbels monolithically with walls. Locate wall vertical construction joints midway between corbels. Where only a single corbel is located, place it also monolithically within wall and locate wall vertical construction joint a minimum of three feet from face of corbel.
 - 7. Make joints perpendicular to main reinforcement.
 - 8. Continue all reinforcement across joints.
 - 9. Allow a minimum of 48 hours before placement of adjoining concrete construction.
- E. Construction Joints - Spacing:
 - 1. General - Structures not intended to contain liquid:
 - a. Wall vertical construction joints:
 - 1) 60 feet maximum centers.
 - 2) At wall intersections, 30 feet maximum from corner.
 - b. Wall horizontal construction joints: 20 - 25 foot centers.
 - c. Base slab, floor, and roof slab construction joints:
 - 1) Placements to be approximately square and not to exceed 3500 square feet.
 - 2) Maximum side dimension of a slab pour to be 65 feet.

2. Structures intended to contain liquids:
 - a. Wall vertical construction joints:
 - 1) 30 feet maximum centers.
 - 2) At wall intersections, 15 feet maximum from corner.
 - b. Wall horizontal construction joints: 10 - 15 foot centers.
 - c. Base slab, floor, and roof slab construction joints:
 - 1) Placements to be approximately square and not to exceed 2000 square feet.
 - 2) Maximum side dimension of a slab pour to be 50 feet.
- F. Bonding at Construction Joints:
1. Obtain bond between concrete pours at construction joints by thoroughly cleaning and removing all laitance from construction joints. Before new concrete is placed, all construction joints shall be coated with bonding agent, cement grout, or dampened.
 - a. General - Use cement grout or dampening for all construction joints except as noted in Article 3.03 - F.1.b. below, or at Contractor's option use bonding agent for all construction joints.
 - 1) Treatment of joint surfaces:
 - a) Roughen the surface of the concrete to expose the aggregate uniformly.
 - b) Remove laitance, loosened particles of aggregate or damaged concrete at the surface.
 - c) Dampen the hardened concrete (but do not saturate) immediately prior to placing of fresh concrete or grout.
 - 2) Cover the hardened concrete of horizontal joints with a coat of cement grout of similar proportions to the concrete, except substitute fine aggregate for coarse aggregate.
 - a) Place grout as thick as possible on vertical surfaces.
 - b) Place 3 inch layer of grout in bottoms of wall or column lifts immediately before placing concrete and at least 1/2 inch thick on other horizontal surfaces. Vibrate grout and first layer of concrete simultaneously.
 - c) Place fresh concrete before grout has attained its initial set.
 - b. Use bonding agent for walls and slabs of tanks and structures designed to contain liquids and at all joints in beams, girders, and slabs.
 - 1) Joints receiving an adhesive shall be prepared, and the adhesive applied in accordance with the manufacturer's recommendations.
- G. Joints in Slabs on Grade:
1. Locate joints in slabs on grade as indicated on Contract Drawings or as shown on approved shop drawings.
 2. Maximum spacing of joints shall be at 24 to 36 times the slab thickness in both directions. As a general rule, ratios of the long to short side should not exceed 1.25 to 1.5.
 3. Time cutting properly with set of concrete, if saw cut joints are required or permitted.
 - a. Start cutting as soon as concrete has hardened sufficiently to prevent aggregates being dislodged by saw.
 - b. Complete before shrinkage stresses become sufficient to produce cracking.
- H. Expansion Joints:
1. Do not permit reinforcement or other embedded metal items bonded to concrete (except smooth dowels bonded on only one side of joint) to extend continuously through an expansion joint.

3.04 PREPARATION BEFORE PLACING

- A. Complete formwork and secure all reinforcement and embedded items in place.
- B. Formwork Erection (floor slab on grade):
 1. Verify lines, levels, and measurement before proceeding with formwork.
 2. Hand trim sides and bottom of earth forms; remove loose dirt.
 3. Align form joints.
 4. Slope floor as required per Drawings.
- C. Remove all snow, ice, and mud prior to placing concrete.

- D. Do not place concrete on frozen ground.
- E. Do not place concrete on ground with standing water or when upper 2 inches of ground is saturated.
- F. Do not place concrete during rain, sleet, or snow.
- G. Vapor Barrier (where required for floor slab on grade):
 - 1. Install per ASTM E1643.
 - 2. Place membrane over compacted fill prior to placement of base fill; minimum number of joints.
 - 3. Overlap sheets and seal joints with tape in accordance with manufacturer's recommendations.
- H. Concrete floor slab topping. Additional preparation requirements are:
 - 1. Abrade surface by chipping or scarifying before cleaning as necessary for good bonding.
 - 2. Fill voids, cracks, and cavities in existing concrete surface.
 - 3. Thoroughly dampen slab surface, but do not leave standing water.

3.05 CONCRETE CONVEYING

- A. Deliver concrete from the mixer to the place of final deposit as rapidly as practical by methods, which will prevent segregation or loss of ingredients.

3.06 CONCRETE DEPOSITING

- A. Deposit concrete continuously or in layers of such thickness that no concrete will be deposited on concrete which has hardened sufficiently to cause the formation of seams or planes of weakness within the section.
- B. Place concrete at such a rate that the concrete which is being integrated with fresh concrete is still plastic.
- C. Do not deposit concrete which has partially hardened or has been contaminated by hardened materials.
- D. Remove rejected concrete from the Site.
- E. Deposit concrete as nearly as practicable in its final position to avoid segregation due to handling or flowing.
- F. Free fall of concrete shall not exceed 4 feet. Use chutes equipped with hopper heads for placing where a drop of more than 4 feet is required.

3.07 PLACING CONCRETE SLABS

- A. Deposit and consolidate concrete slabs in a continuous operation.
- B. Consolidate concrete placed in slabs by vibrating bridge screeds, roller pipe screeds, or other methods acceptable to Engineer.
 - 1. Bring slab surfaces to the correct level with a straight edge and then strike off.
 - 2. Use bullfloats or darbies to smooth the surface, leaving it free from bumps and hollows.
- C. Do not leave screed stakes in concrete.
- D. Do not sprinkle water on the plastic surface. Do not disturb the slab surfaces prior to start of finishing operations.

3.08 PLACING GROUT

- A. Blast with water and clean all concrete surfaces to be in contact with grout overlay.

- B. Apply proprietary bonding agent immediately before placement of grout.
- C. Max. grout design $f'g = 3000$ psi. Max. cementitious content 500 lb/cy. Max. w/c ratio of 0.45.

3.09 PLACING CONCRETE FLOOR SLAB TOPPING

- A. Existing Concrete Base:
 - 1. Apply required bond-breaker, bonding compound (rewettable or nonrewettable), or epoxy adhesive.
 - 2. Mix and scrub bonding slurry into dampened concrete to a thickness of 1/16 to 1/8 inch, without puddling. Place while slurry is still tacky.
 - 3. Place topping mix after rewettable bonding compound has dried or while nonrewettable bonding compound or epoxy adhesive is still tacky.
- B. Placement:
 - 1. Spread topping mixture evenly over prepared base to the required elevation and strike off.
 - 2. Do not permit cold joints or seams to develop within pour strip.
 - 3. Bull float or darby to level surface.
 - 4. Uniformly slope surface to drains.
 - 5. After topping has stiffened sufficiently to permit and water sheen has disappeared, float surface at least twice to a uniform sandy texture.
 - 6. For reinforced toppings, provide necessary chairs or supports and maintain position of reinforcing mesh as shown on Drawings.
- C. Joints:
 - 1. Contraction:
 - a. Construct contraction joints to match and coincide with joints in base slab.
 - b. Install semi-rigid joint filler full depth of contraction joints.
 - 2. Construction: Coat face with epoxy adhesive.
 - 3. Isolation: Place approximately 3/4 inch lower than floor slab to allow installation of joint sealant.
 - 4. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints. Leave contact faces of joint clean and dry.

3.10 COLD WEATHER PLACING

- A. Do not place concrete when the air temperature is less than 40 degrees F. without the specific approval of Engineer.
- B. Cold Weather Concrete Work: ACI 306.1, except as modified by the requirements of these Contract Documents.
- C. Do not place concrete against any frozen substrate, including subgrade soils and surfaces of formwork.
- D. Do not place concrete around any embedment, including reinforcing steel that is at a temperature below freezing.
- E. The temperature of the concrete delivered at the site shall conform to the following limitations:

Air Temperature	Minimum Concrete Temperature	
	< 12 Inches Thick	12 - 36 Inches Thick
	Above 30° F	60° F
0° to 30° F	65° F	60° F
Below 0° F	70° F	65° F

- F. If water or aggregate is heated above 100 degrees F., combine water with the aggregate in the mixer before cement is added. Do not mix cement with water or with mixtures of water and aggregate having a temperature greater than 100 degrees F.
- G. When the mean daily temperature is less than 40 degrees F., maintain the temperature of the concrete between 50 and 70 degrees F. for the required curing period.
- H. Arrangements for Heating, Covering, Insulation, Or housing the Concrete Work:
 - 1. Made in advance of placement.
 - 2. Adequate to maintain the required temperature without injury due to concentration of cold or heat.
 - 3. Keep protection in place for a minimum of 3 days.
- I. Do not use combustion heaters during the first 24 hours, unless precautions are taken to prevent exposure of the concrete to exhaust gases.
- J. Once the cold weather concrete protection is removed, continue concrete curing for the remainder of the 10 day curing period.

3.11 HOT WEATHER PLACING

- A. Comply with ACI 305 when hot weather conditions exist.
- B. Maintain concrete temperature at time of placement below 90 degrees F.
- C. When the temperature of the steel is greater than 120 degrees F., spray steel forms and reinforcement with water prior to placing concrete.
- D. Keep all surfaces protected from rapid drying. Provide windbreaks, shading, fog spraying, sprinkling, ponding, or wet covering in advance of placement.

3.12 CONSOLIDATION

- A. Consolidate all concrete in accordance with provisions of ACI 309.
- B. Consolidate each layer of concrete immediately after placing by use of internal concrete vibrators. Maintain a frequency of not less than 8,000 vibrations per minute for each internal vibrator.
- C. Provide adequate number of units and power source at all times. Use a minimum of 2 vibrators for all work and maintain spare units to ensure adequacy.
- D. Insert the vibrator so as to penetrate the lift immediately below the one being placed. Do not insert the vibrator into lower courses which have begun to set.
- E. Limit spacing between insertions of the vibrator to 12-18 inches and do not exceed twice the radius of action as shown in ACI 309 or 18 inches.
- F. Do not use vibrators to transport concrete inside the forms.
- G. Vibrate concrete to minimize entrapped air and surface voids on formed surfaces.

3.13 CONCRETE SLAB FINISHING

- A. Float Finish:
 - 1. Apply float finish to all slab surfaces.
 - 2. After placing and screeding concrete slabs, do not work the surface until ready for floating. Begin floating when the surface water has disappeared and when the concrete has stiffened sufficiently to permit operation of a power-driven float.
 - 3. Consolidate the surface with power-driven float or by handfloating if the area is small or inaccessible to power units.

4. Check and level the surface plane to a tolerance not exceeding 1/4 inch in 10 feet when tested with a 10 foot straight-edge placed on the surface at not less than 2 different angles.
 5. Immediately after leveling, refloat the surfaces to a smooth, uniform, granular texture.
- B. Trowel Finish:
1. Apply steel trowel finish to all interior floor slabs, topping, and stair treads and all tank slabs which do not receive a concrete topping. Do not apply to air entrained concrete without discussing timing with concrete supplier.
 2. Apply float finish to slabs as described above in Part 3.11.A.
 3. After floating, begin the first trowel finish operation using a power-driven trowel. Begin final troweling when the surface produces a ringing sound as the trowel is moved over the surface.
 4. Consolidate the concrete surface by the final hand troweling operation, free from trowel marks, uniform in texture and appearance, and with a surface plane tolerance not exceeding 1/8 inch in 10 feet when tested with a 10 foot straight-edge.
- C. Broom Finish:
1. Apply non-slip broom finish to all exterior sidewalks and aprons.
 2. Apply float finish to slabs as described above in Part 3.11.A.
 3. Immediately after floating, slightly roughen the concrete surface by brooming in the direction perpendicular to the main traffic route. Use a fiber-bristle broom.
- D. Prominently exposed Class A finish:
1. Concrete faces exposed to view as part of the architectural design or surfaces to receive finishes of any type (paint, textured paint, etc.) shall receive a class A smooth form finish as defined by ACI 347.3.4. These class A surfaces have no more than 1/8 inch abrupt or gradual irregularities in a 5'-0" area and no holes larger than 1/8" on the surface. The contractor shall then fill all holes and grind the exposed surface to provide a finish compatible with a heavily scrutinized surface. The final finish shall be a Smooth Rubbed Finish: Conform to ACI 301.

3.14 FINISHING FORMED SURFACES

- A. Provide a smooth formed surface to all formed surfaces not exposed to view, unless otherwise noted in Paragraph B. Smooth formed finish shall consist of the following:
1. Construct formwork in accordance with Section 03 11 00.
 2. Patch all tie holes and defects larger than 1/8-inch in diameter and/or 1/8-inch deep.
 3. Remove all fins, seams and concrete "buttons" protruding more than 1/16-inch.
- B. Provide a special form finish to all formed surfaces exposed to view:
1. Prepare 3 test samples of various textures for approval by Engineer. Each sample shall be approximately 6 feet by 6 feet in size and located on an unexposed wall surface as directed by Engineer.
 2. Perform all Concrete Crack Repairs in accordance with Article 3.14.B.
 3. Remove all form release agents, curing compounds, hardeners, salts, efflorescence, laitance, loose material, unsound concrete, and other foreign materials by sandblasting, shot blasting, mechanical scarification, or other suitable methods.
 4. Surface Preparation:
 - a. Expose, but not undercut or loosen, aggregate.
 - b. Expose all bugholes, cracks and subsurface voids.
 - c. Provide a clean, sound substrate with sufficient surface profile.
 5. Filling of deep voids, bugholes, etc., exceeding 1/8-inch depth:
 - a. Dampen surface with clean water to obtain saturated surface-dry (SSD) with no standing water.
 - b. Brush-apply a small quantity of mixed patching material as a scrub coat to prepare substrate. Thoroughly key-in and work material throughout cavity to promote bond.
 - 1) If scrub coat dries out before wet mortar can be placed, remove scrub coat similar to laitance removal.
 - c. Place repair mortar onto wet scrub coat using brush with firm trowel pressure.
 - 1) Completely fill voids.
 - 2) Key in and compact thoroughly to secure bond.

- 3) Apply patching material in lifts of 1/4-inch (8mm) to 2-inches (51mm) and trowel to desired finish promptly after placing material.
- d. For successive lifts, thoroughly score each lift and allow reaching initial set before next layer is applied.
- e. Perform wet curing of patched areas for the following conditions:
 - 1) If temperature exceed 85 degrees F (29 degrees C).
 - 2) If relative humidity is below 30 percent.
 - 3) If wind speed exceeds 15 mph
 - 4) If patches are exposed to direct sunlight for 72 hours after placement.
- f. Special curing compounds are allowed with approval of Owner and Engineer. Do not use solvent-based curing compound.
6. Dampen surface with clean water just prior to application of finishing compound.
7. Mix 1 part bonding agent to 3 parts clean water for mixing liquid.
8. Mix concrete finishing compound with mixing liquid as specified by the manufacturer.
9. Apply 2 coats using a stiff fiber brush or textured spray equipment. Spray application of the first coat requires back brushing to properly fill voids, bugholes and nonmoving cracks.
 - a. First coat: Apply at 2 pounds per sq. yd. and allow to cure a minimum 24 hours.
 - b. Second coat: Apply at 2 pounds per sq. yd., allow to set and then float to a uniform finish.
10. Perform damp curing to applied product.

3.15 FINISHING CONCRETE FLOOR SLAB TOPPING

- A. Consolidate surface with power-driven floats as soon as floor topping can support equipment and operator. Repeat float passes and restraightening until surface has a uniform, smooth, granular texture.
- B. Trowel Finish: After floating, begin first trowel finish operation using power driven trowels. Final troweling operation is to produce finished surface free of trowel marks, uniform in texture and appearance.

3.16 CURING

- A. Protect freshly placed concrete floor topping from premature drying and excessive cold or hot temperatures.
- B. Apply evaporation retarder to concrete floor topping in hot, dry, or windy conditions before and during finishing operations.
- C. Immediately after placement, damp cure all concrete for a minimum of 7 days.
- D. Cover all slabs and topping with approved burlap-polyethylene film and keep in place throughout the curing period.
- E. Cover walls, beams, columns and other formed surfaces with burlap-polyethylene film or spray with an approved curing compound.
- F. Anchor all burlap-polyethylene film at the edges to prevent moisture loss.
- G. Rewet all slab surfaces at least once a day during the curing period.

3.17 PATCHING

- A. Repair honeycomb and other defective areas, fill surface voids, and fill form tie holes and similar defects in accordance with ACI 301.
- B. Inject concrete cracks as observed during construction and leak testing operations with epoxy to manufacturer's recommendations. Confirm procedures with Owner and Engineer prior to installation.
- C. Reinforce or replace deficient work as directed by Engineer and at no additional cost to Owner.

- D. The Contractor shall repair defects in existing concrete elements affected by the new construction in as directed by the Engineer.

3.18 CLEAN UP AND DISPOSAL

- A. Upon completion of the walls and prior to any painting, thoroughly clean all exposed or painted concrete surfaces of all concrete spatters, form oil, or other foreign material detrimental to appearance or painting.
- B. Remove all excess concrete debris remaining after completion of placement and form removal from the Site and dispose of in a proper and legal manner.

3.19 ANCHORING DOWELS

- A. Drill hole in concrete to the size and depth recommended by the adhesive supplier and as approved by Engineer.
- B. Clean hole with a nylon brush and use compressed air to blow out hole.
- C. Fill hole with anchoring adhesive in accordance with manufacturer recommendations.

3.20 POST-INSTALLED ANCHORS

- A. Drill hole in concrete to the size and depth recommended by the anchor supplier using recommended bit and technique.
- B. Clean hole with a nylon brush and use oil-free compressed air to blow out hole.
- C. For adhesive anchors, fill hole with anchoring adhesive in accordance with manufacturer's recommendations.
- D. For mechanical anchors, install using a calibrated torque wrench to the manufacturer's recommended torque. Special Inspector shall observe and confirm use of appropriate torque on every anchor installed.
- E. For overhead installed adhesive anchors: use adhesive specifically designed for overhead use and submit product data.
- F. See Structural Notes on drawings for further requirements.

3.21 XYPEX

- A. Add to the following:
 - 1. 02 – Grit Structure
 - 2. 03 – SBR Structure (including attached Vault and Digester)
 - a. Base Slab.
 - b. Walls.
 - 3. 04 – Reed Beds
 - a. Walls.

3.22 TOLERANCES FOR CONCRETE FLOOR SLAB TOPPING

- A. As defined in ASTM E1155, "Standard Test Method for Determining Floor Flatness and Levelness Using the F-Number System."
 - 1. Type of flatness and levelness for required floor finish, unless otherwise noted on Structural Drawings:
 - a. Trowel/flat floor finish of vinyl tile, carpet, coatings:
 - 1) Floor flatness (Ff) of 20.

- 2) Floor levelness (FI) of 17.
- b. Scratch floor finish of full-set ceramic tile, concrete toppings:
 - 1) Floor flatness (Ff) of 15.
 - 2) Floor levelness (FI) of 13.
- c. Trowel/flat floor finish of exposed concrete with no special flatness/levelness requirements:
 - 1) Floor flatness (Ff) of 20.
 - 2) Floor levelness (FI) of 17.

Table 2-1

	f'c @ 28 days	Maximum Water/Cement + Pozzolan Ratio	Maximum Pozzolan Content (percent of cementitious content)	Aggregate	Entrained Air Content (Refer to ACI 350, Moderate Exp.)	Slump (inches) before and after superplasticizer
A. Concrete for walls, grade beams, slabs, beams, columns, base slabs, pads and all other concrete unless noted below.	4,000 psi	0.45	25% Fly Ash 40% GGBFS 50% Total	Section 2.01.B	6% (per ACI 350 - Table 4.2.1) *	3 ± 1 before 6 ± 1 after
B. Concrete for exterior walks and slabs on grade.	4,500 psi	0.43	25% Fly Ash 40% GGBFS 50% Total	Section 2.01.B	6% (per ACI 350 - Table 4.2.1)	3 ± 1 before 6 ± 1 after
C. Grout for masonry fill	3,000 psi	0.60	25% Fly Ash 40% GGBFS 50% Total	Section 2.01.B	0% - 2%	No requirement
D. Grout - For Filling In Bottom Of Tanks	3,000 psi	0.50	25% Fly Ash 40% GGBFS 50% Total	Section 2.01.B	0% - 2%	6 ± 1 after

* Air is required in these members when they are exposed to moisture and freezing temperatures. Interior concrete in heated structures and footings placed below frost depth is not to be air entrained.

END OF SECTION

SECTION 03 31 30

CONCRETE FLOOR SLAB ON GRADE

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Formwork.
 - 2. Concrete reinforcement and accessories.
 - 3. Cast-in-place concrete.
- B. Related Sections:
 - 1. Section 03 30 00 - Cast-In-Place Concrete

1.02 REFERENCES

- A. ACI 301 - Specifications for Structural Concrete in Buildings
- B. ANSI/ASTM A185 - Welded Steel Wire Fabric for Concrete Reinforcement
- C. ASTM:
 - 1. C33 - Concrete Aggregates
 - 2. C94 - Ready- Mixed Concrete
 - 3. C150 - Portland Cement
 - 4. C260 - Air Entraining Admixtures for Concrete

1.03 SUBMITTALS

- A. Concrete Mix Design.

1.04 QUALITY ASSURANCE

- A. Perform work in accordance with ACI 301.
- B. Maintain copy of ACI 301 on site.

1.05 PROJECT CONDITIONS

- A. Drawings do not purport to show actual field dimensions, but are intended only to establish location and scope of Work. Field-verify dimensions and assume full responsibility for their accuracy.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Forms: Conform to ACI 301.
- B. Reinforcing Steel:
 - 1. Welded Steel Wire Fabric: Plain type, ANSI/ASTM A185; in 6 by 6 - W.1.4 by W.1.4 WWF coiled rolls; uncoated finish.
- C. Concrete:
 - 1. Cement: ASTM C150, normal - Type 1 portland, grey color.
 - 2. Fine and Coarse Aggregates: ASTM C33.

3. Water: Clean and not detrimental to concrete.
- D. Admixtures:
1. Air Entrainment Admixture: ASTM C260.
- E. Curing Materials:
1. Water: Clean and drinkable.

2.02 ACCESSORIES

- A. Vapor Barrier: ASTM E1745, Class A, minimum 10 mils thick polyethylene film, water vapor transmission of 0.00 or perm level of 0.01.
- B. Floor Hardener: Acid-base, liquid.

2.03 CONCRETE MIX

- A. Mix concrete in accordance with ASTM C94.
- B. Slab On Fill Concrete:
1. Compressive Strength: (28 days): 3,500 psi.
 2. Slump: 4-inch.
- C. Add air entraining agent to mix for concrete exposed to freeze-thaw cycling.

PART 3 EXECUTION

3.01 PREPARATION

- A. Formwork Erection:
1. Verify lines, levels, and measurement before proceeding with formwork.
 2. Hand trim sides and bottom of earth forms; remove loose dirt.
 3. Align form joints.
 4. Slope floor at 0.50 percent toward floor drains from edge of each slab.
- B. Vapor Barrier:
1. Install per ASTM E1643.
 2. Place membrane over compacted fill prior to placement of base fill; minimum number of joints.
 3. Overlap sheets and seal joints with tape in accordance with manufacturer's recommendations.
- C. Reinforcement:
1. Place, support, and secure reinforcement against displacement.
 2. Do not disturb vapor barrier while placing reinforcement.
- D. Existing Work:
1. Provide 1/2-inch expansion joint between floor slab and foundation wall and also around pipes or other fixtures that protrude through the floor.
 2. Place cap strip and sealant over the expansion joint.

3.02 PLACING CONCRETE

- A. Notify Engineer minimum 24 hours prior to commencement of concreting operations.

3.03 FINISH

- A. Trowel finish surfaces.

3.04 TOLERANCES

- A. Provide Class A tolerance to floor slabs according to ACI 301.

3.05 TREATMENT

- A. Apply hardener in accordance with the manufacturer's recommendations to all interior floors.

3.06 FIELD QUALITY CONTROL

- A. Concrete Sampling: Provide 1 specimen (3 cylinders) for each day when concrete is poured.
- B. Concrete Testing:
 - 1. Conduct compression testing of cylinders by independent testing laboratory approved by Engineer.
 - 2. Provide written results of tests to Owner and Engineer.

END OF SECTION

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SECTION 03 41 00

PLANT-PRECAST STRUCTURAL CONCRETE – SOLID ROOF PLANK

PART 1 GENERAL

1.01 SUMMARY

- A. Provide precast reinforced concrete units as follows:
 - 1. Roof panels.
 - a. Solid units.
 - 2. Accessories.
 - a. Joint sealant.
- B. Install the following provided by others:
 - 1. Sleeves and imbedded items for plumbing, heating, or electrical distribution.
- C. Perform the following:
 - 1. Provide openings as indicated on Drawings.
- D. Related Sections:
 - 1. Section 03 30 00 - Cast-in-Place Concrete

1.02 REFERENCES

- A. ACI:
 - 1. 301 - Specifications for Structural Concrete for Buildings
 - 2. 318 - Building Code Requirements for Reinforced Concrete
- B. ANSI/AWS:
 - 1. D1.1 - Structural Welding Code - Steel
 - 2. D1.4 - Structural Welding Code - Reinforcing Steel
- C. ASTM:
 - 1. A36 - Structural Steel
 - 2. A82 - Cold Drawn Steel Wire for Concrete Reinforcement
 - 3. A123 - Hot Dip Galvanized Coatings on Steel Products
 - 4. A153 - Zinc-Coating Iron and Steel Hardware
 - 5. A185 - Wire Fabric for Concrete Reinforcement
 - 6. A276 - Stainless Steel Bars and Shapes
 - 7. A416 - Undercoat Seven-Wire Stress-Relieved Strand for Prestressed Concrete
 - 8. A615 - Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
 - 9. A666 - Cold-Worked Austenitic Stainless Steel Sheets, Plates, Strips
 - 10. C33 - Concrete Aggregates
 - 11. C144 - Aggregate for Masonry Mortar
 - 12. C150 - Portland Cement
 - 13. C260 - Air Entraining Admixtures for Concrete
 - 14. C1107 - Packaged Dry Nonshrink Hydraulic Cement Grout
 - 15. F593 - Stainless Steel Bolts, Hex Caps, Screws, Studs
- D. CRSI - Manual of Standard Practice
- E. PCI:
 - 1. MNL 116 - Manual for Quality Control for Plants and Production of Precast Concrete Products
 - 2. MNL 120 - Design Handbook-Precast and Prestressed Concrete
 - 3. MNL 123 - Manual on Design of Connections for Precast Prestressed Concrete
 - 4. MNL 124 - PCI Design for Fire Resistance of Precast Prestressed Concrete

1.03 SYSTEM DESCRIPTION

- A. Critical Design Requirements:
 - 1. Allowable tolerances: Panels must comply with the maximum allowable tolerances listed in the *Guide Specifications* of the Precast/Prestressed Concrete Institute (PCI), latest edition.
 - 2. Design calculations must be stamped and signed by a licensed engineer in the state of Wisconsin.
 - 3. Design Deviations:
 - a. Permitted only after Engineer/Architect's written approval of manufacturer's proposed design supported by complete design calculations and drawings.
 - b. Design deviations shall provide an installation equivalent to the basic intent without incurring additional cost to Owner.
- B. Performance Requirements:
 - 1. Size components to withstand design loads in an unrestrained condition according to State Building Code or the following, whichever is greater:
 - a. Loads as listed in the General Structural Notes.
 - 2. Grout Keys: Capable of transmitting horizontal shear of 2,000 pounds per foot.

1.04 SUBMITTALS

- A. Refer to Section 01 33 00.
- B. Product Data: Submit manufacturer's current Product Data including specifications, concrete design mix, handling, storage and installation instructions, and maintenance and cleaning recommendations.
- C. Shop Drawings: Show complete information for fabrication and installation of precast concrete units, including:
 - 1. Member dimensions, cross-section, location, size, type of reinforcement, including special reinforcement, and lifting devices necessary for handling and erection.
 - 2. Layout, dimensions, and identification of each unit corresponding to sequence and procedure of installation.
 - 3. Welded connections by AWS standard symbols.
 - 4. Detail inserts, connections, and joints; including accessories and construction at openings in precast units.
 - 5. Location, details of anchorage devices to be embedded in other construction. Furnish templates if required for accurate placement.
 - 6. Erection procedure for precast units and sequence of erection.
 - 7. Include design calculations stamped and signed by a licensed engineer in the state of Wisconsin.
- D. Samples:
 - 1. Components: Submit samples of anchors, fasteners, hardware, and other materials and components if requested by Engineer.
- E. Quality Assurance/Control Submittals:
 - 1. Test Reports: Written report of proposed mix for each type of concrete and/or other materials at least 15 days prior to start of precast unit production if requested by Engineer.
 - 2. Certificates:
 - a. Certified design calculations: Prepared by structural engineer licensed in state where project is located.
 - b. Submit certificates of approval in compliance with Section 01 33 00 and Conform to IBC code for state in which Project is located.
 - c. Provide AWS D1.1 certification for welders.
 - 3. Material Certificates:
 - a. Concrete materials.
 - b. Reinforcing materials and prestressing tendons.
 - c. Admixtures.

- F. Maintenance Manual: Provide to Owner, maintenance and warranty data in "Maintenance Manual" compliant with Section 01 78 23.

1.05 QUALITY ASSURANCE

- A. Qualifications of Personnel/Firm:
 - 1. Design Calculations: Professional Structural Engineer licensed in the state where project is located.
 - 2. Fabricator: Firm with 5 years successful experience in fabrication of precast concrete units similar to units required for project; with sufficient production capacity to produce required units without delay in work; producer member of PCI and satisfactory participant in its Plant Certification Program.
 - 3. Fabrication Plant: Plant engaged primarily in manufacturing of similar units.
 - 4. Supervision: 1 person present during execution of work, thoroughly trained with 5 years experience in materials and methods required, to direct fabrication and installation.
 - 5. Welder: Certified by AWS D1.1.
- B. Codes and Standards: Comply with referenced standards unless otherwise indicated.
- C. Testing: Perform following ASTM tests for each 50 cubic yards of concrete placed, minimum of weekly, and provide documentation of compliance:
 - 1. Slump: C143
 - 2. Compressive Strength: C31, C192, C39
 - 3. Air Content: C231 or C173
 - 4. Unit Weight: C138
- D. Plant Review: If requested by Engineer, review precast products at plant prior to shipment to job site.
- E. Preinstallation Meetings: Installer and manufacturer's technical representative shall meet with Engineer prior to the start of installation.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Protection: Comply with manufacturer's recommendations for job-site storage and protection.
- B. Deliver precast structural concrete units to Site in such quantities and at such times to ensure continuity of installation.
- C. Damaged Material: Replace damaged material prior to acceptance at no additional cost to Owner.
- D. Lift and support units only at designated lifting and supporting points as shown on Shop Drawings.
- E. Place stored units so that identification marks are discernible.
- F. Separate stacked members by battens across full width of each bearing point.
- G. Do not use upper member of stacked tier as storage area for shorter member or heavy equipment.
- H. Protect units from contact with soil or ground.

1.07 PROJECT CONDITIONS

- A. Environmental Requirements: Heat surfaces to be grouted to above freezing prior to installation of grout; keep temperature above 40 degrees F for 48 hours after completion of grouting.
- B. Existing Conditions: Drawings do not purport to show actual field dimensions, but are intended only to establish location and scope of Work. Field-verify dimensions and assume full responsibility for their accuracy.

1.08 SEQUENCING

- A. Coordination with Other Trades: Coordinate with installation of other materials and erection of other structural systems, including items to be cast in pre-cast units.

PART 2 PRODUCTS

2.01 MANUFACTURER

- A. Precast Concrete Units:
 - 1. Standard of Quality: Design is based on products of Molin Concrete Products Company, Circle Pines, MN www.molin.com/
 - 2. Other Acceptable Manufacturers: Subject to compliance with requirements, acceptable manufacturers and products are:
 - a. Concrete Inc., Grand Forks, ND www.ciprecast.com
 - b. County Materials, Eau Claire, WI www.countymaterials.com
 - c. Fabcon, Savage, MN www.fabcon-usa.com
 - d. Gage Bros. Concrete www.gagebrothers.com
 - e. Hanson www.hansonspancretemidwest.com
 - f. Manufacturer of comparable products submitted in compliance with Section 01 25 13.
- B. Nonmetallic Grout:
 - 1. Acceptable manufacturers:
 - a. Crystex, L & M Construction Chemicals, Inc.
 - b. Masterflow 928, Master Builders, Inc.
 - c. Manufacturer of comparable products submitted in compliance with Section 01 25 13.

2.02 MATERIALS

- A. Formwork:
 - 1. General Requirements: Provide forms and form facing materials of metal, plastic, wood, other acceptable material, non-reactive with concrete, which produces required finish surfaces.
 - 2. Construction: Accurate, mortar-tight, of sufficient strength to withstand pressures due to concrete placing operations, temperature changes, and when prestressed, pretensioning and detensioning operations; completed units of shapes, lines, dimensions indicated, within fabrication tolerances specified in PCI MNL 116.
 - 3. Design: Unless forms for plant manufactured prestressed concrete units are stripped prior to detensioning, design so stresses are not induced in precast units due to deformation of concrete under prestress or to movement during detensioning.
- B. Reinforcing Materials:
 - 1. Reinforcing Bars:
 - a. Deformed billet-steel: ASTM A615, Grade 60.
 - b. Deformed rail-steel: ASTM A616.
 - c. Deformed axle-steel: ASTM A617.
 - d. Deformed low-alloy steel: ASTM A706.
 - 2. Steel Wire: Plain, cold-drawn, ASTM A82.
 - 3. Wire Fabric:
 - a. Welded Steel: ASTM A185.
 - b. Welded Deformed Steel: ASTM A497.
 - 4. Supports for Reinforcement:
 - a. Bolsters, chairs, spacers, other devices for spacing, supporting, fastening reinforcing.
 - b. Comply with CRSI recommendations.
 - c. For exposed-to-view concrete surfaces, where legs of supports are in contact with forms, support with legs which are plastic protected (CRSI, Class 1) or stainless steel protected (CRSI, Class 2).

- C. Prestressing Tendons:
 1. Uncoated, 7-wire stress-relieved strand complying with ASTM A416.
 2. Either Grade 250 or Grade 270.
 3. At manufacturer's option, similar strand, but with size and ultimate strength increased approximately 15 percent, or strand with increased strength but fewer number of wires.

- D. Concrete Materials:
 1. Portland Cement: ASTM C150, Type I or Type III; one brand and type throughout unless otherwise acceptable to Engineer.
 2. Aggregates: ASTM C33, and as specified, from single source for exposed concrete.
 3. Lightweight Aggregate: ASTM C330.
 4. Water: Drinkable, free from foreign materials in amounts harmful to concrete and embedded steel.
 5. Admixtures: Certified by manufacturer to be compatible with other required admixtures.
 - a. Air-entraining 6 percent, ASTM C260.
 - b. Water reducing, accelerating, high range water reducing admixtures: ASTM C494 Type A.
 - c. No other admixtures may be used without Engineer's acceptance.
 - d. Salts: The use of calcium chloride, chloride ions or other salts is not permitted.

- E. Supplementary Cementitious Materials:
 1. Fly Ash: ASTM C618, Class C, with maximum loss on ignition of 3 percent.
 2. Metakaolin Admixture: ASTM C618, Class N.
 3. Silica Fume Admixture: ASTM C1240, with optional chemical and physical requirement.
 4. Ground Granulated Blast-Furnace Slag: ASTM C989, Grade 100 or 120.

- F. Grout Materials:
 1. Cement Grout: Portland cement, ASTM C150, Type I, and clean, natural sand, ASTM C144. Mix 1 part cement to 3 parts sand, by volume, with minimum water required for placement and hydration.
 2. Nonmetallic Shrinkage-resistant Grout:
 - a. Premixed, nonmetallic, noncorrosive, nonstaining product containing selected silica sands, portland cement, shrinkage compensating agents, plasticizing and water reducing agents.
 - b. ASTM C1107, Grade B.

2.03 PRECAST CONCRETE UNITS

- A. General Requirements:
 1. Free of voids or honeycomb, with straight true edges and surfaces.
 2. Texture:
 - a. Digger Roof Members: Broomed or raked top finish for bonding with concrete floor topping.
 3. Reinforcement: Adequate to resist transporting and handling stresses.

- B. Solid Plank: Precast prestressed concrete units.
 1. Provide headers of cast-in-place concrete or stainless steel, according to solid slab unit fabricator's written recommendations.
 2. Provide solid, monolithic precast slab units forming an integral part of slab unit system. Design and fabricate to dimensions and details indicated for solid slab units

2.04 ACCESSORIES

- A. Joint Sealant: As recommended by precast concrete manufacturer for interior and exterior locations, or if no recommendation by manufacture, use multi-component polyurethane sealant, including backing rod.

- B. Clips, hangers, other accessories required for installation and for support of subsequent construction or finishes.

- C. Other Materials: Materials not specifically described but required for complete, proper installation of structural precast concrete, subject to acceptance of Engineer.

2.05 MIXES

- A. General Requirements: Prepared by independent testing facility or by qualified precast manufacturing plant personnel, at precast manufacturer's option for each type of concrete required.
- B. Proportioning: By either laboratory trial batch or field experience methods, using materials to be employed for each type of concrete required. Comply with ACI 318.
- C. Compressive Strength: 5,000 psi minimum at 28 days.
- D. Release Strength for Prestressed Units: 3,500 psi minimum.
- E. Curing Compression Test Cylinders:
 - 1. Use same methods as for precast concrete work.
 - 2. Do not begin concrete production until Engineer reviews mixes and evaluations.

2.06 FABRICATION

- A. Comply with manufacturing and testing procedures, quality control recommendations, dimensional tolerances of PCI MNL-116, and as specified for types of units required.
- B. Openings:
 - 1. Cast-in holes for openings larger than 8-inch diameter or 8-inch square in accordance with final Shop Drawings.
 - 2. Other smaller holes may be field cut by trades requiring them, as acceptable to Engineer.
- C. Form Preparation:
 - 1. Coat surfaces with bond-breaking compound before reinforcement is placed, with commercial formulation form-coating compounds that will not bond with, stain nor adversely affect concrete surfaces, and will not impair subsequent treatments of concrete surfaces requiring bond or adhesion.
 - 2. Comply with manufacturer's instructions.
- D. Installation of Reinforcement:
 - 1. Preparation: Clean off loose rust and mill scale, earth, other materials which reduce or destroy bond with concrete.
 - 2. Displacement: Accurately position, support, secure reinforcement against displacement by formwork, construction, or concrete placement operations.
 - 3. Support: Metal chairs, runners, bolsters, spacers, and hangers, as required.
 - 4. Place to obtain at least minimum coverages for concrete protection.
 - 5. Arrange, space and securely tie bars and bar supports to hold reinforcement in position during concrete placement operations.
 - 6. Wire Ties: Set so ends are directed into concrete, not toward exposed concrete surfaces.
 - 7. Cut ends of strands not enclosed or covered flush and cover with high strength mortar, bonded to unit with epoxy resin bonding agent.
- E. Pretensioning:
 - 1. Single strand tensioning method or multiple-strand tensioning method.
 - 2. Comply with PCI MNL-116 requirements.
- F. Concrete Placement:
 - 1. Continuous operation to prevent formation of seams or planes of weakness in precast units, complying with requirements of ACI 304.
 - 2. Thoroughly consolidate placed concrete by internal and external vibration without dislocation or damage to reinforcement and built-in items.

- G. Identification:
 - 1. Permanent markings to identify pick-up points and orientation in structure, complying with markings indicated on final Shop Drawings.
 - 2. Imprint date of casting on each precast unit on a surface which will not show in finished structure.
- H. Curing by Moisture Retention:
 - 1. Form cure minimum 20 hours by moisture retention (without heat) method or accelerated heat curing with low-pressure live steam or radiant heat and moisture.
 - 2. Do not subject concrete to steam or hot air until after the concrete has attained its initial set. Take precautions to prevent moisture loss from concrete if using hot air for curing.
 - 3. Do not allow temperature of concrete to exceed 160 degrees F.
 - 4. Keep wet continuously for at least 6 days after being removed from the forms.
 - 5. Following curing period, allow the units to air dry for minimum 4 days before shipping to Site.
 - 6. Extend curing period if air temperature is below 50 degrees F.
- I. Detensioning:
 - 1. Timing: Delay until concrete has attained at least 70 percent of design stress, as established by test cylinders.
 - 2. Heat-cured Concrete: Perform while concrete is still warm and moist, to avoid dimensional changes which may cause cracking or undesirable stresses in concrete.
 - 3. Pretensioned Tendons: Gradual release of tensioning jacks or by heat cutting tendons, using sequence and pattern to prevent shock or unbalanced loading.

2.07 FINISHES

- A. Formed Surfaces: For formed surfaces of precast concrete as indicated for each type of unit, and as follows:
 - 1. Standard Finish:
 - a. Normal plant run finish produced in forms that impart smooth finish to concrete.
 - b. Small surface holes caused by air bubbles, normal form joint marks, minor chips and spalls will be tolerated, but no major or unsightly imperfections, honeycomb, or structural defects will be permitted.
- B. Unformed Surfaces:
 - 1. Consolidate concrete; bring to proper level with straightedge, float, to smooth uniform finish.
 - 2. Surfaces for Toppings: Apply scratch finish to precast units that will receive concrete topping after installation.
 - 3. Following initial strike off, transversely scarify surface to provide ridges approximately 1/4 inch deep.

2.08 SOURCE QUALITY CONTROL

- A. Fabrication Tolerances: Conform to referenced standards.
- B. Tests, Inspections:
 - 1. Testing: Unit dimensions smaller or greater than required, and outside specified tolerance limits are subject to additional testing as specified.
 - 2. Strength of Units: Strength of units will be considered potentially deficient if manufacturing processes fail to comply with any requirements which may affect strength, including following conditions:
 - a. Failure to meet compressive strength tests requirements.
 - b. Reinforcement, pretensioning and detensioning of tendons of prestressed concrete, not conforming to specified fabrication requirements.
 - c. Failure to cure, protect units against extremes in temperature as specified.
 - d. Precast units damaged during handling and erection.

3. Suspected Non-compliance Testing: When there is evidence that strength of units does not meet specification requirements, the concrete testing service shall take cores drilled from hardened concrete for compressive strength determination, complying with ASTM C42 and as follows:
 - a. At least 3 representative cores from units of suspect strength, from locations directed by Engineer.
 - b. Test cores in saturated surface dry condition per ACI 318 if concrete will be wet during use of completed structure.
 - c. Test cores in air-dry condition per ACI 318 if concrete will be dry during use of completed structure.
 - d. Strength of concrete for each series of cores will be considered satisfactory if average compressive strength is at least 85 percent of 28-day design compressive strength.
 - e. Test results are to be made in writing on same day tests are made, copies given to Engineer, Contractor, and precast manufacturer. Include project name, number, date, manufacturer's name, concrete testing service name, identification letter, name, type of member or members represented by core tests, design compressive strength, compression breaking strength and type of break (corrected for length-diameter ratio), direction of applied load to core with respect to horizontal plan of concrete as placed, and moisture condition of core at time of bearing.
 4. Patching: Where core test results are satisfactory and precast units are acceptable for use in work, fill core holes solid with patching mortar. Finish to match adjacent concrete surfaces.
 5. Defective Work: Replace with units that meet requirements of this section. Make corrections to other work affected by or resulting from corrections to precast concrete work at no cost to Owner.
- C. Verification of Performance:
1. Owner may employ separate testing laboratory to evaluate manufacturer's quality control and testing methods.
 2. Allow access to materials storage areas, concrete production equipment, concrete placement and curing facilities.
 3. Cooperate, provide samples of materials and concrete mixes as requested.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Work of Other Trades: Prior to commencing work, carefully inspect and verify that work is complete to point where this installation may properly commence.
- B. Verification of Conditions: Verify that the structural precast concrete may be installed in accordance with original design, pertinent codes and regulations, and pertinent portions of referenced standards.
- C. Discrepancies:
 1. Immediately notify Engineer.
 2. Do not proceed with installation in areas of discrepancy until fully resolved.
 3. Commencement of installation signifies acceptance of surface conditions.

3.02 PREPARATION

- A. Protection: Protect installed work and materials of other trades.
- B. Surface Preparation, Field Welding and Cutting: Protect units from damage, provide non-combustible shield as required.

3.03 ERECTION

- A. Compliance: Comply with manufacturer's instructions, including product technical bulletin installation instructions and Shop Drawing details.

- B. Bearing Surface:
 1. Where indicated, as precast units are being erected.
 2. Set on level, uniform bearing surfaces.
- C. Powder-Actuated Fasteners: Do not use for surface attachment of accessory items in precast, prestressed unit unless otherwise accepted by precast manufacturer.
- D. Installation Tolerances: Do not exceed following tolerance limits:
 1. Variation from plumb: 1/4-inch in 20-foot run or story height, 1/2-inch total in 40-foot or longer run.
 2. Variation from level or elevations: 1/4-inch in 20-foot run; 1/2-inch in 40-foot run; total plus/minus 1/2 inch any location.
 3. Variation from position in plan: plus/minus 1/2-inch maximum any location.
 4. Offset in alignment of adjacent members any joint: 1/16-inch in 10-inch run: 1/4-inch maximum.
- E. Grouting Connections and Joints: After precast concrete units placed and secured, grout open spaces at connection and joints.
 1. Retain grout in place until sufficiently hard to support itself.
 2. Pack spaces with stiff grout material; tamp until voids completely filled.
 3. Finish smooth, plumb, level with adjacent concrete surfaces.
 4. Keep grouted joints damp for not less than 24 hours after initial set.
 5. Promptly remove grout material from exposed surfaces before it hardens.
- F. Sealing Joints:
 1. Seal exposed and non-exposed, exterior and interior joints. Use primer and backer rod as recommended by sealant manufacturer.
 2. Seal joints between roof elements, between wall elements anywhere roof and walls join.
- G. Topping on floor plank: Plank which are to receive topping shall receive a transverse broom finish at the plant, and shall have keys between planks grouted at least 4 days before topping is placed. Immediately before placing topping, pressure-wash surface of plank and blow clean with oil-free compressed air, then rub with cement slurry as a bonding agent, working just ahead of concrete placement. Surface to be free of standing water but slurry must be wet when topping is placed. Wet cure topping (burlap/poly) for a minimum of 7 days.

3.04 FIELD QUALITY CONTROL

- A. Testing: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections.
- B. Testing agency to report tests results promptly in writing to Contractor and Engineer.
- C. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of corrected work with specified requirements.

3.05 REPAIR/RESTORATION

- A. Touch up marred finishes, but replace units that cannot be restored to factory-finished appearance. Use materials, procedures recommended or furnished by manufacturer.
- B. Damaged Metal Surface: Clean, restore finish to a level that is acceptable to the Engineer.
- C. Units Having Dimensions Smaller or Greater Than Required and Outside Specified Tolerance Limits: If appearance or function of structure is adversely affected, or if larger dimensions interfere with other construction, repair, or remove and replace as required to meet construction conditions.

3.06 ADJACENT PANEL ALIGNMENT

- A. Panels not in flush alignment with adjacent panels, and beyond allowable tolerance, must be replaced or, if possible, may be mechanically straightened and permanently fastened to remain at this intended alignment.
- B. Fastener hardware for such corrections must be concealed and cast into the original panels to allow for such correction. See Drawings.

3.07 CLEANING

- A. Site:
 - 1. Do not allow accumulation of scraps, debris arising from work of this section.
 - 2. Maintain premises in neat, orderly condition.
- B. System:
 - 1. Remove temporary covering and other provisions made to minimize soiling of other work.
 - 2. Promptly clean, repair surfaces stained, marred or otherwise damaged during work.
 - 3. Clean exposed surfaces of structural precast concrete using materials and methods recommended by manufacturer.
 - 4. Do not use cleaning materials or processes that could change the appearance of exposed concrete finishes.
 - 5. When work is completed, remove unused materials, containers, equipment, and debris.

END OF SECTION

SECTION 04 20 00 - UNIT MASONRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes

1. All unit masonry work.
2. Glazed concrete masonry units (CMU).
3. Cast stone masonry units in unit masonry walls.
4. Limestone masonry.
5. Reinforcement and anchorages.
6. Grout, mortar, and flashings.
7. Patching.
8. Building-in as required items furnished by other Section contractors.
9. Cutting and fitting for built-in items.
10. CMU bond-beam and lintels complete with reinforcement and concrete.
11. Reinforced CMU walls.

B. Related work and requirements

1. Section 04 23 00: Glass Unit Masonry
2. Section 04 72 00: Cast Stone Masonry

1.2 REFERENCES

A. General: Comply with all provisions except as may be modified herein. All referenced codes and standards, including all revisions and commentaries are those currently adopted as of the date of this Project Manual.

B. Standards:

1. American Society for Testing and Materials (ASTM)
 - a. A82 Cold Drawn Steel Wire for Concrete Reinforcement
 - b. A153 Zinc Coating (Hot Dip) on Iron and Steel Hardware
 - c. A641 Zinc-Coated (Galvanized) Carbon Steel Wire
 - d. C55 Concrete Building Brick
 - e. C67 Sampling and Testing Brick and Structural Clay Tiles
 - f. C73 Calcium Silicate Brick (Sand-Lime Brick)
 - g. C90 Load Bearing Concrete Masonry Units
 - h. C 1 Masonry Cement
 - i. C126 Ceramic Glazed Structural Clay Facing Tile, Facing Brick, and Solid Masonry Units
 - j. C144 Aggregate for Masonry Mortar
 - k. C150 Portland Cement
 - l. C207 Hydrated Lime for Masonry Purposes
 - m. C216 Face Brick
 - n. C270 Mortar for Unit Masonry
 - o. C476 Grout for Masonry
 - p. C568 Standard Specification for Limestone Building Stone
2. Wisconsin Department of Safety and Professional Services – Safety and Buildings Division
 - a. Wisconsin Commercial Building Code, Current Edition

3. The Masonry Society, American Concrete Institute, and American Society of Civil Engineers
 - a. Specification for Masonry Structures, Current Edition

1.3 SUBMITTALS

- A. Product Data: Submit manufacturer's product data for each type of masonry unit, accessory, and other manufactured products, proprietary mortar ingredients (Portland cement, masonry cement, mortar cement, lime, and admixtures), joint reinforcement, cleaning agent.
- B. Shop Drawings: Submit shop drawings for stone trim in form of cutting and setting drawings showing sizes, profiles, and locations of each stone trim unit required, fabrication dimensions and placement locations for reinforcing steel and accessories, flashing details, temporary wall bracing.
- C. Samples:
 1. Samples of special brick and CMU shapes (three each), if any, prior to manufacture for job quantities.
 2. Limestone Masonry Units: Submit sets of full-size production range samples that show the full range of exposed color and texture.
 3. Ceramic Glazed Concrete Masonry Units: Submit sets of full-size production range samples which show the full range of exposed color and texture.
 4. Samples of weep hole ventilator, and mortar color.
- D. Certificates: Submit certificate or other evidence that CMU complies with Wisconsin Department of Safety and Professional Services – Safety and Buildings Division requirements.
- E. Quality Control Submittals
 1. Design Data: Mortar mix designs, grout mix design
 2. Test Reports: Pre-construction, Field & Source quality
 3. Certifications: Compliance with specified requirements, compliance with specified ASTM Standards, Brick IRA
 4. Inspection Reports: Materials, protection measures, construction procedures, reinforcement, grouting
 5. Manufacturer's instructions: Cleaning agents, mortar, color pigments...

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications:
 1. CMU Manufacturer: Minimum five years experience in manufacture of CMU meeting requirements of Wisconsin Department of Safety and Professional Services – Safety and Buildings Division. Provide all CMU from single manufacturer.
 2. Subcontractor Qualifications: Minimum five years experience specializing in masonry work similar to the Work of this Project.
 3. Requirements of Regulatory Agencies: Comply with all requirements of the State of Wisconsin Department of Safety and Professional Services – Safety and Buildings Division.
- B. Allowable Tolerances:
 1. CMU: Per ASTM C 90.

C. Field Construction Mock-Up:

1. Prior to ordering stone selected for this project obtain sufficient number to erect approximately 4-foot long (including a 2-foot long outside corner return) by 4-foot high by full thickness sample wall panel at the project site in a location directed by the A/E. Include the full range of limestone masonry units, glazed CMU units, mortar colors, back-up, reinforcement and ties, and thru-wall flashing, to represent completed masonry work. Clean one-half of exposed masonry faces of sample wall complying with specification requirements for exterior masonry.
2. Do not order masonry until sample wall has been viewed and approved for color, texture, construction, and quality of appearance by the A/E. Maintain the approved sample wall on the project site until masonry work is accepted as the standard for masonry appearance. Remove sample wall and all evidence thereof from site upon acceptance of masonry work, unless directed otherwise by A/E.
3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless such deviations are specifically approved by A/E in writing.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Carefully pallet or neatly stack masonry on the site undamaged, and adequately protected. Upon delivery of each masonry shipment to the job site, sample shipment and compare with the approved sample wall. Report any deviations immediately to Owner. Cull-out, credit, and immediately remove from the site any defective brick. Resort or cull as necessary, especially when plant palletized, to avoid spotty or irregular ranges of color or texture in the finished wall.

1.6 FIELD CONDITIONS

- A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.
1. Extend cover a minimum of 24 inches down both sides of walls, and hold cover securely in place.
 2. Where one wythe of multi-wythe masonry walls is completed in advance of other wythes, secure cover a minimum of 24 inches down face next to unconstructed wythe, and hold cover in place.
- B. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.
1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
 2. Protect sills, ledges, and projections from mortar droppings.
 3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
 4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.
- C. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.

- D. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.

PART 2 - PRODUCTS

2.1 LIMESTONE MASONRY UNITS

- A. Provide Buechel Stone Corporation, Fond du Lac Tailored Blend Limestone, ASTM C568, Classification III:
 - 1. Maximum absorption rate tested in accordance with ASTM C97: 3 percent.
 - 2. Minimum density tested in accordance with ASTM C97: 2,560 kg per cubic meter.
 - 3. Minimum compressive strength tested in accordance with ASTM C170: 55 Mpa.
 - 4. Minimum flexural strength tested in accordance with ASTM C 880: 8.27 Mpa.
- B. Provide full veneer units in sizes and shapes to achieve pattern shown in elevations.

2.2 MASONRY ASSEMBLY

- A. Shall meet the following minimum requirements: $f_m=2250$ psi

2.3 CONCRETE MASONRY UNITS (CMU)

- A. General: Manufactured units made with portland cement, water and suitable mineral aggregates, with or without admixtures, normal weight.
- B. Load Bearing Units: ASTM C 9011a, normal weight, type II, 3275 psi.
- C. Provide 75 percent solid units or otherwise to provide fire resistance ratings indicated on Drawings.
- D. Concrete Brick: ASTM C 55, Grade N, normal weight, of same type as block units.

2.4 GLAZED CONCRETE MASONRY UNITS (CMU)

- A. Provide Trenwyth Astra-Glaze-SW+ ASTM C9011a lightweight or medium weight with externally heat-polymerized cast-on facing conforming to ASTM C744. Manufactured units made with portland cement, water and suitable mineral aggregates, with or without admixtures.
 - 1. Color: As noted in the Room Finish Symbols Legend.
 - 2. Provide standard units with nominal face dimensions of 16 inches long by 8 inches high by thicknesses indicated on Drawings. Provide soaps and special shapes as shown on drawings.
 - 3. Provide double-faced units for interior partition walls.
 - 4. 3275 psi

2.5 MASONRY UNITS:

- A. Provide special shapes where required for lintels, corners, jambs, sash, expansion joints, headers, bond beams, and other special conditions indicated including applications which cannot be produced by sawing of standard unit sizes.

- B. Bullnosed Masonry Units: Provide bullnose edged units where indicated.
- C. Unit Compression Strength: Provide units with minimum average net-area compressive strength of 2150 psi.
- D. Size (width): Manufactured to dimensions 3/8-inch less than nominal dimensions.

2.6 CAST STONE MASONRY

- A. See Section 04 72 00.

2.7 MORTAR MATERIALS

- A. Mortar:
 - 1. Test for compressive strength and water retention; ASTM C270-10.
 - 2. Mortar compressive strengths 28 days as follows:
 - Type M: 2500 psi at 28 days – below grade
 - Type S: 1800 psi at 28 days – above grade
- B. Portland Cement: ASTM C 150, Type I. Use only one brand and kind of Portland cement from one source throughout, unless prior written approval is obtained from A/E.
- C. Hydrated Lime: ASTM C 207, Type S, pressure hydrated non-air-entrained.
- D. Sand: ASTM C 144, except for joints less than 1/4-inch use aggregate graded with 100 percent passing the No. 16 sieve. Provide from single source.
- E. Water: Potable, fresh, clean, clear and free of injurious amounts of oil, acid, alkali, salts, organic matter or other detrimental substances and handled in clean containers.
- F. Masonry Cement: ASTM C 91.
- G. Premixed Cement and Lime: Conform to requirements specified above for Portland Cement and Hydrated Lime, pre-packaged, labeled in proportion and quantity.
- H. Admixtures: Not permitted.
- I. Mortar Colorant: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes and complying with ASTM C 979. Use only pigments with a record of satisfactory performance in masonry mortar. Color as selected by A/E from manufacturer's full range.
- J. Water Repellent Additive: Equivalent to W.R. Grace & Co. "Dry-Block", ACM Chemistries, Inc. "RainBloc", or BASF "Rheopel". Add additive to mortar mix for use with exterior decorative CMU units.

2.8 GROUT

- A. Masonry Grout: ASTM C-476-10
 - 1. Grout compressive strength of $f'_g=3000$ psi at 28 days.
 - 2. Max water/cement + pozzolan ration=.60

2.9 CONCRETE FILL

- A. Redi-Mix concrete, 3000 psi, 3/8-inch maximum aggregate.

2.10 MASONRY ACCESSORIES

- A. Continuous Joint Reinforcement:
1. Single Wythe: Prefabricated electrically flush or butt welded wire units, truss or ladder type, not less than 10-feet long, with matching corner units, fabricated from cold drawn steel wire complying with ASTM A 82. Size units 1-1/2 inches to 2 inches less than width of wall or partition. Provide galvanized (zinc coated) units conforming with Class 3 requirements of ASTM A 641 in all interior walls and with Class B requirements of ASTM A 153 in all exterior walls and in interior partitions enclosing wet areas. Equivalent to Hohmann & Barnard, Inc. #120 or #220.
 2. Multiple Wythe: Provide same type as above except with number of side rods as follows:
 3. Concrete Masonry: One side rod for each face shell of CMU back-up and CMU facing wythe. Equivalent to Hohmann & Barnard, Inc. #140.
 4. Composite Construction: One side rod for each face shell of CMU back-up and one rod for brick wythe. Equivalent to Hohmann & Barnard, Inc. #130.
- B. Individual Ties and Anchors:
1. Unless otherwise indicated, provide any of the following types of anchors:
 2. Wire-Bond Type III-X or Hohmann & Barnard, Inc. X-Seal anchor with two prongs capable of piercing insulation and sheathing and abut to the steel stud. Pronged legs shall be of adequate length to accommodate insulation and sheathing thickness. Provide anchor manufacturer's standard, self-adhering, self-sealing, barrier membrane strip manufactured to fit behind anchor and extend beyond pronged legs.
 3. Masonry Anchors: Z type rigid anchors, 3/16-inch thick x 1-1/4 inches wide x minimum 16 inches long with 2 inch bends on each end equivalent to Hohmann & Barnard, Inc. #344.
 4. Provide all ties and anchors with hot dip galvanized coating conforming to ASTM A 153, Class B2. Fabricate for use intended.
- C. Bond beam and lintel reinforcing: ASTM A 615, Grade 60.
- D. Thru-wall flashing
1. General: Thru-wall flashing is a composite system consisting of the following components:
 2. Flexible Flashing: W.R. Grace & Company "Perm-A-Barrier", Fiberweb "Aqua-Flash 500", Carlisle Coatings & Waterproofing, Inc. "CCW-705-TWF", W.R. Meadows "Air-Shield", Henry Company "Blueskin TWF", Hohmann & Barnard, Inc. "Textroflash", or approved equivalent self-sealing, self-healing, fully adhering, composite flexible wall flashing, consisting of a pliable, adhesive rubberized-asphalt compound, bonded to a high-density, cross-laminated polyethylene film to produce an overall thickness of not less than 40 mils.
- E. Metal Flashing Drip: 24 gauge, G-90 galvanized commercial quality prefinished steel sheet, coated with high performance fluoropolymer coating (Kynar 500), equivalent to Petersen "Pac-Clad" or Vincent "ColorKlad". Color: As selected by A/E from manufacturer's standard colors of not less than 30 colors.
- F. Flashing Accessories: Surface primer/conditioner and mastic compatible with flexible flashing as recommended by manufacturer of flexible flashing.
- G. Metal Termination Bar: Minimum 1/8-inch x 1-inch x 12-foot extruded aluminum bar with prepunched holes for fasteners.

- H. Metal Coping Flashing: Dead soft stainless steel Type 302/304, 0.015 inches thick. Fabricate full width of wall plus a 3/4-inch drip turned down 45 degrees with a 1/2-inch continuous hem; with deformations for mortar bond.
- I. Mesh cavity weep/vent: Archovatons, Inc.; CavClear Weep Vents, Mortar Net Solutions; Mortar Net Weep Vents, or approved equivalent free-draining mesh, full height and width of head joint and depth 1/8-inch less than depth of outer wythe. Color(s) selected by A/E from manufacturer's full range of colors.
- J. Collar joint drainage material: MortarNet by Mortar Net Solutions, or approved equal; Free-draining polymer mesh material full length of wall, full height first course.
- K. Movement joint filler: Premolded, flexible cellular neoprene filler strips complying with ASTM D 1056, Type 2, Class A, Grade 1, compressible up to 35 percent, of width and thickness indicated.
- L. Bond Breaker Strips: Asphalt saturated, organic roofing felt complying with ASTM D 226, Type I (No. 15 asphalt felt).

2.11 MORTAR MIXES

- A. Measure materials for mortars by volume in a manner whereby proportions can be controlled within two percent. Mix cementitious materials, powdered admixtures, and masonry sand dry. Add lime putty for exterior mortar, when lime is not prepackaged with cement, and then water to bring to proper consistency for use. Mix materials in an approved type machine mixer of adequate capacity for 3 to 5 minutes after all materials have been introduced and until materials are evenly distributed throughout the batch and the mixture is uniform in color and consistency.
- B. Use maximum water consistent with good workability and freedom from smearing the face of masonry work. Use no mortar that has stood more than one hour after initial mixing. Re-temper mortar less than one hour old as necessary to maintain its workability, but use before it is one hour old or otherwise discard. No anti-freeze ingredient or contaminate of any type permitted.
- C. Mortar for exterior and interior load bearing and non-load bearing walls: ASTM C 270 Type M (below grade) and S (above grade) Mortar conforming to the proportion specification requirements.
- D. Prepared masonry cements may be used in lieu of above mixes for interior non-load bearing CMU work only, except use mixes above for interior CMU work enclosing wet areas.
- E. Mortar Colorant: Proportion and mix colorant with other ingredients to produce color specified or required by A/E.

2.12 FOAMED-IN-PLACE INSULATION

- A. Provide foamed-in-place insulation in CMU walls where noted.

- B. Core-Fill 500 as manufactured by Tailored Chemical Products, or approved equal.
 - 1. Surface Burning Characteristics:
 - a. Flame Spread of 0
 - b. Smoke Developed of 5
 - c. Fuel Contributed of 0
 - 2. Combustion Characteristics: Class A
 - 3. Thermal Value: R-4.9 per inch

2.13 FABRICATION/MANUFACTURE

- A. CMU: Manufacture from Portland cement, water, and suitable aggregates. Standard units with nominal 16-inch long x 8-inch high face, width as indicated, **two core type only**.
Continuous Joint Reinforcement: Fabricate reinforcement for exterior walls with 3/16-inch diameter continuous rods, minimum one rod for each face shell, and #9 gage cross rods 16 inches on center (heavy-duty weight). For interior walls fabricate reinforcement with two #9 gage continuous rods and #9 gage truss or ladder type cross rods 16 inches on center (standard weight).
- B. Metal Flashing Drip:
 - 1. Fabricate flashing drip in 8 to 10 foot lengths. Bend and break to true, sharp and straight lines and angles. Where flashing drip intercepts other elements, cope to accurate fit, sealing as required.
 - 2. Exposed exterior edge of flashing drip shall uniformly extend a minimum of 1/8-inch beyond exterior wythe with a minimum 1/2-inch continuous hem turned downward approximately at a 45-degree bend to serve as a drip. Notch hem and taper-cut drip for the underlying piece at joint.
 - 3. Fabricate flashing drip at interior and exterior corners in one-piece with corners mitered, extending not less than 18 inches in length both ways from the corner.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Inspect Work of other Section contractors on which or to which unit masonry is to be built, supported, or attached, to determine completeness and proper alignment to receive unit masonry. Do not commence work until all defective work has been corrected.

3.2 PREPARATION

- A. Verify that items provided by other Section contractors are properly sized and located.
- B. Establish lines, levels, and coursing. Protect from disturbance.
- C. Provide temporary bracing during erection of masonry work. Maintain in place until building structure provides permanent bracing.

3.3 COURSING

- A. General:
 - 1. Place masonry to lines and levels indicated. Maintain horizontal joint plane through all wythes of wall.

2. Maintain masonry courses to uniform width. Make vertical and horizontal joints equal and of uniform thickness.
3. Unless otherwise indicated, lay CMU in running bond. Where scheduled to be reinforced vertically and grouted, align cores. Course one block unit and one mortar joint to equal 8 inches. Form concave mortar joints throughout except cut joints flush for masonry walls that are concealed or scheduled to be covered by other materials.

B. Construction Tolerances:

1. Variation from Plumb: For vertical lines and surfaces of columns, walls, and arises, do not exceed 1/4-inch in 10-feet, nor 3/8-inch in 20-feet, nor 1/2-inch in 40-feet or more.
For external corners, expansion joints, control joints, and other conspicuous lines, do not exceed 1/4-inch in 20-feet, nor 1/2-inch in 40-feet or more. For vertical alignment of head joints, do not exceed plus or minus 1/4-inch in 10-feet, nor 1/2-inch maximum.
2. Variation from Level: For bed joints and lines of exposed lintels, sills, parapets, horizontal grooves, and other conspicuous lines, do not exceed 1/4-inch in 20-feet, nor 1/2-inch in 40-feet or more. For top surface of bearing walls, do not exceed 1/8-inch in 10-feet, nor 1/16-inch within width of a single unit.
3. Variation of Linear Building Line: For position shown in plan and related portion of columns, walls, and partitions, do not exceed 1/2-inch in 20-feet, nor 3/4-inch in 40-feet or more.
4. Maximum Variation in Cross Sectional Dimensions: For columns and thickness of walls, from dimensions indicated on Drawings, do not exceed minus 1/4-inch nor plus 1/2-inch.
5. Variation in Mortar Joint Thickness: Do not vary from bed joint thickness indicated by more than plus or minus 1/8-inch, with a maximum thickness limited to 1/2-inch. Do not vary bed joint thickness from bed joint thickness of adjacent courses by more than 1/8-inch. Do not vary from head joint thickness indicated by more than plus or minus 1/8-inch. Do not vary head joint thickness from adjacent head joint thickness by more than 1/8-inch. Do not vary from collar joint thickness indicated by more than minus 1/4-inch or plus 3/8-inch.

3.4 PLACING AND BONDING

A. Lay concrete masonry units as follows:

1. Hollow concrete masonry units with face-shell mortar bedding.
2. Hollow concrete masonry units with full mortar bedding for starting course on footings or foundation walls as well as all courses of piers, columns, and pilasters, and where adjacent cells or cavities are filled with grout.
3. Solid concrete masonry units with full mortar bedding.
4. Buttering corners of joints, and deep or excessive furrowing of mortar joints not permitted.

B. Fully bond intersections, and external and internal corners.

C. Do not shift or tap masonry units after mortar has taken initial set. Where adjustment must be made, remove mortar and replace.

D. Remove excess mortar as the work progresses and before it tenaciously adheres to the face of the masonry.

E. Perform job site cutting with proper tools to provide straight unchipped edges. Take care to prevent breaking masonry unit corners or edges.

F. Isolate masonry partitions from vertical structural framing members with an isolation joint as indicated.

3.5 SOLID COMPOSITE CONSTRUCTION

- A. In the joint between brick and CMU backup, fill joint full with grout.

3.6 CAST STONE MASONRY

- A. Receive cast stone masonry units and anchorages from Section 04 72 00 contractor and install in accordance with requirements specified in Section 04 72 00.

3.7 REINFORCEMENT AND ANCHORAGES

- A. In multi-wythe masonry, install continuous joint reinforcement at maximum of 16 inches o.c. vertically.
- B. In single wythe and composite (solid) masonry, install continuous joint reinforcement at maximum of 16 inches o.c. vertically.
- C. Place reinforcement in first and second horizontal joints above and below openings. Extend 16 inches minimum each side of opening.
- D. Place joint reinforcement continuous in first and second joint below top of walls.
- E. Lap joint reinforcement ends minimum 6 inches. Extend 16 inches minimum each side of opening.
- F. Reinforce [joint corners and] intersections with masonry anchors 16 inches o.c. vertically.

3.8 GROUTING

- A. Non-Engineered: Pour masonry grout in all hollow metal frames - jamb and heads, built into masonry work. Fill CMU core adjacent to openings.
- B. Engineered:
 - 1. Definitions:
 - a. Hollow unit masonry partitions in which certain cells are continuously filled with grout, and in which reinforcement is embedded.
 - 2. Construction Requirements:
 - a. Place reinforced hollow unit masonry to provide unobstructed vertical continuity of the cells to be filled. Bed fully walls and cross webs forming such cells to be filled in mortar to prevent leakage of grout. Bond by lapping units in successive vertical courses, and in accordance with ACI 318.
 - b. Vertically align cells to maintain a clean, unobstructed continuous vertical cell measuring not less than 2 inches by 3 inches.
 - c. Provide cleanout openings at the bottom of all cells at each pour of grout where such grout pour is in excess of 4-feet in height. Remove overhanging mortar or other obstruction or debris from the insides of cell walls. Close cleanouts before grouting, after inspection.
 - d. Place reinforcing bars in CMU cores. Support and secure against displacement. Maintain position within 1/2-inch of true dimension.
 - e. Lap reinforcing bars at splices, minimum 48 bar diameters.
 - f. Fill all cells containing vertical reinforcement solidly with grout. Pour grout in lifts of 8-feet maximum height. Consolidate grout at time of pouring by puddling or vibrating. Reconsolidate again by puddling later, before plasticity is lost.

- g. Minimum slump at time of placement: 8 inches.
- h. When total grout pour exceeds 8-feet in height, pour grout in 4-foot lifts. Special inspection during grouting required. Minimum cell dimension: 3 inches.
- i. When grouting is stopped for one hour or longer, form horizontal construction joints by stopping the pour of grout not less than 1/2-inch below the top of the uppermost unit grouted.
- j. No admixtures permitted without prior approval by the A/E.

3.9 MASONRY FLASHINGS

- A. Remove all deleterious materials from surfaces to be flashed. Apply surface conditioner by spray, brush, or roller at the rate recommended by manufacturer to dirty or dusty surfaces or surfaces having irregular or rough texture.
- B. Properly position flexible flashing, remove release paper and place against surface by pressing firmly into place by hand roller. Fully adhere flexible flashing to surface to prevent water from migrating under flashing. Extend flexible flashings through exterior wythe, turn up minimum 8 inches and mechanically anchor to substrate through termination bars.
- C. Lap end joints minimum 2 inches, roll all overlaps with hand roller and seal overlaps watertight using flexible flashing manufacturer's recommended mastic.
- D. Install concealed end dams at longitudinal ends of flexible flashing over lintels, at column abutments, and adjacent to building expansion joints by turning flexible flashing material up a minimum of 2 inches to form a pan. Seal all pan seams watertight using flexible flashing manufacturer's recommended mastic. Flashing at typical movement joints shall be continuous.
- E. Apply a bead or trowel coat of flexible flashing manufacturer's recommended mastic along top edge of flashing and termination bars, seams, cuts, and penetrations.
- F. Flexible flashing shall be continuous around corners.
- G. Remove protective film (if any) from surface of metal flashing drip. Install metal flashing drip on double beads of sealant and fully adhere flexible flashing to top of metal flashing drip. Seal laps in flashing drip with elastomeric sealant for watertight construction. **Stop flexible flashing 1/2-inch back from outside face of exterior wythe.** Avoid damage to metal flashing drip finish.
- H. Install metal coping flashings beneath all copings. Set in thin uniform mortar bed. Lap end joints four inches.

3.10 MISCELLANEOUS

3.11 FOAMED-IN-PLACE INSULATION

- A. Fill Glazed CMU from un-glazed side of wall. Pressure inject through holes drilled into every vertical column of block cells at an approximate height of 4 feet from finished floor level.

- B. Fill all open cells and voids in hollow concrete masonry walls where shown on drawings. Patch holes with mortar and score to resemble existing surface.

3.12 LINTELS

- A. Install loose steel lintels as scheduled and as detailed.
- B. Construct beam block lintels using Concrete Fill and reinforcing bars as scheduled and as detailed.

3.13 BOND BEAMS

- A. Reinforce bond beams with two #5 bars, one inch from bottom of channel unless otherwise indicated.
- B. Lap splices minimum 24 bar diameters.
- C. Place and consolidate Concrete Fill (not mortar) without disturbing reinforcing.

3.14 MOVEMENT JOINTS

- A. General: Install movement joints in unit masonry where indicated on Drawings. If not indicated, provide vertical movement joints not more than 24-feet apart and at offsets, changes in wall height, openings, building corners, and junctions of walls. Locate joints in concrete masonry back-up midway between joints in exterior clay masonry.
- B. Concrete Masonry Back-Up: Provide joints at building outside corners. Provide joints at one end of openings less than 6-feet long and at both ends for openings six feet or greater. Locate joints at the end of steel lintels and bond beams.
- C. Form movement joints in concrete masonry back-up by one of the following methods at Contractor's option:
 - 1. Fit bond breaker strips into hollow contour in ends of block units on one side of movement joint. Fill the resultant core with grout and rake joints in exposed faces.
 - 2. Install preformed movement joint gaskets designed to fit standard sash block.
- D. Exterior Limestone Masonry Veneer: Locate movement joints on each side of outside building corners, four feet maximum on side of greatest expected movement and between 8 and 12 feet on the opposite side, unless otherwise indicated. Provide joints at both ends of masonry openings greater than 8 feet long, unless otherwise indicated.
- E. Form movement joints in limestone veneer masonry as work progresses, made free of mortar and all other nonresilient materials within 24 hours after initial construction. Provide joint fillers and prevent accumulation of mortar droppings.
- F. Vertical movement joints shall be 1/2-inch wide in stone products and 3/8-inch in concrete products.
- G. Discontinue horizontal joint reinforcing at movement joints.
- H. Maintain joint free and clear of mortar.

3.15 BUILT-IN WORK

- A. As work progresses, build-in metal door frames, fabricated metal frames, window frames, wood nailing strips, anchor bolts, plates, reglets, and other items to be built in the work supplied by other Section contractors.
- B. Build-in items plumb and level.
- C. Bed anchors of hollow metal frames in mortar joints.
- D. Do not build-in organic materials subject to deterioration.

3.16 CUTTING AND FITTING

- A. Cut and fit masonry units for chases, pipes, conduit, sleeves, ductwork, door and window openings. Cooperate fully with other contractors to ensure correct size, shape and location.
- B. Obtain A/E approval prior to cutting or fitting any area which is not indicated on Drawings, or which may impair appearance or strength or masonry work.

3.17 REPAIRING AND POINTING

- A. Remove and replace masonry units which are loose, chipped, broken, stained or otherwise damaged, or if units do not match adjoining units as intended. Provide new units to match adjoining units and install in fresh mortar or grout, pointed to eliminate evidence of replacement.
- B. Pointing: During the tooling of joints, enlarge any voids or holes, except weep holes, and completely fill with mortar. Point-up all joints at corners, openings and adjacent work to provide a neat, uniform, appearance, properly prepared for application of caulking or sealant compounds.

3.18 FIELD QUALITY CONTROL

- A. Clean completed masonry work as the work progresses to avoid the use of acidic cleaning solutions and excessive final cleaning.
- B. Remove surplus mortar as masonry units are laid. After tooling, mortar tailings shall be cut off with a trowel. Excessive mortar and dirt shall be cleaned from masonry surfaces by hand with wooden paddles and nonmetallic scrape hoes or chisels as scaffolds are removed, and at end of each day's work, leaving the surface of the masonry clean and finished. Utilize equipment or techniques in full compliance with these specifications. (See Cleaning following). ALL MASONRY SHALL BE IN CONDITION FOR FINAL ACCEPTANCE AT THE END OF EACH DAY'S WORK.
- C. At end of each day's work, cover tops of incomplete work to prevent moisture infiltration.
- D. After completion of masonry work on exterior walls, inform GC to maintain covers on tops of walls, installed by this Section contractor, until roofing and roof edge work has been completed.

3.19 CLEANING

- A. Test cleaning methods on a test CMU and face brick wall area of approximately 50 sq. ft. Obtain A/E's approval of cleaned test wall areas before proceeding with cleaning of masonry.
- B. Clean and wash down exposed interior and exterior masonry surfaces. Remove excess mortar as the work progresses and before it tenaciously adheres to the face of the masonry. Clean as units are being set and again upon completion. Upon final completion, if directed by A/E, wash down all masonry work to remove construction dirt.
- C. Clean existing masonry surfaces immediately adjacent and below new masonry surfaces.
- D. CMU: Dry brush daily and upon final pointing.
- E. Cast Stone Masonry: Comply with cleaning requirements specified in Section 04 72 00.
- F. Limestone Masonry Units:
 - 1. Remove excess mortar and mortar smears as work progresses.
 - 2. Allow walls to air dry. Brush off mortar with stiff fiber brush. Do not use metallic tools for cleaning.
 - 3. Clean limestone units to comply with recommendations in "ILI Handbook" of Indiana Limestone Institute of America, Inc.

3.20 PROTECTION

- A. Use all means necessary to protect the Work of this Section from any and all damage.
- B. Provide protection without damaging completed work. Protect from staining. Protect from all construction activity.

End of Section

SECTION 04 23 00 - GLASS UNIT MASONRY

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes
 - 1. Extent of glass unit masonry as indicated on Drawings.
- B. Related work and requirements
 - 1. Section 04 20 00: Unit Masonry
 - 2. Section 05 50 00: Metal Fabrications
 - 3. Section 07 92 00: Joint Sealants

1.2 SUBMITTALS

- A. Product Data: Submit manufacturer's technical data for glass block, cementitious materials, waterproofing admixtures for mortar, and glass unit masonry accessories.
- B. Shop Drawings: Show fabrication and installation details for glass unit masonry, including vertical and horizontal coursing, anchors, reinforcement, and expansion strips.
- C. Samples: Submit samples of glass block for each form, pattern, and color indicated including mortar color samples.

1.3 QUALITY ASSURANCE

- A. Single Source Responsibility: Obtain materials for glass unit masonry from a single source for each type of material required.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Protect glass block during storage and construction from damage, soiling and moisture.
- B. Protect aggregate during storage and construction against wetting by rain, snow or ground water and against intermixture with earth or other materials.
- C. Protect cementitious materials and metal accessories from, respectively, deterioration and corrosion by moisture and other causes. Store in a dry location and in original packages.

1.5 FIELD CONDITIONS

- A. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.
- B. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Hollow Glass Block: Hollow units made from transparent glass, with manufacturer's standard edge coating.
 - a. Nippon Electric Glass Co., Ltd.
 - b. Pittsburgh Corning Corporation
 - c. WECK Glass Block

2.2 GLASS BLOCK

- A. Hollow Glass Block: Non-loadbearing blocks made by fusing together two halves of clear, colorless pressed glass to produce partially evacuated hollow units with manufacturer's standard coating factory-applied on edge surfaces complying with the following requirements for pattern, size and other characteristics:
 - 1. Transparent Pattern: Smooth outer and inner faces.
 - 2. Edge Coating Color: Provide manufacturer's standard white color.
 - 3. Square Unit Sizes: Actual size of 3-7/8 inches thick by 8 inches.

2.3 MORTAR MATERIALS

- A. Portland Cement: ASTM C 150, Type I or Type II. Provide natural color or white cement as required to produce mortar color selected by A/E.
- B. Hydrated Lime: ASTM C 207, Type S.
- C. Sand: ASTM C 144, graded for thin joints.
- D. Water: Potable, free of substances capable of having a deleterious effect on mortar or glass unit masonry.
- E. Mortar Colorant: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes and complying with ASTM C 979. Use only pigments with a record of satisfactory performance in masonry mortar. Color as selected by A/E from manufacturer's full range.
- F. Water-Repellent Admixture: Dry mixture of stearates, water reducing agents, and fine aggregates intended to reduce capillarity in mortar.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. BASF "Hydrocide Powder"

2.4 ACCESSORIES

- A. Panel (Joint) Reinforcement: Ladder-type units, butt welded, not lapped and welded; complying with ASTM A 951 in straight lengths of not less than 10-feet, and as follows:

- B. Hot-Dip Galvanized Steel Wire: ASTM A 82 for uncoated wire and ASTM A 153, Class B2 for zinc coating applied by hot-dip process to products after fabrication and assembly.
 - 1. Wire Size: W1.7 or 0.148-inch diameter.
 - 2. Spacing of Side Rods: 2 inches center to center, unless otherwise indicated. [1-5/8 inches for 3 inches thick units.]
 - 3. Spacing of Cross Rods: Not more than 16 inches apart.
- C. Panel Anchors: Glass unit masonry manufacturer's standard perforated steel strips, 0.0359-inch uncoated thickness x 1-3/4 inches wide x length required, and hot-dip galvanized after fabrication to comply with ASTM A 153.
- D. Asphalt Emulsion: Cold-applied asphalt emulsion complying with ASTM D 1187 or ASTM D 1227.
- E. Expansion Strips: Either 4 lb. density glass fiber strips or white polyethylene foam complying with requirements of glass block manufacturer, 3/8-inch thick x 3 inches wide x 24 inches long.
- F. Sealant: As specified in Section 07 92 00.

2.5 MORTAR MIXES

- A. Do not lower the freezing point of mortar by using admixtures or anti-freeze agents. Do not use calcium chloride.
- B. Mortar for Glass Unit Masonry: Comply with ASTM C 270, proportion specification for Type S portland cement-lime mortar. Do not use masonry cement.
- C. Mix water-repellent admixture in mortar mix according to directions of admixture manufacturer.
- D. Mix mortar to produce a stiff but workable consistency that is drier than mortar for ordinary unit masonry. Do not retemper mortar after it has taken its initial set.

PART 3 - PART THREE - EXECUTION

3.1 INSPECTION

- A. Examine sills, jambs and heads surrounding glass unit masonry panels to verify that they are complete and of correct size and in correct location to receive glass unit masonry.
- B. Do not proceed with installation of glass unit masonry until conditions are satisfactory.

3.2 INSTALLATION

- A. Sill, Head and Jamb Preparation: Apply a heavy coat of asphalt emulsion to sill, allow to dry before placing mortar. Adhere expansion strips to jambs and heads with gobs of asphalt emulsion, taking care to extend expansion strips to sill.
- B. Setting Glass Unit Masonry:

1. Set first and succeeding courses of glass unit masonry with completely filled bed and head mortar joints, with no furrowing.
 2. Lay-up glass unit masonry plumb with courses level, accurately spaced and coordinated with other work. Maintain 1/4-inch joint width unless otherwise indicated.
 3. Use rubber mallet to tap units into position. Do not use steel tools and do not allow units to come into contact with metal accessories and frames.
 4. Use wedges in mortar joints of lower courses where needed to prevent mortar from being squeezed out of joints.
 5. Keep expansion joints free of mortar.
 6. Tool exposed joints slightly concave using a jointer larger than joint width. Perform tooling while mortar is still plastic and before it takes final set.
 7. Remove wedges, if used, and fill voids with mortar.
 8. Remove surplus mortar from face of glass block at time joints are tooled.
- C. Panel Reinforcing:
1. Install panel reinforcing in horizontal joints at 16 inches o.c. vertically and run continuously from end to end of panels.
 2. Place panel reinforcing in joints immediately above and below all openings within glass unit masonry panels.
 3. Lap panel reinforcing not less than 6 inches where more than one length is necessary.
 4. Embed panel reinforcing in mortar bed by placing lower half of mortar bed first, then pressing panel reinforcing into place and covering with upper half of mortar bed and then troweling it smooth.
- D. Panel Anchors:
1. Install panel anchors at locations indicated and in same horizontal joints where panel reinforcing occurs. Extend panel anchors at least 12 inches into joint and bend within expansion joints at edges of panels.
 2. New Unit Masonry: Embed other end of panel anchor, after bending portion crossing expansion joint, in horizontal mortar joint closest in elevation to joint in glass unit masonry containing panel anchor.
- E. Steel Members: Attach by 1/4-inch diameter steel bolts in tapped holes or by welding per AWS D1.1 "Structural Welding Code".
- F. Install expansion strips at jambs, heads, mullions and other locations indicated.
- G. Seal joints with backer rod and sealant where indicated.

3.3 CLEANING

- A. Clean glass unit masonry after mortar has attained final set but before it has dried on block surfaces by use of scrub brush with stiff fiber bristles and damp cloth. Do not use abrasive cleaners, steel wool or wire brush.

End of Section

SECTION 04 72 00 - CAST STONE MASONRY

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Cast stone masonry units for decorative window sills, lintels, surrounds, belt courses, moldings, and copings in unit masonry walls, custom fabricated, complete with required reinforcement and cast-in connection devices.
- B. Extent of cast stone masonry work is indicated on the Drawings.

1.2 RELATED WORK AND REQUIREMENTS

- A. Section 04 20 00: Unit Masonry

1.3 SUBMITTALS

- A. Product Data: Submit for each type of cast stone unit required. Include instructions for handling, storage, installation and protection of cast stone.
- B. Shop Drawings: Submit shop drawings showing complete information for fabrication and installation details of cast stone units. Indicate material descriptions, member dimensions and cross-section; fabrication tolerances; location, size and type of reinforcement, supports, anchors and fasteners, including special reinforcement and lifting devices, if required, for handling and erection.
 - 1. Include building elevations showing layout of units and locations of joints and anchors.
 - 2. Show location and type of inserts for cast stone unit anchors and supports that are to be built into concrete or masonry back-up.
- C. Samples: Prepare full-size samples of cast stone units as necessary to achieve color approval, for Architect's inspection at production plant or project site. Obtain Architect's approval of quality, color, and texture of surface finish prior to start of fabrication or installation of cast stone. Acceptable samples may be incorporated in the work.
- D. Qualification Data: For manufacturer.
- E. Material Test Reports: For each mix required to produce cast stone, based on testing according to ASTM C 1364, including test for resistance to freezing and thawing. Provide test reports based on testing within previous two years.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A qualified manufacturer of cast stone units similar to those indicated for this Project that has sufficient production capacity to manufacture required units, and is a plant certified by the Cast Stone Institute.
- B. Manufacturing Standards: Comply with recommendations for manufacturing tolerances, procedures and production methods of the Cast Stone Institute.

- C. Source Limitations: Provide all materials of same type and from same source or manufacturer to ensure uniform color and texture.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver cast stone units to project site in such quantities and at such times to ensure continuity of installation. Store units at project site to prevent cracking, distortion, warping, staining, or other physical damage.

PART 2 - PRODUCTS

2.1 CAST STONE MATERIALS

- A. General: Comply with ASTM C 1364 and the following:
- B. Portland Cement: ASTM C 150, Type I or Type III containing not more than 0.60 percent total alkali when tested according to ASTM C 114. Use only one brand, type, and source of supply of cement throughout the project, unless otherwise acceptable to A/E. Provide natural color or white cement as required to produce cast stone color indicated.
- C. Fine Aggregates: ASTM C 33, graded and washed natural aggregates, gradation and colors as required to produce indicated cast stone textures and colors.
- D. Coarse Aggregates: ASTM C 33, graded and washed natural aggregates, gradation and colors as required to produce indicated cast stone textures and colors.
- E. Color Pigment: ASTM C 979, synthetic mineral oxide pigments or colored water-reducing admixtures, color stable, non-fading, and resistant to lime and other alkalis. Color as required to produce cast stone color indicated.
- F. Admixtures: Use only admixtures specified or approved in writing by A/E.
 - 1. Do not use admixtures that contain more than 0.1 percent water-soluble chloride ions by mass of cementitious materials. Do not use admixtures containing calcium chloride.
 - 2. Use only admixtures that are certified by manufacturer to be compatible with cement and other admixtures used.
 - 3. Air-Entraining Admixture: ASTM C 260. Add to mixes for units exposed to the exterior at manufacturer's prescribed rate to result in an air content of 4 to 6 percent, except do not add to zero-slump concrete mixes.
 - 4. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
 - 5. Water-Reducing, Retarding Admixture: ASTM C 494/C 494M, Type D.
 - 6. Water-Reducing, Accelerating Admixture: ASTM C 494/C 494M, Type E.
- G. Reinforcement: Deformed steel bars complying with ASTM A 615/A 615M, Grade 60. Use galvanized or epoxy-coated reinforcement when covered with less than 1-1/2 inches of cast stone material.
- H. Galvanized Coating: ASTM A 767/A 767M.
- I. Epoxy Coating: ASTM A 775/A775M.

- J. Embedded Anchors and Other Inserts: Fabricated from stainless steel complying with ASTM A 240/A 240M, ASTM A 276, or ASTM A 666, Type 304.
- K. Water: Clean, fresh, free from oil, acid, organic matter, or other deleterious substances.

2.2 CAST STONE UNITS

- A. Basis of Design: Provide units by Edwards Cast Stone Company, or pre-approved equal.
 - 1. Color and texture: Edwards Cast Stone style 18-008.
- B. Provide cast stone units complying with ASTM C 1364 using either the vibrant dry tamp or wet-cast method.
- C. Provide units that are resistant to freezing and thawing as determined by laboratory testing according to ASTM C 666/C 666M, Procedure A, as modified by ASTM C 1364.
- D. Fabricate units with sharp corners and accurately reproduced details, with indicated texture on all exposed surfaces unless otherwise indicated.
 - 1. Slope exposed horizontal surfaces 1:12 to drain unless otherwise indicated.
 - 2. Provide raised fillets at backs of sills and at ends indicated to be built into jambs.
 - 3. Provide drips on projecting elements unless otherwise indicated.
- E. Fabrication Tolerances:
 - 1. Variation in Cross Section: Do not vary from indicated dimensions by more than 1/8 inch.
 - 2. Variation in Length: Do not vary from indicated dimensions by more than 1/360 of the length of unit or 1/8 inch, whichever is greater, but in no case by more than 1/4 inch.
 - 3. Warp, Bow, and Twist: Not to exceed 1/360 of the length of unit or 1/8 inch, whichever is greater.
 - 4. Location of Grooves, False Joints, Holes, Anchorages, and Similar Features: Do not vary from indicated position by more than 1/8 inch on formed surfaces of units and 3/8 inch on unformed surfaces.
- F. Curing: Cure units in enclosed moist curing room at 95 to 100 percent relative humidity and temperature of 100 deg F (38 deg C) for 12 hours or 70 deg F (21 deg C) for 16 hours. Keep units damp and continue curing to comply with one of the following:
 - 1. No fewer than five days at mean daily temperature of 70 deg F (21 deg C) or above.
 - 2. No fewer than six days at mean daily temperature of 60 deg F (16 deg C) or above.
 - 3. No fewer than seven days at mean daily temperature of 50 deg F (10 deg C) or above.
 - 4. No fewer than eight days at mean daily temperature of 45 deg F (7 deg C) or above.
- G. Acid etch units after curing to remove cement film from surfaces to be exposed to view.
- H. Colors and Textures: Provide units matching [A/E's sample.] [Existing units.] [Calcium silicate masonry units specified in Section 04 20 00.] [As selected by A/E from manufacturer's full range.]

2.3 ACCESSORIES

- A. Clips, Plates, Bolts, Dowels, and Miscellaneous Anchors: Type 304 stainless steel complying with ASTM A240/A 240M, ASTM A 276, or ASTM A 666 for items in direct contact with cast stone, unless indicated otherwise.
- B. Setting Buttons and Shims: Nonstaining, thickness to suit joint thickness. For pointed joints, sized to avoid interference with pointing operation.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Cast stone supplier shall provide all connection and setting hardware.
- B. Furnish erection plans, anchorage placement drawings, templates, and connection inserts in a timely manner to Section 04 20 00 Contractor for placement.

3.2 SETTING CAST STONE

- A. Install cast stone units to comply with requirements specified in Section 04 20 00 and the following:
 - 1. Set cast stone as indicated on Drawings. Set units accurately in locations indicated with edges and faces aligned according to established relationships and indicated tolerances.
 - 2. Install anchors, supports, fasteners, and other attachments indicated or necessary to secure units in place.
 - 3. Wet joint surfaces thoroughly before applying mortar or setting in mortar.
 - 4. Set units in full bed of mortar with full head joints unless otherwise indicated. Set units with joints 1/4 to 3/8 inch wide unless otherwise indicated. Build anchors and ties into mortar joints as units are set.
 - 5. Keep head joints in coping and other units with exposed horizontal surfaces open to receive sealant.

3.3 CLEANING

- A. Clean exposed facings to remove dirt and stains that may be on units after erection and completion of joint treatments. Wash and rinse in accordance with cast stone manufacturer's recommendations. Protect other work from damage due to cleaning operations. Do not use cleaning materials or processes that could change the character of exposed cast stone finishes.

End of Section

SECTION 05 12 00

STRUCTURAL STEEL FRAMING

PART 1 GENERAL

1.01 SUMMARY

- A. Provide structural steel:
 - 1. Columns.
 - 2. Beams.
 - 3. Shop priming and field painting.
 - 4. Auxiliary materials:
 - a. Direct tension indicators.
 - b. Electrodes for welding.
 - c. Structural steel primer.
 - d. Cement Grout:
 - 1) Portland cement, sand.
 - e. Nonmetallic shrinkage-resistant grout:
 - 1) Premixed nonmetallic grouting compound, CE CRD-C621.
- B. Furnish the following for other sections to install, including but not limited to:
 - 1. Embedments:
 - a. Anchor bolts.
- C. Perform the following:
 - 1. Touch-up primer paint.
 - 2. Finish paint.
- D. The following is not included:
 - 1. Lintels not attached to the structural steel frame.
- E. Related Sections:
 - 1. Section 03 30 00 - Cast-in-Place Concrete
 - 2. Section 04 20 00 - Unit Masonry Assemblies
 - 3. Section 09 91 50 - Shop Painting

1.02 REFERENCES

- A. AISC:
 - 1. Code of Standard Practice for Steel Buildings and Bridges
 - 2. Specifications for the Design, Fabrication, and Erection of Structural Steel for Buildings, including Commentary" and Supplements
 - 3. Specifications for Structural Joints using ASTM A325 or A490 Bolts, approved by Research Council on Riveted and Bolted Structural Joints of the Engineering Foundation
- B. ASTM:
 - 1. A6 - General Requirements for Delivery of Rolled Steel Plates, Shapes, Sheet Piling, and Bars for Structural Use
 - 2. A36 - Carbon Structural Steel
 - 3. A53 - Pipe, Steel, Black, Hot Dipped, Zinc Coated, Welded, Seamless
 - 4. A148 - High Strength Steel Castings, Carbon, Structural
 - 5. A307 - Carbon Steel Bolts and Studs
 - 6. A325 - Structural Bolts, Steel, Heat Treated
 - 7. A490 - Structural Bolts, Alloy Steel, Heat Treated
 - 8. A500 - Cold-Formed, Welded and Seamless Carbon Steel Structural Tubing
 - 9. A501 - Hot-Formed, Welded and Seamless Carbon Steel Structural Tubing
 - 10. A992 - Structural Steel Shapes

- C. AWS:
 - 1. D1.1 - Structural Welding Code
 - 2. Standard Qualification Procedure

1.03 DEFINITIONS

- A. Structural Steel Lintels: Lintels are included with structural steel only if attached to the structural steel frame.

1.04 SYSTEM DESCRIPTION

- A. Performance Requirements:
 - 1. Connections: Where connections are not detailed, provide details of connections to withstand loads indicated and comply with other information and restrictions indicated.
 - 2. Select and complete connections using AISC's Manual of Steel Construction: Load and Resistance Factor Design; Allowable Stress Design.
- B. Environmental Design Requirements:
 - 1. Use high-recycled-content steel.

1.05 SUBMITTALS

- A. Refer to Section 01 33 00.
- B. Product Data: Producer's or manufacturer's specifications and installation instructions for following products. Include laboratory test reports, other data to show compliance with specifications (including specified standards):
 - 1. Structural steel (each type), including certified copies of mill reports covering chemical and physical properties.
 - 2. High-strength bolts (each type), including nuts and washers.
 - 3. Structural steel primer paint.
- C. Shop Drawings:
 - 1. Prepare under supervision of Professional Engineer, registered in the state in which Project is located.
 - 2. Include complete details, schedules for fabrication, assembly of structural steel members procedures and diagrams; details of cuts, connections, camber, holes, other data.
 - 3. Indicate welds by standard AWS symbols; show size, length, and type of weld.
 - 4. Provide setting drawings, templates, directions for installation of anchor bolts, other anchorages to be installed by others.

1.06 QUALITY ASSURANCE

- A. Codes and Standards:
 - 1. Comply with referenced standards, except as otherwise indicated.
 - 2. Delete following sentence of Paragraph 4.2.1 - Code of Standard Practice for Steel Buildings and Bridges: "This approval constitutes Owner's acceptance of all responsibility for design adequacy of any connections designed by fabricator as a part of preparation of these Shop Drawings."
- B. Conflicting Requirements: More stringent shall govern.
- C. Qualifications for Welding Work:
 - 1. Qualify welding processes, operators in accordance with AWS "Standard Qualification Procedure".
 - 2. Provide certification that welders have satisfactorily passed AWS qualification tests.
 - 3. If recertification of welders is required, retesting will be Contractor's responsibility.
- D. Surveys:
 - 1. Owner may employ services of registered Professional Engineer or land surveyor to verify tolerance compliance.
 - 2. If out of compliance, Contractor responsible for payment.

1.07 DELIVERY, STORAGE & HANDLING

- A. Delivery: Ensure uninterrupted progress of work.
- B. Storage:
 - 1. Permit easy access for inspection and identification.
 - 2. Keep steel members off ground, using pallets, platforms, or other supports.
- C. Protection:
 - 1. Protect steel members, packaged materials from erosion and deterioration.
 - 2. Do not store materials on structure in manner that might cause distortion or damage to members or supporting structures.
- D. Damaged Materials or Structures: Repair or replace as directed.

1.08 PROJECT CONDITIONS

- A. Drawings do not purport to show actual field dimensions, but are intended only to establish location and scope of Work. Field-verify dimensions and assume full responsibility for their accuracy.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Acceptable Manufacturers: Subject to compliance with specified requirements, acceptable manufacturers and products are:
 - 1. Non-shrink Nonmetallic Grouts:
 - a. *Bonsal Construction Grout* by W. R. Bonsal Company www.bonsal.com
 - b. *Hi-Flow Grout* by Euclid Chemical Company www.euclidchemical.com
 - c. *Kemset* by ChemMasters Corporation www.chemmasters.net
 - d. *Crystex* by L & M Construction Chemicals, Inc www.lmcc.com
 - e. *Masterflow 713* by Unicon of BASF www.unicon.ca
 - f. *SonogROUT* by BASF www.basfbuildingsystems.com
 - 2. Manufacturer of comparable products submitted in compliance with Section 01 25 13.

2.02 MATERIALS

- A. General:
 - 1. Materials to be smooth and free of surface blemishes, including pitting, seam marks, roller marks, rolled trade names, and roughness.
 - 2. Remove blemishes by grinding, or by welding and grinding, prior to cleaning, treating, and application of surface finishes.
- B. Wide Flange Shapes and Structural Tees cut from wide flanges: ASTM 992.
- C. Steel Pipe: ASTM A53, Grade B.
- D. Cold-form Steel Tubing: ASTM A500, Grade B.
- E. All Other Structural Steel Shapes, Plates, and Bars: ASTM A36.
- F. Anchor Bolts: ASTM A307, non-headed type unless otherwise indicated.
- G. Epoxy Adhesive Anchors:
 - 1. Hilti: HY 200 Injection Adhesive Anchors, Hilti HVA Adhesive Anchor, Hilti HIT 70 Masonry Anchor, or approved equal.
 - 2. If the embedment length is not shown on the Drawings, provide the embedment length recommended by the manufacturer to develop the full allowable strength of the bolt.

- H. Unfinished Threaded Fasteners:
 1. ASTM A307, Grade A. Use only where explicitly called for.
 2. Regular low-carbon steel bolts and nuts.
 3. Provide hexagonal heads and nuts for all connections.

- I. High-strength Threaded Fasteners:
 1. Heavy hexagon structural bolts, heavy hexagon nuts, hardened washers.
 2. Quenched and tempered medium carbon steel bolts, nuts, and washers.
 3. Comply with ASTM A325.
 4. Direct tension indicator washers may be used.

- J. Electrodes for Welding: Comply with AWS.

- K. Non-metallic Shrinkage-resistant Grout:
 1. Pre-mixed, non-metallic, non-corrosive, non-staining.
 2. Containing selected silica sands, portland cement, shrinkage compensating agents, plasticizing and water reducing agents.
 3. Comply with CRD-C621.
 4. Subject to compliance with requirements, products may include, but are not limited to:
 - a. *Euco N.S.*; Euclid Chemical Co.
 - b. *Crystex*; L&M Construction
 - c. Chemicals Masterflow 713; Master Builders
 - d. *Upcon*; Upco Chemical Division, USM Corporation.

2.03 FABRICATION

- A. Shop Fabrication and Assembly:
 1. Fabricate and assemble structural assemblies in shop to greatest extent possible in accordance with AISC Specifications and as indicated on final Shop Drawings.
 2. Provide camber in structural members where indicated.
 3. Where finishing is required, complete assembly, including welding of units, before start of finishing operations.
 4. Provide finish surfaces of members exposed in final structure free of markings, burrs, and other defects.

- B. Marking and Delivery:
 1. Mark and match-mark materials for field assembly.
 2. Fabricate for delivery sequence that will expedite erection and minimize field handling of materials.

- C. Connections:
 1. Shop connections: Weld or bolt as indicated.
 2. Field connections: Bolt, except where welded connections or other connections are indicated.
 3. Principal bolted connections: Provide high-strength threaded fasteners except where unfinished bolts are indicated.
 4. Bolted connections of secondary framing members to primary members. Provide high-strength threaded fasteners except where unfinished bolts are indicated.
 5. Temporary bracing: Provide unfinished threaded fasteners.

- D. High-Strength Bolted Construction:
 1. Install in accordance with AISC "Specifications for Structural Joints using ASTM A325 or A490 Bolts."

- E. Welded Construction: Comply with AWS Code for procedures, appearance, quality of welds, and methods used in correcting welding work.

- F. Holes for Other Work:
 1. Provide holes required for securing other work to structural steel framing, and for passage of other work through steel framing members, as shown on final Shop Drawings.
 2. Provide threaded nuts welded to framing, other specialty items as indicated to receive other work.
 3. Cut, drill, or punch holes perpendicular to metal surfaces.

4. Do not flame cut holes or enlarge holes by burning.
5. Drill holes in bearing plates.

2.04 SHOP PAINTING

- A. General Requirements:
 1. Shop paint structural steel, except:
 - a. Members or portions of members to be embedded in concrete or mortar.
 - b. Members to receive fireproofing.
 2. Paint embedded steel that is partially exposed on exposed portions and initial 2 inches of embedded areas only.
 3. Apply top coats to surfaces that are inaccessible after assembly or erection. Change color of each coat to distinguish it from the previous coat.
- B. Materials:
 1. Refer to Section 09 91 50.
 2. Members to receive fireproofing: Primer approved by fireproofing or intumescent paint manufacturer in compliance with UL or FM assemblies.
- C. Painted items shall be fully dry before handling or shipping.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Work of Other Trades: Prior to commencing work, carefully inspect and verify that work is complete to point where this installation may properly commence.
- B. Verification of Conditions: Verify that Structural Steel may be installed in accordance with original design, pertinent codes and regulations, and pertinent portions of referenced standards.
- C. Discrepancies: Immediately notify Engineer. Do not proceed with installation in areas of discrepancy until fully resolved. Commencement of installation signifies acceptance of surface conditions.

3.02 PREPARATION

- A. Protection: Protect installed work and materials of other trades.

3.03 ERECTION

- A. Surveys:
 1. Employ registered Professional Engineer or land surveyor for accurate erection of structural steel if deemed necessary.
 2. Check elevations of concrete and masonry bearing surfaces, and locations of anchor bolts and similar devices, before erection work proceeds, and report discrepancies to Engineer.
 3. Do not proceed with erection until corrections have been made, or compensating adjustments to structural steel work have been agreed upon with Engineer.
- B. Temporary Shoring and Bracing:
 1. Provide connections of sufficient strength to bear imposed loads. Remove when permanent members are in place and final connections are made.
 2. Provide temporary guy lines to achieve proper alignment of structures as erection proceeds. Provide temporary planking and working platforms as necessary to effectively complete work.
- C. Anchor Bolts:
 1. Anchor bolts and other connectors: As required for securing structural steel to foundations and other in-place work.
 2. Templates and other devices: As necessary for presetting bolts and other anchors to accurate locations.

3. Refer to Division 3 for anchor bolt installation requirements in concrete, and Division 4 for masonry installation.
- D. Setting Bearing Plates:
1. Clean concrete and masonry bearing surfaces of bond-reducing materials and roughen to improve bond to surfaces. Clean bottom surface of base and bearing plates.
 2. Set loose and attached base plates and bearing plates for structural members on wedges or other adjusting devices.
 3. Tighten anchor bolts after supported members have been positioned and plumbed.
 4. Do not remove wedges or shims, but if protruding, cut off flush with edge of base or bearing plate prior to packing with grout.
 5. Pack grout solidly between bearing surfaces and bases or plates to ensure that no voids remain.
 6. Finish exposed surfaces, protect installed materials, and allow to cure.
 7. Comply with grout manufacturer's instructions.
- E. Field Assembly:
1. General requirements: Set structural frames accurately to lines and elevations indicated. Align and adjust various members forming part of complete frame or structure before permanently fastening. Clean bearing surfaces and other surfaces which will be in permanent contact before assembly. Perform necessary adjustments to compensate for discrepancies in elevation and alignment.
 2. Level and plumb individual members of structure within specified AISC tolerances.
 3. Establish required leveling and plumbing measurements on mean operating temperature of structure. Allow for difference between temperature at time of erection and mean temperature at which structure will be when completed and in service.
 4. Splice members only where indicated and accepted on Shop Drawings.
- F. Erection Bolts: On exposed welded construction, remove erection bolts, fill holes with plug welds, grind smooth at exposed surfaces.
1. Comply with AISC Specifications for bearing, adequacy of temporary connections, alignment, removal of paint on surfaces adjacent to field welds.
 2. Do not enlarge unfair holes in members by burning or by use of drift pins, except in secondary bracing members. Ream holes that must be enlarged to admit bolts.
- G. Gas Cutting:
1. Do not use gas cutting torches in field for correcting fabrication errors in primary structural framing.
 2. Cutting permitted only on secondary members that are not under stress, as acceptable to Engineer.
 3. Finish gas-cut sections equal to sheared appearance when permitted.

3.04 REPAIR/RESTORATION

- A. Touch-up Painting:
1. Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint.
 2. Apply paint to exposed areas using same material as used for shop painting, by brush or spray to provide minimum dry film thickness of 1.5 mils.
 3. Touch up marred finishes.
 4. Verify paint for areas to be fireproofed.

3.05 FIELD QUALITY CONTROL

- A. Special Inspections: Comply with requirements of Section 01 45 00 or 01 45 10.

3.06 ADJUSTING

- A. Replace damaged materials with new materials complying with specified requirements.

3.07 CLEANING

- A. Site: Do not allow accumulation of scraps, debris arising from work of this section. Maintain premises in neat, orderly condition.
- B. Other Work:
 - 1. Remove temporary covering and other provisions made to minimize soiling of other work.
 - 2. Promptly clean surfaces soiled by this section, repair surfaces stained, marred or otherwise damaged during work.
- C. Structural Steel:
 - 1. Clean exposed surfaces of structural steel using materials and methods recommended by manufacturer.
 - 2. When work is completed, remove unused materials, containers, equipment, and debris.
 - 3. Collect offcuts and scrap and place in designated areas for recycling.

3.08 PROTECTION

- A. Provide final protection and maintain conditions, in a manner acceptable to manufacturer to ensure work is without damage or deterioration at time of Substantial Completion.

END OF SECTION

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SECTION 06 10 00 - ROUGH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes

1. Wood framing.
2. Wood grounds, nailers, and blocking.
3. Wood furring.
4. Rough hardware items in conjunction with carpentry work such as bolts, washers, straps, hangers, stirrups, anchors, etc.
5. Temporary enclosures and protection.

1.2 REFERENCES

A. Standards:

1. APA - American Plywood Association
 - a. "APA Product Guide - Grades & Specifications"
 - b. "APA Design/Construction Guide - Residential & Commercial"
2. AWPA - American Wood Preservers Association
3. NFPA - National Forest Products Association
 - a. "National Design Specification for Wood Construction"
 - b. "Manual for Wood Frame Construction"
4. PS1 - US Product Standard for Construction and Industrial Plywood
5. PS 20 - American Softwood Lumber Standard

1.3 SUBMITTALS

- A. Wood Preservative Treatment: Submit data for wood preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative treated.
- B. Certification: Treatment process and product shall meet EPA regulations for environmental exposure and OSHA regulations for worker exposure.

1.4 QUALITY ASSURANCE

- A. Rough carpentry lumber shall be grade stamped by an agency certified by the Board of Review of the American Lumber Standards Committee and manufactured in accordance with Product Standard PS 20-70, as published by the Department of Commerce.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Keep carpentry materials dry during delivery. Store lumber and plywood in stacks with provision for air circulation within stacks. Protect bottom of stacks against contact with damp or wet surfaces, and protect exposed materials against weather.

- B. Do not store dressed or treated lumber or plywood outdoors.
- C. Immediately upon delivery to job site, place materials in area protected from weather.
- D. Store materials a minimum of 6 inches above ground on framework or blocking and cover with protective waterproof covering providing for adequate air circulation or ventilation.
- E. Do not store seasoned materials in wet or damp portions of the building.

1.6 PROJECT CONDITIONS

- A. Coordination: Fit carpentry work to other work; scribe and cope as required for accurate fit. Correlate location of furring, nailers, blocking, grounds and similar supports to allow attachment of other work.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

- A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.
- B. Factory mark each piece of lumber with grade stamp of grading agency.
 - 1. For exposed lumber indicated to receive a stained or natural finish, mark grade stamp on end or back of each piece or omit grade stamp and provide certificates of grade compliance issued by grading agency.
- C. Maximum Moisture Content of Lumber: 19 percent for 2-inch nominal thickness or less, no limit for more than 2-inch nominal thickness unless otherwise indicated.

2.2 WOOD-PRESERVATIVE-TREATED MATERIALS

- A. Preservative Treatment by Pressure Process: Where lumber or plywood is indicated on Drawings as treated, or is specified herein to be treated, comply with applicable requirements of AWWA U1. Use Category UC2 for interior construction not in contact with the ground, use Category UC3b for exterior construction not in contact with the ground, and use Category UC4a for items in contact with the ground.
- B. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.
 - 1. Kiln-dry lumber and plywood after treatment to a maximum moisture content of 19 percent and 15 percent respectively. Do not use material that is warped or that does not comply with requirements for untreated material.
 - 2. Mark lumber and plywood with treatment quality mark of an inspection agency approved by the ALSC Board of Review.

- C. Application: Treat items indicated on Drawings, and the following:
 - 1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with flashing and waterproofing.
 - 2. Wood sills, sleepers, blocking, furring, and similar concealed members in contact with masonry or concrete.
 - 3. Plywood in contact with masonry or concrete or used with flashing and waterproofing.

2.3 LUMBER MATERIALS

- A. Blocking: Standard grade Pine, Fir or equivalent, suitable for pressure treatment.

2.4 SHEET MATERIALS

- A. Plywood Wall Sheathing: APA Rated Sheathing, Exterior, 5/8-inch thick, [fire-retardant-treated].
- B. Plywood Roof Sheathing: APA Rated Sheathing, Exterior, 5/8-inch thick. Provide "H" clips.

2.5 MISCELLANEOUS MATERIALS

- A. Rough Hardware:
 - 1. General: Provide commercial quality and type of rough hardware as required to securely hold all wood members in place in accordance with NFPA National Design Specifications.
 - 2. Nails, Spikes, and Staples: Hot dipped galvanized complying with ASTM A 153 for exterior locations, high humidity locations, and treated wood; plain finish for other interior locations; size and type to suit application.
 - 3. Bolts, Nuts, Washers, Lags, Pins, and Screws: Provide type and size to suit application with finish as follows:
 - a. Interior Locations: Plain finish.
 - b. Exterior Locations, High Humidity Locations, and Treated Wood: Corrosion resistant coated fasteners.
- B. Fasteners: Toggle bolt type for anchorage to hollow masonry, expansion shield and lag bolt type for anchorage to solid masonry and concrete, bolts or power activated type for anchorage to steel.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General:
 - 1. Discard units of material with defects which might impair quality of work, and units which are too small to use in fabricating work with minimum joints or optimum joint arrangement.
 - 2. Set carpentry work to required levels and lines, with members plumb and true to line and cut and fitted.

3. Securely attach carpentry work to substrate by anchoring and fastening as shown and as required by recognized standards.
 4. Select fasteners of size that will not penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting of wood; predrill as required.
- B. Wood Grounds, Nailers, and Blocking:
1. Provide wherever shown and where required for attachment of other work. Form to shapes as shown and cut as required for true line and level of work to be attached. Coordinate location with other work involved.
 2. Attach to substrates as required to support applied loading. Countersink bolts and nuts flush with surfaces, unless otherwise indicated. Build into masonry during installation of masonry work.
 3. Attach perimeter roof edge wood nailers to structure with suitable fasteners to meet fascia and coping performance design criteria specified in Section 07 71 00.
- C. Wood Furring:
1. Install plumb and level with closure strips at edges and openings. Shim with wood as required for tolerance of finished work.

3.2 TEMPORARY ENCLOSURES

- A. This Section Contractor shall take general charge of furnishing, erecting, keeping in good repair and removal of all necessary temporary guard rails, barricades, pedestrian walkways, temporary ladders, building enclosures and partitions (including temporary wood doors hung on temporary wood bucks at exterior door entrances, doors to be locked with heavy padlocks) and all other necessary temporary enclosures as required as the work progresses.

End of Section

SECTION 06 40 00 - ARCHITECTURAL WOODWORK

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Solid Surface Window Sills.
- B. Related work and requirements
 - 1. Section 06 10 00: Rough Carpentry: Grounds and support framing.

1.2 SUBMITTALS

- A. Product Data: Submit for each type of product and process specified and incorporated into items of architectural woodwork during fabrication, finishing, and installation.
- B. Shop Drawings: Submit in conformance with the requirements of the Architectural Woodwork Standards.
- C. Samples: Submit the following samples:
 - 1. Solid surface material, 8-inch x 8-inch for each type, color, and edge detail.

1.3 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver until painting, wet work, grinding and similar operations that could damage, soil or deteriorate the work have been completed in installation areas. If sills must be stored in other than installation areas, store only in areas meeting requirements specified for installation areas.

1.4 PROJECT CONDITIONS

- A. Do not install sills until indoor temperature and humidity are within the range recommended by the "Architectural Woodwork Standards" for the location of the Project and will be maintained in installation and storage areas.
- B. Field Measurements: Where sills are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
- C. Established Dimensions: Where architectural woodwork is indicated to fit to other construction, establish dimensions for areas where architectural woodwork is to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Fasteners and Anchorages: Provide all nails, screws, bolts, nuts, washers, and other anchoring devices of the type, size, material, and finish required for application indicated to provide secure attachment, concealed where possible, and complying with applicable Federal Specifications.

2.2 ARCHITECTURAL SILLS

- A. Quality Standards: Comply with AWS Section 11 - Countertops.
- B. Solid Surface window sills:
- C. Grade: Custom.
- D. Material: Homogeneous solid sheets of filled plastic resin complying with the material and performance requirements of ANSI Z124.3, Type 5 or Type 6, without a precoated finish.
 - 1. Thickness: 1/2-inch thick unless otherwise noted.
 - 2. Color: As noted in Room Finish Symbols Legend.
- E. Front Edge: Waterfall unless otherwise indicated on Drawings.
- F. Back Splash: Applied butt joint; 4-inches high unless otherwise indicated on Drawings. Provide square top at splash.
- G. Products: Subject to compliance with requirements, provide one of the following:
 - 1. Wilsonart
 - 2. Avonite
 - 3. Corian; DuPont Polymers
 - 4. Gibraltar; Ralph Wilson Plastics Company
 - 5. Hi-Macs
 - 6. Meganite, Inc.
 - 7. Romanite

2.3 FABRICATION

- A. General:
 - 1. Fabricate work to dimensions, profiles, and details indicated on drawings.
 - 2. Measurements: Before proceeding with fabrication of work required to be fitted to other construction, obtain field measurements and verify dimensions and shop drawing details as required for accurate fit.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install work plumb, level, true and straight with no distortions. Shim as required using concealed shims. Install to a tolerance of 1/8-inch in 8-feet for plumb and level (including tops); and with no variations in flushness of adjoining surfaces.
- B. Scribe and cut work to fit adjoining work, leaving gaps of 1/32-inch maximum, and refinish cut surfaces or repair damaged finish at cuts. Do not use additional overlay trim for this purpose.
- C. Anchor work to anchors or blocking built-in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with woodwork.
- D. Sills: Anchor securely to base units and other support systems as required. Caulk space between sill and adjoining surfaces with sealant.

3.2 CLEANING, ADJUSTMENT, AND PROTECTION

- A. Cleaning: Clean all work of this Section prior to acceptance by Owner. Repair damaged and defective work where possible to eliminate defects functionally and visually. Where not possible to repair, replace at no cost to Owner. Adjust joinery for uniform appearance.
- B. Protection: Protect all work of this Section until acceptance by Owner. Advise Prime Contractor of final protection and maintained conditions necessary to ensure that architectural woodwork will be without damage or deterioration at time of acceptance.

End of Section

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SECTION 07 21 00 - THERMAL INSULATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes
 - 1. Building insulation.
 - 2. Accessories.
- B. Related work and requirements
 - 1. Section 04 20 00: Unit Masonry (for CMU insulation)
 - 2. Section 07 24 13: Polymer-Based Exterior Insulation and Finish System
 - 3. Section 07 53 00: Elastic Membrane Roofing; roof insulation

1.2 SUBMITTALS

- A. Product Data: Submit manufacturer's product data and installation instructions for each product specified.

1.3 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Protection from Deterioration: Do not allow insulation materials to become wet or soiled, or covered with ice or snow. Comply with manufacturer's recommendations for handling, storage, and protection during installation.

PART 2 - PART TWO - PRODUCTS

2.1 MATERIALS

- A. General: Provide insulating materials that comply with requirements indicated for materials, compliance with referenced standards, and other characteristics.
- B. Preformed Units: Sizes to fit applications indicated, selected from manufacturer's standard thicknesses, widths and lengths.
- C. Extruded Polystyrene Board Insulation:
 - 1. Rigid, cellular thermal insulation with closed-cells and integral high density skin, complying with ASTM C 578, of type, minimum compressive strength, and minimum 5 year aged R-value per inch thickness at 75 degrees F (23.9 degrees C) indicated below, with maximum flame-spread and smoke-developed indexes of 25 and 450, respectively, per ASTM E 84.
 - a. Below Grade and Under Floors: Type IV, 1.55 pcf minimum density, R-5.0.
 - b. Under Concrete Slabs and Vegetated Roofing: Type VII, 2.20 pcf minimum density, R-5.0.
 - 2. Manufacturers: Subject to compliance with requirements, provide rigid board insulation products from one of the following:

- a. The Dow Chemical Company
 - b. DiversiFoam Products
 - c. Owens Corning
 - d. Pactiv Building Products
- D. Mineral Wool Board Insulation:
- 1. Unfaced, Mineral Wool Board Insulation: ASTM C 612, Type II; with maximum flame spread and smoke developed indexes of zero per ASTM E 84; passing ASTM E 136 for combustion characteristics.
 - 2. In Cavities of Exterior Walls: Nominal density of 6 pcf, R-4.2 per inch thickness at 75 degrees F.
 - 3. Basis-of-Design Product: Subject to compliance with requirements, provide Thermafiber; RainBarrier HD insulation or an equivalent product by, but not limited to, the following:
 - a. Roxul, Inc.
- E. Polyisocyanurate Board Insulation:
- 1. Rigid, cellular thermal insulation with polyisocyanurate closed-cell foam core and glass fiber mat facer laminated to both sides; complying with ASTM C 1289-13e1, Type II, Class 1, Grade 2; Long Term Thermal Resistance (LTTR) value of 5.6 for one inch thickness.
 - 2. Manufacturers: Subject to compliance with requirements, provide rigid board insulation products from one of the following:
 - a. Johns Manville
 - b. Atlas Roofing Corp.
 - c. Firestone Building Products

2.2 ACCESSORIES

- A. Sill Sealer: Equivalent to Dow Styrofoam Sill Seal, selected from manufacturer's standard widths to suit width of sill members indicated.
- B. Insulation Furring System: Equivalent to CertiStud extruded polystyrene insulation with built-in furring studs and shiplap edges as manufactured by DiversiFoam Products.
- C. Mechanical Anchors: Type and size as recommended by insulation manufacturer for type of application and condition of substrate.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Examine the substrate and the conditions under which the insulation work is to be performed. Notify the Prime Contractor of any unsatisfactory conditions and do not proceed with the insulation work until unsatisfactory conditions have been corrected.
- B. Remove all fins, projections, dirt, etc., from substrate prior to installing rigid board insulation.

3.2 INSTALLATION

A. General:

1. Comply with manufacturer's instructions for particular conditions of installation in each case. If printed instructions are not available or do not apply to project conditions, consult manufacturer's technical representative for specific recommendations before proceeding with work.
2. Extend insulation full thickness as shown over entire area to be insulated. Cut and fit tightly around obstructions, and fill voids with insulation. Remove projections that interfere with placement.
3. Tightly butt all insulation joints with vertical joints staggered. Fill voids in completed installation with adhesive, mastic, or foam sealant as recommended by insulation manufacturer.
4. Apply a single layer of insulation of required thickness, unless otherwise indicated or required to make up total thickness.
5. Apply insulation materials to substrate by method indicated, complying with manufacturer's recommendations. If no specific method is indicated, bond insulation materials to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units.
6. Perimeter Insulation: Set rigid board insulation in adhesive applied on inside face of the exterior foundation wall vertical surfaces a minimum of 48 inches, unless otherwise indicated. Use type of adhesive recommended by manufacturer of insulation.

- B. Roof Insulation: Furnish polyisocyanurate board insulation to Section 06 10 00 contractor for installation under metal roofing.

3.3 PROTECTION

- A. Protect installed insulation and vapor retarders from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation and vapor retarders are subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

End of Section

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SECTION 07 24 23 - EXTERIOR FINISH SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Extent of exterior finish system is indicated on Drawings.
- B. Related work and requirements
 - 1. Section 07 92 00: Joint Sealants

1.2 SUBMITTALS

- A. Product Data: Submit manufacturer's technical data for each component of exterior finish system.
- B. Samples:
 - 1. Submit manufacturer's standard color charts and small scale samples indicating textural choices available for initial selection purposes. Upon request, submit 2-foot square samples for each finish, color, and texture selected by A/E.
 - 2. Submit sealant manufacturer's standard bead samples consisting of strips of actual products showing full range of colors available.
 - 3. Sealant Compatibility and Test Report: Submit test report from sealant manufacturer certifying that materials forming joint substrates of system have been tested for compatibility and adhesion with joint sealants; include sealant manufacturer's interpretation of results relative to sealant performance and recommendations for primers and substrate preparation needed to obtain adhesion.
 - 4. Installer Qualification: Submit data for firms and persons specified in "Quality Assurance" article to demonstrate their capabilities and experience. Include list of completed projects with project names, addresses, names of Architects and Owners, including installer certificates signed by system manufacturer.

1.3 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Member in good standing of the EIFS Industry Member Association (EIMA), regularly engaged in manufacturing products for system indicated and with at least 5 years successful experience in applications similar to that required for this Project.
- B. Installer Qualifications: Member in good standing of the EIFS Industry Members Association (EIMA) with a minimum of 5 years experience and who has completed systems similar in material, design, and extent to that indicated for this project that have resulted in construction with a record of successful in service performance, and certified in writing by system manufacturer as qualified to install manufacturer's system.
- C. Single Source Responsibility: Obtain materials for system from either a single manufacturer or manufacturers approved by the system manufacturer as compatible with other system components.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products in original, unopened packages and containers with manufacturer's labels identifying products legible and intact.
- B. Store materials inside and under cover; keep them dry, protected from the weather, direct sunlight, surface contamination, aging, corrosion, damaging temperatures, damage from construction traffic, and other causes.

1.5 PROJECT CONDITIONS

- A. Environmental Conditions: Do not install system when ambient outdoor temperatures are 40 deg. F (4 deg. C) and falling unless temporary protection and heat are provided to maintain ambient temperatures above 40 deg. F (4 deg. C) during installation of wet materials and for 24 hours after installation or longer to allow them to become thoroughly dry and weather resistant.

1.6 GUARANTEE

- A. Guarantee completed system to be free of defects in workmanship and materials for a period of five (5) years after Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Parex, Inc.; ACF for Soffits or an equivalent system by one of the following:
 - 1. Dryvit Systems, Inc.
 - 2. Senergy, Inc.
 - 3. Sto Corp.
 - 4. Tec Incorporated, an H.B. Fuller Co.

2.2 MATERIALS

- A. General: Provide reinforcing fabrics, base and finish coat materials, sealants, and accessories that are compatible with one another and approved for use by system manufacturer.
- B. Reinforcing Fabric: Balanced, alkali-resistant open weave glass fiber fabric treated for compatibility with other system materials; made from continuous multi-end strands with tensile strength of not less than 145 lbs. and 150 lbs. in warp and fill directions, respectively, per ASTM D 1682 and complying with ASTM D 578 and the following requirements for minimum weight:
 - 1. Standard Reinforcing Fabric: 4.5 oz. per sq. yd., coated for protection against alkali, equivalent to Parex 355 Standard Mesh.
 - 2. Detail Reinforcing Fabric: 4.5 oz. per sq. yd., equivalent to Parex 356 Short Detail Mesh used for back wrapping and details and to embed in base coat at joints in exterior gypsum sheathing.

- C. Base Coat Materials: System manufacturer's standard job-mixed formulation of portland cement complying with ASTM C150, Type I, white, and system manufacturer's standard acrylic polymer base equivalent to Parex 121 Base Coat.
- D. Primer: System manufacturer's standard factory-mixed, elastomeric-polymer primer for preparing base-coat surface for application of finish coat equivalent to Parex 310 Primer.
- E. Finish Coat Materials: System manufacturer's standard factory-mixed formulation of 100 percent acrylic polymer emulsion admixture, colorfast mineral pigments, sound stone particles, and fillers equivalent to Parex DPR Optimum Finish.
 - 1. Stone Particle Size: 1.0 mm
 - 2. Finish and Texture: Match A/E's sample.
 - 3. Colors: As selected by A/E from manufacturer's full range.
- F. Water: Clean and potable.
- G. Trim Accessories: Control joints, expansion joints, corner beads, casing beads, etc. as required to suit conditions indicated and comply with system manufacturer's requirements; manufactured from vinyl; coordinate depth of accessories with thickness of base and finish coats required.
- H. Soffit Vents: Type DRM-50-V-200 with clear anodized finish as manufactured by Fry Reglet Corp., or equivalent.
- I. Sealant: Multi-part nonsag urethane sealant compatible with sealant backing materials, joint substrates, and other related materials. Equivalent to Tremco DyMeric 240FC.
 - 1. Sealant Colors: As selected by A/E from manufacturer's color chart of not less than 30 colors.
- J. Sealant Primer and Backing Materials: Provide primer and backing materials for use and application per sealant manufacturer's requirements as specified in Section 07 92 00.

2.3 MIXING

- A. General: Comply with system manufacturer's requirements for combining and mixing materials. Do not introduce admixtures, water, or other materials except as approved by system manufacturer. Mix materials in clean containers. Use materials within time period specified by system manufacturer or discard.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Examine substrates and conditions to determine if they are in satisfactory condition for installation of system. Notify Prime Contractor and do not proceed with installation of system until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Protect contiguous work from moisture deterioration and soiling resulting from application of systems. Provide temporary covering and other protection needed to prevent spattering of exterior finish coatings on other work.
- B. Protect system, substrates, and wall construction behind them from inclement weather during installation. Prevent infiltration of moisture behind system and deterioration of substrates.
- C. Substrate Preparation: Prepare and clean substrates to comply with system manufacturer's requirements to obtain optimum bond between substrates and finish coatings.

3.3 INSTALLATION

- A. General: Comply with system manufacturer's current published instructions for installation of system as applicable to each type of substrate indicated.
- B. Trim Accessories:
 - 1. Install expansion joints at locations where expansion and control joints occur in surface of construction directly behind sheathing and at locations required by system manufacturer and approved by A/E.
 - 2. Install control joints at locations indicated, or if not indicated, at locations required by system manufacturer and approved by A/E.
 - 3. Install soffit vents and trim accessories at locations required by system manufacturer and approved by A/E. Mechanically fasten accessories to substrates.
- C. Base Coat: Apply base coat to exposed surfaces of gypsum sheathing in thickness required by system manufacturer.
- D. Reinforcing Fabric: Embed reinforcing fabric of type indicated below in wet base coat to produce wrinkle-free installation with fabric continuous or lapped at corners and lapped or otherwise treated at joints to comply with system manufacturer's requirements. Apply second base coat in same manner as first application, except without reinforcing fabric, so that reinforcing fabric is completely embedded. Do not apply second base coat until first base coat has cured a minimum of 24 hours.
 - 1. Standard reinforcing fabric unless otherwise indicated.
 - 2. Embed strip reinforcing fabric in base coat before applying first layer of reinforcing fabric.
- E. Primer: Apply over dry base coat according to system manufacturer's written instructions.
- F. Finish Coat: Apply finish coat over dry primed base coat, maintaining a wet edge at all times for uniform appearance, in thickness required by system manufacturer to produce a uniform finish of texture and color matching approved sample and free of cold joints, shadow lines, and texture variations.
- G. Sealant: Prepare joints and apply sealants in accordance with applicable requirements specified in Section 07 92 00.

3.4 CLEANING AND PROTECTION

- A. Remove temporary covering and protection of other work. Promptly remove protective coatings from window and door frames, and any other surfaces outside areas indicated to receive protective coating. Clean splatters and droppings from all work and adjacent surfaces.
- B. Provide final protection and maintain conditions in a manner acceptable to Installer and system manufacturer, which ensure system being without damage or deterioration at time of Substantial Completion.

End of Section

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SECTION 07 53 00 - ELASTOMERIC MEMBRANE ROOFING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes
 - 1. Loosely laid and ballasted single ply elastic sheet membrane roofing system.
 - 2. Substrate boards.
 - 3. Roof insulation.
 - 4. Roofing accessories.
- B. Related work and requirements
 - 1. Section 06 10 00: Rough Carpentry
 - 2. Section 07 71 00: Roof Specialties

1.2 DEFINITIONS

- A. Roofing Terminology: Refer to ASTM D 1079 and glossary of NRCA's "The NRCA Roofing and Waterproofing Manual" for definition of terms related to membrane roofing.

1.3 PERFORMANCE REQUIREMENTS

- A. General Performance: Installed membrane roofing and base flashings shall withstand basic wind speed, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Membrane roofing and base flashings shall remain watertight.
- B. Material Compatibility: Provide roofing materials that are compatible with one another under conditions of service and application required, as demonstrated by membrane roofing manufacturer based on testing and field experience.

1.4 SUBMITTALS

- A. Product Data: For each type of product required for the roofing work.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 - 1. Roof edge details, location and type of all roof penetration flashing details, and other details required for proper roof system installation.
 - 2. Insulation type and thickness.
 - 3. Tapered insulation, including slopes.
 - 4. Crickets, saddles, and tapered edge strips, including slopes.
- C. Qualification Data: For qualified Installer and manufacturer.
- D. Product Test Reports: Based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, for components of membrane roofing system.

- E. Maintenance Data: Two copies of bound manual containing manufacturer's approved emergency repair procedures and materials, maintenance procedures, and customer service information.
- F. Warranties: Sample of warranties specified in this Section.
- G. Inspection Report: Two copies of roofing system manufacturer's inspection report of completed roofing installation.
- H. Preinstallation Conference: Submit two copies of minutes of the conference.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A qualified manufacturer that is UL listed or FM Approvals approved for membrane roofing system identical to that used for this Project.
- B. Installer Qualifications: A qualified firm that is approved, authorized, or licensed by membrane roofing system manufacturer to install manufacturer's product; fully responsible for all Work of this Section and related Work of Section 07 71 00; and that is eligible to receive manufacturer's warranty.
- C. Source Limitations: Obtain components for membrane roofing system from same manufacturer as membrane roofing.
- D. Exterior Fire-Test Exposure: ASTM E 108 or UL 790, Class A; for application and roof slopes indicated, as determined by testing identical membrane roofing materials by UL, FM Global, or another qualified testing agency acceptable to authorities having jurisdiction. Identify products with appropriate markings of applicable testing agency.
- E. Requirements of Regulatory Agencies: State of Wisconsin Commercial Building Code, Current Edition.
- F. Rigid Foamed Plastic Insulation: Classified, tested, and rated by a Wisconsin Department of Safety and Professional Services – Safety and Buildings Division approved testing laboratory for use intended, compatible with membrane and approved by membrane manufacturer.
- G. Preinstallation Conference: Prior to installation of roofing and associated work, meet at project site with Prime Contractor, Roofing Subcontractor and Foreman, manufacturer's representative, installers of related work, and other entities concerned with roofing performance. Inform Architect and Owner of scheduled meeting date. Purpose of the meeting will be to inspect substrate and roofing materials, review installation methods and recommendations, and address any questions. Prime Contractor shall provide at least 72 hours advance notice to participants prior to convening preinstallation conference and record significant conference discussions, agreements, and disagreements, including required corrective measures and actions. Distribute minutes of the conference to each party present and other parties requiring information.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver roofing materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, approval or listing agency markings, and directions for storing and mixing with other components.
- B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing manufacturer. Protect stored liquid material from direct sunlight. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.
- C. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.
- D. Handle and store roofing materials and place equipment in a manner to avoid permanent deflection of deck.

1.7 PROJECT CONDITIONS

- A. Weather: Proceed with roofing work when existing and forecasted weather conditions permit roofing to be installed according to manufacturer's written instructions and warranty requirements.

1.8 WARRANTY

- A. Roofing Manufacturer's Warranty: Manufacturer's standard form, without monetary limitation, signed by roofing system manufacturer agreeing to promptly repair or replace components of membrane roofing system that fail in materials or workmanship within specified warranty period.
- B. Warranty includes membrane roofing, base flashings, roof insulation, roofing accessories, and other components of membrane roofing system.

Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Carlisle SynTec Incorporated; "Sure-Seal Design "B" Loose-Laid Ballasted Roofing System" or equivalent system by one of the following:
 - 1. Firestone Industrial Products Co.
 - 2. Johns Manville Corporation
 - 3. Versico, Inc.

2.2 MATERIALS AND SYSTEM COMPONENTS

- A. Membrane: ASTM D 4637, Type I, non-reinforced, uniform, flexible ethylene-propylene-diene-monomer (EPDM) sheet, .060- inch thick. Color: Black.
- B. Flexible Flashing Material: Manufacturer's standard system compatible with roof membrane and to allow for expansion.
- C. Bonding Adhesive: As recommended by membrane manufacturer for particular substrate and project conditions, formulated to withstand uplift pressures indicated.
- D. Seaming Material: Single-component, butyl splicing adhesive and splice cleaner or manufacturer's standard, synthetic-rubber polymer primer and 3-inch wide minimum, butyl splice tape with release film.
- E. Lap Sealant: Manufacturer's standard, single-component sealant, color to match membrane roofing.
- F. Water Cutoff Mastic: Manufacturer's standard butyl mastic sealant.
- G. Metal Termination Bars: Manufacturer's standard, predrilled stainless-steel or aluminum bars, approximately 1-inch wide by 1/8-inch thick with caulk cup; with anchors.
- H. Compressible Tube: Closed cell polyethylene tube compatible with roof membrane, size to suit details on Drawings.
- I. Molded Pipe Flashing: Purpose-made molded pipe flashings for plumbing vents and other similar roof penetrations, compatible with materials with which it is used.
- J. Miscellaneous Accessories: Provide pourable sealers, preformed inside and outside corner sheet flashings, reinforced EPDM securement strips, T-joint covers, in-seam sealants, termination reglets, cover strips, and other accessories.

2.3 ROOF INSULATION

- A. General: Preformed roof insulation boards manufactured or approved by membrane roofing manufacturer, selected from manufacturer's standard sizes suitable for application, of thicknesses indicated.
 - 1. Type A: Rigid, cellular thermal insulation with polyisocyanurate closed-cell foam core and glass fiber mat facer laminated to both sides; complying with ASTM C 1289-13e1, Type II, Class 1, Grade 2; Long Term Thermal Resistance (LTTR) value of 5.6 for one inch thickness.
 - 2. Type B: Same as Type A except tapered to provide positive drainage as indicated on Drawings.

2.4 ROOFING ACCESSORIES

- A. General: Furnish roof insulation accessories recommended by insulation manufacturer for intended use and compatibility with membrane roofing.

- B. Full-Spread Applied Insulation Adhesive: Insulation manufacturer's recommended spray-applied, low-rise, two-component urethane adhesive formulated to attach roof insulation to substrate or to another insulation layer.

2.5 AGGREGATE BALLAST

- A. Aggregate Ballast: Provide aggregate ballast that will withstand weather exposure without significant deterioration and will not contribute to membrane degradation, of the following type and size:
 - 1. Aggregate Type: Smooth, washed, riverbed gravel or other stone approved in writing by membrane manufacturer.
 - 2. Size: ASTM D 448, Size 4, ranging in size from 3/4 to 1-1/2 inches.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, and obtain membrane manufacturer's approval of substrates, blocking, curbs, work penetrating the roof, and other conditions affecting performance of roofing.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction. Remove roof drain plugs when no work is taking place or when rain is forecast.
- B. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system at the end of the workday or when rain is forecast. Remove and discard temporary seals before beginning work on adjoining roofing.
- C. Receive and prepare items penetrating or to be built-in to the roofing system. Coordinate and supervise work of Section 07 71 00 contractor relating to installation of metal flashing components.
- D. Verify that existing roof insulation is dry before proceeding with installation of additional insulation boards.
- E. Remove roof insulation that is wet or damp. Removal will be paid for by adjusting the Contract Sum according to unit prices included in the Contract Documents.

3.3 INSULATION INSTALLATION

- A. General:
 - 1. Comply with membrane roofing system and insulation manufacturer's written instructions for installing roof insulation.

2. Install insulation to thickness indicated in multiple layers over entire surface to be insulated, cutting and neatly fitting around obstructions and penetrations with no gaps greater than 1/4-inch. Stagger boards and offset joints in both directions between layers. Butt board joints over metal deck top flutes for firm bearing.
 3. Lay flat stock insulation with long joints continuous and at right angle to the longitudinal roof area dimension with short joints staggered.
 4. Do not install more insulation each day than can be covered with membrane before end of day and before start of inclement weather.
- B. Cant Strips, Crickets, and Saddles: Install additional layers of Type B insulation to effect drainage as shown on Drawings. Adhere tapered insulation to roof insulation with appropriate adhesive to resist uplift pressure at corners, perimeter, and field of roof according to membrane roofing system manufacturer's written instructions.
- C. Roof System on Concrete Deck (Tapered Slope):
1. Bottom Layer: Minimum two layers of Type A insulation, total 5 [insert number] inches thick. Loosely lay insulation over substrate.
 2. Top Layer (Tapered): Install Type B insulation, thickness as required to meet slope profiles indicated on the roof plan. Loosely lay insulation over bottom layer of insulation.

3.4 LOOSELY LAID AND BALLASTED MEMBRANE ROOFING INSTALLATION

- A. Loosely lay membrane roofing over area to receive roofing according to membrane roofing system manufacturer's written instructions. Unroll membrane roofing and allow to relax before installing.
- B. Comply with requirements in SPRI RP-4 for System 1.
- C. Accurately align membrane roofing and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.
- D. Mechanically fasten or adhere perimeter of membrane roofing according to requirements in SPRI RP-4.
- E. Apply membrane roofing with side laps shingled with slope of roof deck where possible.
- F. Tape Seam Installation: Clean and prime both faces of membrane lap seams (joints), apply splice tape, and firmly roll side and end laps of overlapping sheets according to manufacturer's written instructions to ensure a watertight seam, free of air bubbles, wrinkles and fishmouths. Apply lap sealant and seal exposed edges of membrane roofing terminations.
- G. Leave seams uncovered until inspected by membrane roofing system manufacturer.
- H. Repair tears, voids, and lapped seams in roofing that does not comply with requirements.
- I. Spread sealant or mastic bed over deck drain flange at roof drains and securely seal membrane roofing in place with clamping ring.
- J. Provide a 12-inch square piece of uncured EPDM membrane at each membrane "T" joints. Ensure that uncured EPDM membrane pieces are fully bonded.

- K. Aggregate Ballast:
1. Protect newly installed insulation and membrane roof areas at staging areas for ballast buggies and all high traffic areas during ballasting operations with 6-mil visqueen, 1-inch thick rigid insulation, and 1/2-inch thick (minimum) exterior grade plywood or as required by roof membrane manufacturer. Remove upon completion of project and dispose off site.
 2. Apply uniformly over membrane roofing at the rate required by membrane roofing system manufacturer, but not less than the following, spreading with care to minimize possibility of damage to membrane roofing system. Lay ballast as membrane roofing is installed, leaving membrane roofing ballasted at the end of the workday.
 - a. Ballast Weight: Size 4 aggregate, 10-lb./sq. ft.

3.5 BASE FLASHING INSTALLATION

- A. Install sheet flashings and preformed flashing accessories and adhere to substrates according to membrane roofing system manufacturer's written instructions.
- B. Apply bonding adhesive to substrate and underside of sheet flashing at required rate and allow to partially dry. Do not apply to seam area of flashing.
- C. Flash penetrations and field-formed inside and outside corners with cured or uncured sheet flashing.
- D. Clean splice areas, apply splicing cement, and firmly roll side and end laps of overlapping sheets to ensure a watertight seam installation. Apply lap sealant and seal exposed edges of sheet flashing terminations.
- E. Terminate and seal top of sheet flashings and mechanically anchor to substrate through termination bars.

3.6 FIELD QUALITY CONTROL

- A. Membrane manufacturer's authorized representative shall observe installation of roofing system to the extent required by the manufacturer.
- B. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion and submit report to Architect.
- C. Repair or remove and replace components of membrane roofing system where inspections indicate that they do not comply with specified requirements.
- D. Additional inspections, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.7 PROTECTION AND CLEANING

- A. Protect membrane roofing system from damage and wear during remainder of construction period. When remaining construction will not affect or endanger roofing, inspect roofing for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.

- B. Correct deficiencies in or remove membrane roofing system that does not comply with requirements, repair substrates and repair or reinstall membrane roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.

End of Section

SECTION 07 65 00 - FLEXIBLE FLASHING

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Flexible flashings other than roof flashings. Accessory flashing supports.

1.2 SUBMITTALS

- A. Product Data: Submit two copies of manufacturer's technical product data, installation instructions and general recommendation for prefabricated and prefinished products required. Include data substantiating that materials and performance comply with requirements.

1.3 PROJECT CONDITIONS

- A. Coordinate work of this Section with adjoining work for proper sequencing of each installation to ensure best possible weather resistance and protection of materials and finishes against damage.
- B. Perm-A-Barrier Flashing can only be applied in air and surface temperatures of 25 degrees F and above.
- C. After precipitation, allow a minimum of 24 hours for drying before installing the flashing.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Flexible Flashing: W.R. Grace Perm-A-Barrier 40-mil membrane, self-sealing fully adhering composite flexible flashing.
- B. Flashing Supports: Steel sheet, ASTM A 526, 20 gauge with G90 zinc coating.
- C. Miscellaneous:
 - 1. Perm-A-Barrier Surface Conditioner
 - 2. Termination Mastic: Bituthene Mastic

PART 3 - EXECUTION

3.1 COORDINATION

- A. Coordinate the Work of this Section with Section 04 20 00 contractor.

3.2 PREPARATION

- A. Assure that substrate is sound and adequate to receive flashing materials.

- B. Surface conditioner is required for dirty or dusty surfaces or surfaces having irregular or rough texture.
- C. When required apply surface conditioner by spray, brush or roller at the rate recommended by manufacturer.
- D. Allow surface conditioner to dry completely before flashing application. The surface conditioner is considered dry when the substrate returns to its original color (minimum 1 hour). To test for dryness, rub small conditioned area by hand. Wet conditioner will ball up under the fingertips. Let dry until conditioner cannot be rubbed off.
- E. If conditioned areas are not covered that day, recondition area if there is significant dust or dirt contamination.

3.3 INSTALLATION

- A. Flexible flashing:
- B. Precut pieces of Perm-A-Barrier flashing to easily handled lengths for each location.
- C. Remove silicone coated release paper and position flashing carefully before placing it against the surface.
- D. When properly positioned, place against surface by pressing firmly into place by hand roller or a blunt object, such as the back of a utility knife. Fully adhere flashing to substrate to prevent water from migrating under the flashing.
- E. Overlap adjacent pieces 2 inches and roll all overlaps with a steel hand roller or blunt object.
- F. Trim bottom edge flush with exposed face of building.
- G. At heads, sills and other horizontal terminations of flashing, turn up ends a minimum of 6 inches, cut and make careful folds to form a pan and seal with Bituthene Mastic per manufacturer's detail drawings.
- H. Apply a bead or trowel coat of Bituthene Mastic along top edges, seams, cuts and penetrations.
- I. Seal all penetrations through flashing with Bituthene Mastic.
- J. Flashing Supports:
- K. Break sheet metal to profile indicated and fasten to substrate to support flexible flashing across cavity.

End of Section

SECTION 07 71 00 – ROOF SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes

1. Architectural sheet metal roof specialties including, but not limited to:
 - a. Roof edge fascia.
 - b. Flashing receivers and counterflashing.
 - c. Miscellaneous closures and trim.

1.2 RELATED WORK AND REQUIREMENTS

- A. Section 07 92 00: Joint Sealants

1.3 PERFORMANCE REQUIREMENTS

- A. General: Manufacture and install roof specialties to withstand exposure to weather and resist thermally induced movement without failure, rattling, leaking, or fastener disengagement due to defective manufacture, fabrication, installation, or other defects in construction.
- B. SPRI Wind Design Standard: Manufacture and install roof edge fascia and copings tested according to SPRI ES-1 and capable of resisting design pressures.
- C. Roof specialties manufacturer shall determine design pressures required for this Project's roof specialties based on SPRI ES-1 standard.
- D. Thermal Movements: Provide roof specialties that allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, hole elongation, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Provide clips that resist rotation and avoid shear stress as a result of thermal movements. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
- E. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.
- F. Water Infiltration: Provide roof specialties that do not allow water infiltration to building interior.

1.4 SUBMITTALS

- A. Product Data: Submit two copies of manufacturer's technical product data, installation instructions and general recommendation for prefabricated and prefinished products required. Include data substantiating that materials and performance comply with requirements.

- B. Shop Drawings: Submit shop drawings indicating roof specialties layout, half size details of profiles and expansion joints, including accessories, anchorages, flashing connections and relationship to supporting structure and to adjoining roof and wall construction.
- C. Samples: Submit three (3) 6-inch square samples of metal with selected color and finish.
- D. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, verifying compliance of roof edge fascia and copings with performance requirements.

1.5 QUALITY ASSURANCE

- A. Industry Standards: Provide products that comply with applicable requirements of SMACNA "Architectural Sheet Metal Manual," except as otherwise indicated.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Do not store roof specialties in contact with other materials that might cause staining, denting, or other surface damage. Store roof specialties away from uncured concrete and masonry.
- B. Protect strippable protective covering on roof specialties from exposure to sunlight and high humidity, except to extent necessary for the period of roof specialties installation.

1.7 PROJECT CONDITIONS

- A. Perform work of this Section under subcontract to Section 07 53 00 contractor. Coordinate work of this Section with adjoining work for proper sequencing of each installation to ensure best possible weather resistance and protection of materials and finishes against damage.

1.8 WARRANTY

- A. Provide 20-year warranty for applied color coatings covering color fade, chalking, and film integrity.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Sheet Metals:
 - 1. Type 1 Concealed from View: Zinc-coated (galvanized) steel sheet, ASTM A 653/A 653M, with G90 coating designation.
 - 2. Type 2 Exposed to View: .050 -inch thick aluminum sheet, ASTM B 209/B 209M, alloy as standard with manufacturer for application of finish indicated, with temper to suit forming operations and performance required.
- B. Fasteners:

1. Exposed: Stainless steel, non-magnetic, of type and size standard with manufacturer for product and application indicated with neoprene washers. Match finish of exposed heads with material being fastened.
 2. Concealed: Same metal as material fastened or other noncorrosive metal as recommended by manufacturer.
- C. Sealants:
1. Sealant for concealed expansion joints in sheet metal: One part, non-hardening, non-skinning, non-drying, and non-migrating polyisobutylene sealant.
 2. Sealant exposed to view: Provide Type 1, custom color as specified in Section 07 92 00.
- D. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D 1187, acid and alkali resistant type; black color.

2.2 ROOF EDGE FASCIA

- A. Fascia and Gravel Stop: Manufactured, two-piece, roof edge fascia consisting of snap-on metal fascia cover in section lengths not exceeding 12-feet and a continuous formed 24 gauge galvanized steel sheet gravel stop with extended vertical leg terminating in a drip edge cleat. Provide matching corner units.
- B. Basis-of-Design Product: Metal-Era, Inc.; "Perma-Tite System 200 Fascia" or an equivalent product by one of the following:
1. Hickman Company, W. P.
 2. Merchant & Evans, Inc.
 3. MM Systems Corporation
 4. Petersen Aluminum Corp.
- C. Fascia Cover: Type 2 sheet steel.
- D. Corners: Factory mitered and mechanically clinched and sealed watertight.
- E. Splice Plates: Concealed, of same material, finish, and shape as fascia cover.
- F. Fascia Accessories: Provide manufacturer's standard downspout scuppers with integral conductor head and downspout adapters and perforated screens of same material and finish as fascia cover.
- G. Downspouts: Open-face rectangular complete with mitered elbows, manufactured from same material and finish as downspout scuppers. Furnish with metal hangers, from same material as downspouts, and anchors.

2.3 FLASHING RECEIVERS AND COUNTERFLASHING

- A. Flashing System: Built-in two-piece type flashing receivers with snap-in counterflashing in lengths not exceeding 12 feet.
- B. Basis-of-Design Product: Metal-Era, Inc.; "CFR2-500" or an equivalent product by one of the following:
1. Fry Reglet Corporation

2. Hickman Company, W. P.
 3. MM Systems Corporation
- C. Receivers: Manufactured units formed to provide secure interlocking of separate receiver and counterflashing pieces, fabricated from Type 2 steel sheet.
 - D. Counterflashings: Manufactured units of heights to overlap top edges of base flashings by 4 inches designed to snap into receiver and compress against base flashings with joints lapped, fabricated from Type 2 steel sheet.
 - E. Corners: Factory mitered and mechanically clinched and sealed watertight.

2.4 PARAPET SCUPPERS

- A. Thru-Wall Scuppers: Manufactured with closure flange trim to exterior, wall flanges to interior, and base extending beyond cant or tapered strip into field of roof, fabricated from Type 2 steel sheet.

2.5 FABRICATION

- A. Fabricate all flashings and sheet metal to profiles shown or required to fit applications indicated and to perform optimally with respect to weather resistance, water tightness, durability, strength, and uniform appearance.
- B. Fabricate roof specialties to allow controlled expansion in running lengths not only for movement of metal components in relationship to one another but also to adjoining dissimilar materials, including flashing and roofing membrane materials, in a manner which is sufficient to prevent water leakage, deformation or damage.
- C. Fabricate "concealed" type expansion joint with minimum 12-inch wide splice with sealant concealed within joint.
- D. Fabricate fully concealed from view cleats, supports, and anchorages from Type 1 steel sheet. Fabricate all other architectural sheet metal from Type 2 steel sheet.
- E. Fabricate downspout scuppers and downspouts of profiles and sizes indicated on Drawings and as required to properly collect and remove water. Fabricate complete with required connection pieces.

2.6 FINISHES

- A. General: Apply coatings either before or after forming and fabricating roof specialties, as required by coating process and as required for maximum coating performance capability. Protect coating promptly after application and cure, by application of strippable film or removable adhesive cover, and retain until installation has been completed.
- B. Fluoropolymer Coating: Full-strength 70 percent "Kynar 500" coating baked-on for 15 minutes at 450 degrees F (232 degrees C), in a dry film thickness of 1.0-mil, 30 percent reflective gloss (ASTM D 523), over minimum 0.2-mil baked-on modified epoxy primer on finish side with a primer on the underside.
 1. Custom Color: Match Kynar 500 Sierra Tan.

PART 3 - EXECUTION

3.1 COORDINATION

- A. Coordinate the Work of this Section with and under supervision of Section 07 53 00 **[edit]** contractor. Also coordinate the installation of roof specialties with installation of Work by other contractors.

3.2 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions, and other conditions affecting performance of the Work.
- B. Examine walls, roof edges, and parapets for suitable conditions for roof specialties.
- C. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 INSTALLATION

- A. General:
 - 1. Install roof specialties according to manufacturer's written instructions. Anchor roof specialties securely in place, with provisions for thermal and structural movement. Use fasteners, protective coatings, separators, sealants, and other miscellaneous items as required for a complete installation of roof specialties.
- B. Install roof specialties level, plumb, true to line and elevation; with limited oil canning and without warping, jogs in alignment, buckling, or tool marks.
- C. Provide uniform, neat seams with minimum exposure of solder and sealant.
- D. Install roof specialties to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before manufacture.
- E. Metal Protection: Protect metals against galvanic action by separating dissimilar metals from contact with each other or with corrosive substrates by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.
- F. Expansion Provisions: Allow for thermal expansion of exposed roof specialties. Space movement joints at a maximum of 12-feet with no joints within 24 inches of corners or intersections unless otherwise shown on Drawings.
- G. Conceal fasteners and expansion provisions wherever possible. Fold back edges on concealed side of exposed edges, to form a hem.
- H. Seal joints as required for watertight construction. Comply with applicable provisions of Section 07 92 00.
- I. Roof Edge Fascia:
 - 1. Install roof edge fascia in strict accordance with manufacturer's written instructions.

2. Anchor roof edge fascia with manufacturer's required devices, fasteners, and fastener spacing to meet performance requirements.
- J. Downspouts: Join sections with manufacturer's standard joint detail. Provide wall brackets with fasteners designed to hold downspouts securely to walls and 1-inch away from walls; locate brackets at top and bottom and at approximately 60 inches o.c. Provide elbows at base of downspout to direct water away from building.
- K. Flashing Receivers and Counterflashing:
 1. Embedded Receivers: Furnish receivers to Section 04 20 00 [edit] contractor to be built-in to masonry.
 2. Surface Mounted Receivers: Install receivers at height so that inserted counterflashings overlap 4 inches over top edge of base flashings.
- L. Counterflashings: Insert counterflashings into receivers; ensure that counterflashings overlap 4 inches over top edge of base flashings. Lap counterflashing joints a minimum of 4 inches and bed with sealant. Fit counterflashings tightly to base flashings.

3.4 CLEANING AND PROTECTION

- A. Remove temporary protective coverings and strippable films as roof specialties and miscellaneous sheet metal closures and trim are installed. On completion of installation, clean finished surfaces. Maintain roof specialties in a clean condition during construction.
- B. Replace roof specialties and sheet metal closures and trim that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures.

End of Section

SECTION 07 84 13 – PENETRATION FIRESTOPPING

PART 1 - PART ONE - GENERAL

1.1 DESCRIPTION

- A. Penetrations in fire-resistance-rated walls.

1.2 RELATED WORK AND REQUIREMENTS

- A. Section 07 84 43: Joint Firestopping

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated including installation instructions.
- B. Product Schedule: For each penetration firestopping system. Include location, illustration of firestopping system, and design designation of qualified testing and inspecting agency.
- C. Product Certificates: Submit certificates signed by manufacturers of firestopping products certifying that their products comply with specified requirements.
- D. Installer Certificates: From Installer indicating penetration firestopping systems have been installed in compliance with requirements and manufacturer's written instructions.
- E. Product Test Reports: For each penetration firestopping system, for tests performed by a qualified testing agency.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: A firm experienced in installing penetration firestopping systems similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful performance. Qualifications include having the necessary experience, staff, and training to install manufacturer's products per specified requirements. Manufacturer's willingness to sell its penetration firestopping products to Contractor or to Installer engaged by Contractor does not in itself confer qualification on buyer.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver penetration firestopping products to Project site in original, unopened containers or packages with intact and legible manufacturer's labels identifying product and manufacturer; date of manufacture; lot number; shelf life, if applicable; qualified testing agency's classification marking applicable to Project; curing time; and mixing instructions for multicomponent materials.
- B. Store and handle firestopping materials to prevent their deterioration or damage due to moisture, temperature changes, contaminants, or other causes.

C. PROJECT CONDITIONS

- D. Environmental Limitations: Do not install penetration firestopping system when ambient or substrate temperatures are outside limits permitted by penetration firestopping system manufacturers or when substrates are wet because of rain, frost, condensation, or other causes.
- E. Install and cure penetration firestopping materials per manufacturer's instructions using natural means of ventilations or, where this is inadequate, forced-air circulation.

1.6 COORDINATION

- A. Coordinate construction of openings and penetrating items to ensure that penetration firestopping systems can be installed according to manufacturer's requirements.
- B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate penetration firestopping systems.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics:
 - 1. Perform penetration firestopping system tests by a qualified testing agency acceptable to authorities having jurisdiction.
 - 2. Test per testing standards referenced in "Penetration Firestopping Systems" Article. Provide rated systems complying with the following requirements:
 - a. Penetration firestopping systems shall bear classification marking of a qualified testing agency.
 - 1) UL in its "Fire Resistance Directory".
 - 2) Intertek Group in its "Directory of Listed Building Products".
 - 3) FM Global in its "Building Materials Approval Guide".

2.2 PENETRATION FIRESTOPPING SYSTEMS

- A. Penetration Firestopping Systems: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated. Penetration firestopping systems shall be compatible with one another, with the substrates forming openings, and with penetrating items if any.
- B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. 3M Fire Protection Products
 - 2. A/D Fire Protection Systems Inc.
 - 3. Grace Construction Products
 - 4. Hilti, Inc.
 - 5. Johns Manville
 - 6. RectorSeal
 - 7. Specified Technologies Inc.

8. Tremco, Inc.; Tremco Fire Protection Systems Group
 9. USG Corporation
- C. Penetrations in Fire-Resistance-Rated Walls: Provide penetration firestopping systems with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg (2.49 Pa).
 1. F-Rating: Not less than the fire-resistance rating of constructions penetrated.
 - D. Exposed Penetration Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, per ASTM E 84.
 - E. Accessories: Provide components for each penetration firestopping system that are needed to install fill materials and to maintain ratings required. Use only those components specified by penetration firestopping system manufacturer and approved by qualified testing and inspecting agency for conditions indicated.
 - F. Accessories include, but are not limited to, permanent forming/damming/backing materials, substrate primers, collars, and steel sleeves.

2.3 FILL MATERIALS

- A. Latex Sealants: Single-component latex formulations that do not re-emulsify after cure during exposure to moisture.
- B. Firestop Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.
- C. Intumescent Composite Sheets: Rigid panels consisting of aluminum-foil-faced elastomeric sheet bonded to galvanized-steel sheet.
- D. Intumescent Putties: Nonhardening, water-resistant, intumescent putties containing no solvents or inorganic fibers.
- E. Intumescent Wrap Strips: Single-component intumescent elastomeric sheets with aluminum foil on one side.
- F. Mortars: Prepackaged dry mixes consisting of a blend of inorganic binders, hydraulic cement, fillers and lightweight aggregate formulated for mixing with water at Project site to form a nonshrinking, homogeneous mortar.
- G. Pillows/Bags: Reusable heat-expanding pillows/bags consisting of glass-fiber cloth cases filled with a combination of mineral-fiber, water-insoluble expansion agents, and fire-retardant additives. Where exposed, cover openings with steel-reinforcing wire mesh to protect pillows/bags from being easily removed.
- H. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.
- I. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants.

2.4 MIXING

- A. Penetration Firestopping Materials: For those products requiring mixing before application, comply with penetration firestopping system manufacturer's written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other items or procedures needed to produce products of uniform quality with optimum performance characteristic for application indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning: Before installing penetration firestopping systems, clean out openings immediately to comply with manufacturer's written instructions and with the following requirements:
 - 1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of penetration firestopping materials.
 - 2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with penetration firestopping materials. Remove loose particles remaining from cleaning operation.
 - 3. Remove laitance and form-release agents from concrete.
- B. Priming: Prime substrates where recommended in writing by manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.
- C. Masking Tape: Use masking tape to prevent penetration firestopping materials from contacting adjoining surfaces that will remain exposed upon completion of the Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove stains. Remove tape as soon as possible without disturbing firestopping's seal with substrates.

3.3 INSTALLATION

- A. General: Install penetration firestopping systems to comply with manufacturer's written installation instructions and published drawings for products and applications indicated.
- B. Install forming materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings.

1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not forming permanent components of firestopping.
- C. Install fill materials by proven techniques to produce the following results:
1. Fill voids and cavities formed by openings, forming materials, accessories and penetrating items as required to achieve required fire-resistance ratings.
 2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
 3. For fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 IDENTIFICATION

- A. Wall Identification: Permanently label walls containing penetration firestopping systems with the words "FIRE AND/OR SMOKE BARRIER - PROTECT ALL OPENINGS," using lettering not less than 3 inches (76 mm) high and with minimum 0.375-inch (9.5-mm) strokes.
1. Locate in accessible concealed floor, floor-ceiling, or attic space at 15 feet (4.57 m) from end of wall and at intervals not exceeding 30 feet (9.14 m).
- B. Penetration Identification: Identify each penetration firestopping system with legible metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches (150 mm) of penetration firestopping system edge so labels are visible to anyone seeking to remove penetrating items or firestopping systems. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:
1. The words "Warning - Penetration Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
 2. Contractor's name, address, and phone number.
 3. Designation of applicable testing agency.
 4. Date of installation.
 5. Manufacturer's name.
 6. Installer's name.

3.5 CLEANING AND PROTECTION

1. Clean off excess fill materials adjacent to openings as the Work progresses by methods and with cleaning materials that are approved in writing by penetration firestopping system manufacturers and that do not damage materials in which openings occur.
2. Provide final protection and maintain conditions during and after installation that ensure that penetration firestopping systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, immediately cut out and remove damaged or deteriorated penetration firestopping material and install new materials to produce systems complying with specified requirements.

End of Section

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SECTION 07 84 43 – JOINT FIRESTOPPING

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Joints in or between fire-resistance-rated constructions.

1.2 RELATED WORK AND REQUIREMENTS

- A. Section 07 84 13: Penetration Firestopping

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated including installation instructions.
- B. Product Schedule: For each joint firestopping system. Include location, illustration of firestopping system, and design designation of qualified testing agency.
- C. Product Certificates: Submit certificates signed by manufacturers of joint firestopping system products certifying that their products comply with specified requirements.
- D. Installer Certificates: From Installer indicating joint firestopping systems have been installed in compliance with requirements and manufacturer's written instructions.
- E. Product Test Reports: For each joint firestopping system, for tests performed by a qualified testing agency.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: A firm experienced in installing joint firestopping systems similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful performance. Qualifications include having the necessary experience, staff, and training to install manufacturer's products per specified requirements. Manufacturer's willingness to sell its joint firestopping products to Contractor or to Installer engaged by Contractor does not in itself confer qualification on buyer.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver joint firestopping products to Project site in original, unopened containers or packages with intact and legible manufacturer's labels identifying product and manufacturer; date of manufacture; lot number; shelf life, if applicable; qualified testing agency's classification marking applicable to Project; curing time; and mixing instructions for multicomponent materials.
- B. Store and handle joint firestopping materials to prevent their deterioration or damage due to moisture, temperature changes, contaminants, or other causes.

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install joint firestopping systems when ambient or substrate temperatures are outside limits permitted by joint firestopping system manufacturers or when substrates are wet because of rain, frost, condensation, or other causes.
- B. Install and cure joint firestopping materials per manufacturer's instructions using natural means of ventilation or, where this is inadequate, forced-air circulation.

1.7 COORDINATION

- A. Coordinate construction of joints to ensure that joint firestopping systems can be installed according to manufacturer's requirements.
- B. Coordinate sizing of joints to accommodate joint firestopping systems.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics:
 - 1. Perform joint firestopping system tests by a qualified testing agency acceptable to authorities having jurisdiction.
 - 2. Test per testing standards referenced in "Joint Firestopping Systems" Article. Provide rated systems complying with the following requirements:
 - a. Joint firestopping systems shall bear classification marking of a qualified testing agency.
 - 1) UL in its "Fire Resistance Directory".
 - 2) Intertek Group in its "Directory of Listed Building Products".

2.2 JOINT FIRESTOPPING SYSTEMS

- A. Joint Firestopping Systems: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of assemblies in or between which joint firestopping systems are installed. Joint firestopping systems shall accommodate building movements without impairing their ability to resist the passage of fire and hot gases.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. 3M Fire Protection Products
 - b. A/D Fire Protection Systems Inc.
 - c. Grace Construction Products
 - d. Hilti, Inc.
 - e. Johns Manville
 - f. RectorSeal
 - g. Specified Technologies Inc.
 - h. Tremco, Inc.; Tremco Fire Protection Systems Group
 - i. USG Corporation

- B. Joints in or between Fire-Resistance-Rated Construction: Provide joint firestopping systems with ratings determined per ASTM E 1966 or UL 2079:
 - 1. Fire-Resistance Rating: Equal to or exceeding the fire-resistance rating of the wall, floor, or roof in or between which it is installed.
- C. Exposed Joint Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.
- D. Accessories: Provide components of joint firestopping systems, including primers and forming materials, that are needed to install elastomeric fill materials and to maintain ratings required. Use only components specified by joint firestopping system manufacturer and approved by the qualified testing agency for conditions indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for joint configurations, substrates, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning: Before installing joint firestopping systems, clean joints immediately to comply with joint firestopping system manufacturer's written instructions and the following requirements:
 - 1. Remove from surfaces of joint substrates foreign materials that could interfere with adhesion of elastomeric fill materials or compromise fire-resistive rating.
 - 2. Clean joint substrates to produce clean, sound surfaces capable of developing optimum bond with elastomeric fill materials. Remove loose particles remaining from cleaning operation.
 - 3. Remove laitance and form-release agents from concrete.
- B. Priming: Prime substrates where recommended in writing by joint firestopping system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.
- C. Masking Tape: Use masking tape to prevent fill materials of joint firestopping system from contacting adjoining surfaces that will remain exposed upon completion of the Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove stains. Remove tape as soon as possible without disturbing joint firestopping systems seal with substrates.

3.3 INSTALLATION

- A. General: Install joint firestopping systems to comply with manufacturer's written installation instructions and published drawings for products and applications indicated.

- B.
- C. Install forming materials and other accessories of types required to support elastomeric fill materials during their application and in position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.
 - 1. After installing elastomeric fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of joint firestopping system.
- D. Install elastomeric fill materials for joint firestopping systems by proven techniques to produce the following results:
 - 1. Elastomeric fill voids and cavities formed by joints and forming materials as required to achieve fire-resistance ratings indicated.
 - 2. Apply elastomeric fill materials so they contact and adhere to substrates formed by joints.
 - 3. For elastomeric fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 IDENTIFICATION

- A. Joint Identification: Identify joint firestopping systems with legible metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches (150 mm) of joint firestopping edge so labels are visible to anyone seeking to remove joint firestopping system. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:
 - 1. The words "Warning – Joint Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
 - 2. Contractor's name, address, and phone number.
 - 3. Designation of applicable testing agency.
 - 4. Date of installation.
 - 5. Manufacturer's name.
 - 6. Installer's name.

3.5 FIELD QUALITY CONTROL

- A. Inspecting Agency: Owner will engage a qualified testing agency to perform tests and inspections according to ASTM E 2393.
- B. Where deficiencies are found or joint firestopping systems are damaged or removed due to testing, repair or replace joint firestopping systems so they comply with requirements.
- C. Proceed with enclosing joint firestopping systems with other construction only after inspection reports are issued and installations comply with requirements.

3.6 CLEANING AND PROTECTION

- A. Clean off excess elastomeric fill materials adjacent to joints as the Work progresses by methods and with cleaning materials that are approved in writing by joint firestopping system manufacturers and that do not damage materials in which joints occur.

- B. Provide final protection and maintain conditions during and after installation that ensure joint firestopping systems are without damage or deterioration at time of Substantial Completion. If damage or deterioration occurs despite such protection, cut out and remove damaged or deteriorated joint firestopping systems and install new materials to produce joint firestopping systems complying with specified requirements.

End of Section

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SECTION 07 92 00 - JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

- A. This section includes:
 - 1. Joint sealants, including joint backing, tape, and primer.
 - 2. Labor, material, tools, equipment, and services necessary for and reasonably incidental to the execution of caulking and sealant work shown on the Drawings or specified herein.
- B. Related work and requirements
 - 1. Refer to schedule at end of this Section.

1.2 SYSTEM PERFORMANCE

- A. Provide joint sealants that have been produced and installed to establish and maintain watertight and airtight continuous seals.

1.3 REFERENCES

- A. Sealant and Waterproofers Institute
- B. "Sealants: The Professionals Guide".

1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's technical data for each joint sealant product required, including instructions for joint preparation and joint sealant application.
- B. Samples: Submit cured strip samples of actual product of each color selected by A/E.
- C. Preinstallation Conference: Submit two copies of minutes of the conference.
- D. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating that sealants comply with requirements.
- E. Warranties: Sample of special warranties.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an Installer who has successfully completed within the last 3 years at least 3 joint sealant applications similar in type and size to that of this Project and who will assign mechanics from these earlier applications to this Project, of which one will serve as lead mechanic.

1. Employ only qualified workers thoroughly skilled and specially trained in the techniques of caulking, who can demonstrate to the satisfaction of the A/E their ability to fill joints solidly and neatly.
- B. Single Source Responsibility for Joint Sealant Materials: Obtain joint sealant materials from a single manufacturer for each different product required.
- C. Application and Mixing Requirements: Mix and apply sealants in strict accordance with the manufacturer's printed directions. Initial mixing and application shall be under the direct supervision of the manufacturer's representative.
- D. Field Construction Mock-Up: Prior to preinstallation conference, apply elastomeric sealants in joints of field-constructed mock-ups of assemblies specified in other sections that are indicated to receive elastomeric joint sealant specified in this Section.
- E. Preinstallation Conference: Prior to installation of joint sealants, meet at project site with Prime Contractor, Sealant Subcontractor and Foreman. Inform Architect and Owner of scheduled meeting date. Purpose of the meeting will be to review mock-ups, sealant installation methods and recommendations, workmanship, and address any questions. Prime Contractor shall provide at least 72 hours advance notice to participants prior to convening preinstallation conference and record significant conference discussions, agreements, and disagreements, including required corrective measures and actions. Distribute minutes of the conference to each party present and other parties requiring information.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to project site in original unopened containers or bundles with labels informing about manufacturer, product name and designation, color, expiration period for use, pot life, curing time and mixing instructions for multicomponent materials.
- B. Store and handle materials to prevent their deterioration or damage due to moisture, temperature changes, contaminants, or other causes.
- C. Do not use caulking materials that have been stored for a period of time exceeding the maximum recommended shelf life of the materials.

1.7 PROJECT/SITE CONDITIONS

- A. Examination: Examine Drawings and verify that all joints are properly detailed and proportioned for expansion and/or control, as recommended in writing by the sealant manufacturer. Immediately notify A/E of any deviations.
- B. Environmental Requirements: Do not proceed with the installation of sealants under adverse weather conditions when joint to be sealed is damp, wet or frozen, or when ambient and substrate temperatures are below or above the manufacturer's recommended limitations for installation. Consult with manufacturer for specific instructions before proceeding.

1.8 WARRANTY

- A. Installer's Warranty: Manufacturer's standard form in which Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within the warranty period of two (2) years from date of Substantial Completion.
- B. Manufacturer's Warranty: Manufacturer's standard form in which joint sealant manufacturer agrees to furnish joint sealants to repair or replace those that do not comply with performance and other requirements specified in this Section within the following warranty periods from date of Substantial Completion.
 - 1. Exterior Silicone Sealants: Twenty (20) years.
 - 2. Other Sealants: Ten (10) years.
- C. Warranties specified in this article exclude deterioration or failure of joint sealants from the following:
 - 1. Movement of the structure caused by structural settlement or errors attributable to design or construction resulting in stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
 - 2. Disintegration of joint substrates from natural causes exceeding design specifications.
 - 3. Mechanical damage caused by individuals, tools, or other outside agents.
 - 4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

- A. Compatibility: Provide joint sealants, joint fillers and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
- B. Liquid-Applied Joint Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied joint sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.
- C. Stain-Test-Response Characteristics: Where sealants are specified to be non-staining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.

2.2 ELASTOMERIC JOINT SEALANTS

- A. Acceptable Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Dow Corning Corporation
 - 2. GE Advanced Materials
 - 3. Pecora Corporation
 - 4. Sika Corporation, Construction Products Division
 - 5. Tremco Incorporated

- B. Type 1: Single-Component, Nonsag, Non-Staining, Neutral-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 50, for Use NT, G, M, A, and O. Equivalent to Tremco Spectrem 2.
 - 1. Type 1 Sealant Colors: Maximum of 4 colors to be selected by A/E from manufacturer's full range.
- C. Type 2: Single-Component, Nonsag, Moisture-Curing Urethane Joint Sealant: ASTM C 920, Type S, Grade NS, Class 35, for Use NT, M, A, and O. Equivalent to Tremco Dymonic FC.
- D. Type 4: Single-Component, Nonsag, Acrylic-Latex Joint Sealant: ASTM C 834, Type OP, Grade NF, formulated to be paintable. Equivalent to Tremco Tremflex 834.
- E. Type 5: Single-Component, Nonsag, Mildew-Resistant, Acid-Curing Silicone Joint Sealant: ASTM C 920,
- F. Type S, Grade NS, Uses NT, G, A, and O. Equivalent to Tremco Tremsil 200.

2.3 JOINT SEALANT BACKING

- A. General: Provide sealant backings of material and type which are nonstaining; are compatible with joint substrates, sealants, primers and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
- B. Plastic Foam Joint Fillers: Preformed, compressible, resilient, nonwaxing, nonextruding strips of flexible, nongassing plastic foam of material indicated below; nonabsorbent to water and gas and of size, shape and density to control sealant depth and otherwise contribute to producing optimum sealant performance.
 - 1. Provide either open cell polyurethane foam or closed-cell polyethylene foam, subject to approval of sealant manufacturer, for cold-applied sealants only. Open cell joint backing not permitted in exterior wall construction.
- C. Bond Breaker Tape: Polyethylene tape or other plastic tape as recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint filler materials or joint surfaces at back of joint where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.

2.4 MISCELLANEOUS MATERIALS

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

PART 3 - EXECUTION

A. INSPECTION

- B. Installer shall inspect joints indicated to receive joint sealants for compliance with requirements for joint configuration, installation tolerances and other conditions affecting joint sealant performance. Installer shall notify A/E in writing listing any conditions detrimental to performance of joint sealant work. Do not allow joint sealant work to proceed until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning of Joints:

- B. Clean out joints immediately before installing joint sealants to comply with recommendations of joint sealant manufacturers and the following requirements:
 1. Remove all foreign material from joint substrates which could interfere with adhesion of joint sealant, including dust, paints, except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer; oil, grease, waterproofing, water repellents, water, surface dirt and frost.
 2. Clean concrete, masonry, unglazed surfaces of ceramic tile and similar porous joint substrate surfaces to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove laitance and form release agents from concrete.
 3. Clean metal, glass, porcelain enamel, glazed surfaces of ceramic tile and other nonporous surfaces by chemical cleaners or other means that are not harmful to substrates or leave residues capable of interfering with adhesion of joint sealants.

- C. Joint Priming: Prime joint substrates where recommended by joint sealant manufacturer. Apply primer to comply with joint sealant manufacturer's recommendations. Confine primers to areas of joint sealant bond, do not allow spillage or migration onto adjoining surfaces.

- D. Masking Tape: Use masking tape where required to prevent contact of sealant with adjoining surfaces which otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION

- A. General: Comply with joint sealant manufacturer's printed installation instructions applicable to products and applications indicated, except where more stringent requirements apply.
- B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications and conditions indicated.
- C. Joint Sealant Backings: Install joint fillers of type indicated to provide support of sealants during application and at position required to produce the cross-sectional shapes and depths of installed sealants relative to joint widths which allow optimum sealant movement capability. Do not leave gaps between ends of joint fillers. Do not stretch, twist, puncture or tear joint fillers. Remove absorbent joint fillers that have become wet prior to sealant application and replace with dry material.

- D. Bond Breaker Tape: Install bond breaker tape between sealants and joint fillers, or back of joints where adhesion of sealant to surfaces at back of joints would result in sealant failure.
- E. Do not install more joint sealant backing or bond breaker tape than can be caulked in one day.
- F. Sealants: Install sealants by proven techniques that result in sealants directly contacting and fully wetting joint substrates, completely filling recesses provided for each joint configuration, and providing uniform, cross-sectional shapes and depths relative to joint widths which allow optimum sealant movement capability.
- G. Tooling of Nonsag Sealants: Immediately after sealant application and prior to time skinning or curing begins, tool sealants to form smooth, uniform beads of concave joint configuration, unless otherwise indicated, to eliminate air pockets, and to ensure contact and adhesion of sealant with sides of joint. Remove excess sealant from surfaces adjacent to joint. Do not use tooling agents that discolor sealants or adjacent surfaces or are not approved by sealant manufacturer.

3.4 PROTECTION AND CLEANING

- A. Protect joint sealants during and after curing period from contact with contaminating substances or from damage resulting from construction operations or other causes so that they are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately and reseal joints with new materials to produce joint sealant installations with repaired areas indistinguishable from original work.
- B. Clean off excess sealants or sealant smears adjacent to joints as work progresses by methods and with cleaning materials approved by manufacturers of joint sealants and of products in which joints occur.

3.5 SCHEDULE

<u>EXTERIOR</u>	<u>SEALANT TYPE</u>
Perimeters of exterior wall openings:	1
Control and expansion joints in exterior surfaces of unit masonry work:	1
Precast concrete coping joints and coping-to-facade joints: Joints in sheetmetal, flashings, and joints above counterflashing receivers:	1 1 or as required in Section 07 71 00
Joints between dissimilar materials:	1
 <u>INTERIOR</u>	
Perimeters of exterior wall openings as detailed on Drawings:	2
Joint between precast plank and adjacent CMU walls:	4

Joints of underside of exposed precast beams or planks:	4
Control and expansion joints on the interior of exterior surfaces of unit masonry walls:	2
Perimeters of interior frames:	4
Interior masonry vertical control joints (block-to-block) block-to-concrete, and intersecting masonry wall:	4
Joints at tops of non-load bearing masonry walls at the underside of structure:	4
Joints between dissimilar materials:	4
Perimeter of toilet room fixtures: (e.g. sinks, urinals, waterclosets)	5

End of Section

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SECTION 08 16 13 – FIBERGLASS DOORS AND FRAMES

PART 1 - GENERAL

1.1 Summary

- A. Included in this section:
 - 1. Fiberglass reinforced doors, frames, transoms and borrowed lights.
- B. Related work and requirements
 - 1. Section 08 11 13: Standard Hollow Metal Doors and Frames
 - 2. Section 08 71 00: Door Hardware
 - 3. Section 08 80 00: Glazing

1.2 SUBMITTALS

- A. Product Data: Submit manufacturers' technical product data substantiating that products comply with requirements.
- B. Shop Drawings: Submit for fabrication and installation of fiberglass doors and frames. Include details of each frame type, elevations of door design types, conditions at openings, details of construction, core material, location and installation requirements of door hardware and reinforcements, and details of joints and connections. Show anchorage and accessory items.
- C. Schedule: Submit schedule of doors and frames using same reference numbers for details and openings as those on the Drawings.
- D. Samples: Submit manufacturer's full range of available color samples for selection by A/E.

1.3 QUALITY ASSURANCE

- A. Regulatory Requirements: Flame Spread: All door and frame components, including gel coat finish, shall have a flame spread classification of 25 or less per ASTM E 84 and shall be self extinguishing per ASTM D 635.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Deliver fiberglass doors and frames cartoned or crated to provide protection during transit and job storage.
- B. Inspect fiberglass doors and frames upon delivery for damage. Minor damages may be repaired provided refinished items are equal in all respects to new work and acceptable to A/E; otherwise, remove and replace damaged items as directed.
- C. Store doors and frames at building site under cover. Place units in a vertical position with heads up, spaced by blocking, on minimum 4-inch high wood blocking. Avoid using non-vented plastic or canvas shelters that could create a humidity chamber. If wrappers on door become wet, remove cartons immediately. Provide 1/4-inch space between each stacked door to permit air circulation.

1.5 WARRANTY

- A. Submit two copies of written agreement on manufacturer's full door and frame warranty form, agreeing to repair or replace defective doors and frames. Warranty shall be in effect during the following period of time after the date of acceptance.
 - 1. Delamination or Failure Due to Corrosion: Life of Installation.
 - 2. Workmanship: 10 years.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Chem-Pruf Door Co., Ltd.
 2. Corrim Company
 3. Corrosion Guard Products
 4. Sküle Door Company, LLC
 5. Simon Door Co., LLC
 6. Tiger Door, LLC

2.2 MATERIALS

- A. Doors:
1. Face Sheets: Minimum 0.120 inch thick seamless sheet consisting of a corrosion resistant resin system with light stabilizing additives and reinforced with fiberglass, 40 percent by weight. Total door thickness shall be nominal 1-3/4 inches. Finish: Smooth seamless finish, 15 mils thick, in color selected by A/E from manufacturer's full range.
 2. Core: Polyurethane foam core for exterior doors and phenolic impregnated paper honeycomb core for interior doors.
 3. Stile and Rails: Pultruded fiberglass tubes, 1-1/2 inches square with solid polymer corner blocks and reinforcements. Metal or wood corner blocks and reinforcements not permitted.
 4. Hardware Reinforcement: Provide non-swelling polymer blocking for application of hardware in accordance with hardware schedule and hardware manufacturer's templates specified in Section 08 71 00.
- B. Frames:
1. Profile: Pultruded fiberglass frame members with welded corners. Finish: Smooth seamless finish, 15 mils thick, in color selected by A/E from manufacturer's full range.
 - a. Jamb Depth: 5-3/4 inches.
 - b. Face Dimension: 2-inches.
 - c. Return: 1/2-inch.
 - d. Stop: 5/8-inch.
 - e. Rabbet: 1-5/16 inch.
 2. Corner Reinforcement: 1/4-inch thick pultruded fiberglass angle factory attached to head bar with stainless steel screws and field attached to jambs with stainless steel screws.
 3. Mortised Hinge Reinforcement: 1/4-inch thick polymer material attached to frame by bonding and stainless steel countersunk screws.
 4. Closer Reinforcement: Same as hinge reinforcement except without screws.
 5. Strike Reinforcement: 3/4-inch thick polymer material attached to frame by bonding and stainless steel countersunk screws.
 6. Provide fiberglass frames for doors, transoms, borrowed lights, and other openings, of types and styles as indicated on Drawings and Schedules. Conceal fastenings, unless otherwise indicated.
- C. Louvers:
1. Profile: Inverted V-Blade with insect screen. Installed with no visible fasteners on exterior face.
 2. Finish: To match door and frame.

2.3 FABRICATION

- A. Fabricate fiberglass door and frame units to be rigid, neat in appearance and free from defects, warp, wave or buckle with corners square. Set members in proper alignment and relationship to

other members with surfaces straight and in a true plane.

- B. Reinforce members and joints with plates, tubes or angles for rigidity and strength.
- C. Fabricate frames with a minimum of three (3) metal anchors or polymer spacers in each jamb up to 84 inches high with one (1) additional anchor for each 24 inches in height above 84 inches for anchorage into adjoining construction.
- D. Fabricate doors with a 1/8 inch clearance at jambs and head and 1/4 inch clearance above threshold or finish floor.
- E. Door Hardware Preparation: Prepare doors and frames to receive mortised and concealed door hardware in accordance with locations specified in and templates provided by Section 08 71 00 contractor. If not indicated, then prep in accordance with "Recommended Locations for Builder's Hardware", published by Door and Hardware Institute. Comply with applicable requirements of ANSI A115 series specifications for door and frame preparation for hardware. **Do not proceed with door hardware preparation until the hardware supplier's hardware schedule has been approved by A/E.**

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Install fiberglass doors, frames, and accessories in accordance with final shop drawings, manufacturer's data, and as herein specified.
- B. Frame Installation:
 - 1. Except for frames located at in-place concrete or masonry installations, place frames prior to construction of enclosing walls and ceilings. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is completed, remove temporary braces and spreaders leaving surfaces smooth and undamaged.
 - 2. In masonry construction, locate 3 wall anchors per jamb at hinge and strike levels.
 - 3. At in-place concrete or masonry construction, set frames and secure to adjacent construction with machine screws and masonry anchorage devices. Fill fasteners with putty and grind smooth.
- C. Door Installation:
 - 1. Fit fiberglass doors accurately in frames, within clearances specified herein.

3.2 CLEANING

- A. Clean surfaces of door opening assemblies and exposed door hardware in accordance with manufacturer's maintenance instructions.

3.3 PROTECTION

- A. Protect door opening assemblies and door hardware from damage by subsequent construction activities until final inspection.

End of Section

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SECTION 08 71 00 - DOOR HARDWARE

PART ONE - GENERAL

DESCRIPTION

Builder's Door Hardware
Miscellaneous Door Hardware

RELATED WORK AND REQUIREMENTS

Division 26: Electrical - final connection of electrically operated hardware

REFERENCES

Standards:

Provide material complying with the following standards as established by the American National Standards Institute, Inc., (ANSI) which is sponsored by the Builders Hardware Manufacturer's Association, Inc., (BHMA). Product tests are to be administered by the ETL Testing Laboratories, Inc., or other official testing laboratories that have been designated by BHMA for the testing of ANSI standard.

Materials and Finishes	BHMA 1301	
Butts and Hinges	ANSI	A156.1
Grade 1		
Bored & Preamsembled Latches	ANSI A156.2	Grade 1
Exit Devices	ANSI A156.3	Grade 1
Door Controls - Closers	ANSI A156.4	Grade 1
Auxiliary Locks	ANSI A156.5	Grade 1
Architectural Door Trim	ANSI A156.6	
Template Hinge Dimensions	ANSI A156.7	
Door Controls - Overhead Holders	ANSI	A156.8
Grade 1		
Mortise Locks & Latches	ANSI	A156.13
Operational Grade 1		
		Security Grade 1
Closer Holder Release Devices	ANSI A156.15	
Auxiliary Hardware	ANSI A156.16	Grade 1
Electrified Strikes and Activators	ANSI A 156.31	

SUBMITTALS

Product Data: Submit product data including installation details, material descriptions, dimensions of individual components and profiles, and finishes.

Shop Drawings: Submit details of electrified door hardware, indicating the following:

 Wiring Diagrams: Detail wiring for power, signal, and control systems and differentiate between manufacturer installed and field installed wiring. Include the following:

1. System schematic.
2. Point-to-point wiring diagram.
3. Riser diagram.
4. Elevation of each door.

Detail interface between electrified door hardware and building and security and access control systems.

Operation Narrative: Describe the operation of doors controlled by electrified door hardware.

Door Hardware Schedule:

Submit to A/E, four complete computer generated or typewritten copies of the proposed door hardware schedule for approval. Prepare schedule using the scheduling sequence and vertical format in Door and Hardware Institute's (DHI) "Sequence and Format for the Hardware Schedule". Do not order hardware until schedule has been reviewed positive by A/E.

When submitting schedules for approval, include two manufacturer's cut sheets on each hardware item proposed. Index with the use of numbers or letter or a combination of both, with the hardware schedule. The index numbers/letters are to be in the right hand column on the same line as the respective manufacturer's numbers. All manufacturers' numbers shall be indexed even when appearing more than once.

Keying Schedule: Submit a separate keying schedule.

Samples: Upon request, provide to A/E one sample of each item of door hardware that is to be furnished for this project. Sample need not be of specified finish unless requested by A/E. Samples will be returned to contractor upon completion of Project.

ANSI: Upon request by A/E, provide hardware manufacturers' letters of compliance that their products meet specified ANSI standards and that they have been tested and meet grades specified.

Templates: Provide templates and/or physical hardware to all trades requiring them in order they may cut, reinforce or otherwise prepare their material or product to receive the hardware item. If physical hardware is required by any manufacturer, ship to them such hardware via prepaid freight in sufficient time to prevent any delay in the execution of their work.

QUALITY ASSURANCE

General:

Hardware has been specified by manufacturer's name, brand, and catalog numbers for the purpose of establishing a basis for quality, finish, design, and operational function.

Hardware shall be substantially manufactured in the United States of America as defined in Wisconsin Statutes.

Supplier Qualifications: Supplier furnishing hardware in the project's vicinity for a period of not less than five (5) years. This supplier shall have experience in the preparation of architectural hardware specifications, estimating, detailing, ordering, servicing of architectural hardware in all its branches and will be available at reasonable times during the course of the work for project hardware consultation to the Owner, A/E, and GC.

Supplier's principal office shall be located within a 100-mile radius of the Project Site.

Keying Meeting:

Consult with Owner at his office and prepare a detailed keying schedule.

Key meeting to be attended by the Owner and hardware supplier. Notify A/E of time and date at least 7 days before meeting.

Pre-Installation Meeting: Do not proceed with field installation of any hardware until after Special Meeting for Hardware Installation has been completed.

DELIVERY, STORAGE, AND HANDLING

Package all items of hardware to be delivered to the job site. Package, arrange, and label in a manner acceptable to GC. Include all necessary screws, bolts, miscellaneous parts, instructions and where necessary installation templates for manufacturer's suggested installation. **Do not include miscellaneous parts and accessories not specified nor intended to be used on the Project.** Clearly label to conveniently identify them and their intended location in the building. Use A/E door schedule mark where applicable.

The GC or contractor of his choice will receive the hardware when delivered at the job site. A dry locked storage space complete with shelving will be provided for the purpose of unpacking, sorting out, checking and storage.

Deliver door hardware to and jointly inventory with GC. Direct factory shipments to the job site not acceptable. Promptly replace items damaged in shipment with proper material without additional cost.

Handle hardware in a manner to minimize marring, scratching, or damage.

OWNER'S INSTRUCTIONS

Upon completion of hardware installation, assist the GC in instructing Owner in function, operation, and maintenance of all hardware and other work of this Section. Include demonstration of electrically controlled hardware devices.

PART TWO - PRODUCTS

MANUFACTURERS

Requirements for design, function, finish, size, and other distinctive qualities of each type of door hardware are specified below or indicated in the hardware schedule. Listed manufacturers' products meeting the requirements in this section are acceptable.

PERFORMANCE REQUIREMENTS

Door Closers: Adjust door closer sweep periods so that, from an open position of 90 degrees, the time required to move the door to an open position of 12 degrees shall be 5 seconds minimum.

DOOR HARDWARE

General: Requirements listed below for items of door hardware are minimum. Refer to Schedule and Remarks for more specific or stringent requirements.

BUTTS

Acceptable Manufacturers:

Bommer	B
Hager	H
Ives	I
McKinney	MK
PBB, Inc.	PBB
Stanley	ST

Number Required:

Up to 5 feet high -	2
5 feet to 7 feet 4 inches -	3 and one additional hinge for each additional 30 inches of height.

Size:

Doors up to 3 feet 4 inches wide:	4-1/2 inches x 4-1/2 inches (SW Interior, HW Exterior).
Doors over 3 feet 4 inches wide:	5 inches x 4-1/2 inches, HW.

Pins:

Exterior and Access Controlled Doors: Non-removable type pins (NRP).
Interior: Non-rising loose pins unless otherwise specified.

Provide non-removable pins at out-swing doors with access control.

Butts Legend (unless otherwise indicated):

Exterior Doors: BB1199 NRP, heavy weight, four ball bearing, stainless steel, with stainless steel pin ANSI A 5111.

Interior Doors (up to 40 inches wide): BB1191 standard weight, two ball bearing, stainless steel, with stainless steel pin ANSI A8112.

Interior Doors (over 40 inches wide): BB1199, heavy weight, four ball bearing, stainless steel, with stainless steel pin ANSI A 5111.

LOCK/LATCHES

Acceptable Manufacturers:

Best Access	BA
Corbin Russwin	CR
Dorma	DOR
Sargent	SGT
Schlage	SCH
Yale	Y

General: Heavy-duty mortised with 2-3/4 inch backset, equivalent to SCH 03A lever handle design.

Strikes: Equivalent to ASA ANSI A115.2 with box.
At wood jambs provide elongated lip strike.

Miscellaneous Locks and Cylinders:

Provide miscellaneous lock devices as scheduled.

Furnish interchangeable core cylinders for cylinder dogging exit devices.

Lock Function Legend (unless otherwise indicated):

Notes: Letters in () denote function as listed in Door, Frame & Hardware Schedule.
All lock functions shall be reviewed with Owner prior to ordering locks.

- (P) Privacy Toilets L9040
- (S) Storeroom L9080
- (LF) Exit Device (lever function with cylinder)

EXIT DEVICES

Acceptable Manufacturers:

Von Duprin	VD
Precision	PRE
Sargent	SGT
Dorma	DOR

Provide as scheduled.

Provide function as noted in hardware groups or scheduled.

Provide the following:

Breakaway type levers, if any.

Cylinder dogging. Required filler plates and shim kits for flush mounting of exit devices on all doors

Provide power supplies for electronic exit devices.

CLOSERS

Acceptable Manufacturers:

Dorma	DOR
LCN	LCN
Norton	NOR
Sargent	SGT

Product: As scheduled.

Provide closers with arms, brackets, drop plates, and other closer accessories to suit the door and frame conditions.

ELECTRIC STRIKES

Acceptable Manufacturers:

Dorma	DOR
Folger Adam	FA
Hess	HE
Von Duprin	VD

Provide with power supplies.

POWER TRANSFER DEVICES

Acceptable Manufacturers:

ABH	ABH
Dorma	DOR
Von Duprin	VD

Provide VD EPT-2 power transfer at each door with electric lock.

CARD ACCESS SYSTEM

Provided by Division 28 Contractor.

FLUSH BOLTS AND STOPS

Acceptable Manufacturers:

Door Controls International	DCI
Hager Companies	HAG
Ives	I
Trimco	TR

Flushbolts: Equipped with extension bolts equivalent to Ives 457/358 of lengths to locate the operating mechanism 12 inches above the floor bottom unit and 72 inches above the floor for top unit. Bottom units require dust proof strike equivalent to Ives DP2.

Door Stops: Provide as required at all doors except where specified otherwise. Include wall stop/holders, door bumpers equivalent to Ives 406/407, floor stops equivalent to Ives FS436/438, roller bumpers equivalent to Ives RB470/471, as required to prevent doors from striking building components or equipment.

DOOR PROTECTION PLATES

Kickplates: 0.050-inch thick, Type 302 stainless steel, square corners and beveled edges.

Height: 12 inches high unless otherwise indicated.

Width: 2 inches less than width of door.

THRESHOLDS, WEATHERSTRIPS AND RAIN CAP

Acceptable Manufacturers:

Hager Companies	HA
National Guard Products	NGP
Pemko	P

DOOR HARDWARE

Reese Enterprises RE

Provide weatherstripping, sill strips, and thresholds at all exterior doors per hardware group, unless noted otherwise.

Fabricate length of thresholds full width of door frame **including width of all jambs**; e.g. threshold at doors 36 inches wide is 40 inches long. Pieced thresholds not acceptable.

Coordinate specified threshold cross-section with sill details indicated on Drawings and verify selection with A/E.

KEYING

Key locks in sets or subsets, and master key as directed by Owner.

Furnish five master keys per set. Provide three change keys for each cylinder.

Provide all keys with manufacturer's name and identify with key change number or designation. Tag each key in a manner to permit easy identification and use.

Deliver master keys by registered mail direct from manufacturer to the Owner, or by personal delivery by authorized manufacturer's representative.

Deliver change keys with locksets to GC.

COMPONENTS AND ACCESSORIES

Provide Phillips head screws and bolts for all items of hardware.

Provide Torx tamper-resistant type screws and bolts for exposed fasteners. Provide one tool kit with driver and six bits. Exposed fastener is each and any fastener that is exposed to view with doors open or closed.

Provide overhead holders and closers with machine screws for attachment to reinforcing in doors and frames.

Provide thresholds with Ackerman Johnson "Star Type" anchors and machine screws.

Provide butts and pivots with self-cleaning machine screws for hollow metal frames and doors.

Self-tapping metal screws in the anchorage of locks, closers, and holders not permitted.

Provide hardware with bolts, screws, fasteners, brackets, fittings, and accessories required for proper installation and performance.

FINISHES

Provide the following BHMA finishes:

Door Butts: 630 stainless steel.

Door Butts (Other Interior Doors): 652 satin chrome.

Locks and Latches: 630 stainless.

Exit Devices: 626 satin chrome

Surface Mounted Closers: Covers and Arms BHMA 689 aluminum.

Door Stops: 626 satin chrome.

Door Protection Plates: 630 stainless.

Overhead Stops/holders: 630 stainless steel.

Thresholds and Weatherstrips: 630 stainless steel.

PART THREE - EXECUTION

INSTALLATION

Deliver hardware scheduled or required to be built-in to metal doors and frames to contractors for that Work.

Deliver all electrically operated products requiring electrician installation to Division 26 contractor for installation.

General:

Install each hardware item in compliance with the manufacturer's instructions and recommendations. Securely fasten all parts to be attached. Fit faces of mortised parts snug and flush. Make sure all operating parts move freely and smoothly without binding, sticking, or excessive clearance.

Wherever cutting and fitting is required to install hardware onto or into surfaces which are later to be painted or finished in another way, remove and store hardware prior to painting or finishing.

Reinstall when finishes have been completed on the surface to which the hardware is to be applied.

HARDWARE MOUNTING LOCATIONS (Unless Detailed or Noted Otherwise):

Butts and Butt Backset: Fiberglass frame manufacturer's standard.

Locksets and Latchsets: 40 inches from finished floor to centerline of **strike**.

Exit Devices and Push Bars: Install so that cross bar is 40 inches from finished floor to centerline of bar. **INSTALL EXIT DEVICES ON DOORS WITHOUT THRU-BOLTING.** Refer to door specifications for door construction.

Kickplates: 1/8 inch from bottom edge, centered on door.

Door Closers: **INSTALL SURFACE MOUNTED CLOSERS ON DOORS WITHOUT THRU-BOLTING.** Refer to door specifications for door construction. Install for maximum opening of 180 degrees whenever possible, or to adjoining wall. Indicate degree of openings on final hardware schedules.

Install head jamb weatherstripping **prior** to attaching surface mounted closer shoe to head jamb.

Install latch side jamb weatherstripping **prior** to attaching strike for **rim exit devices.**

Install sweeps at bottom of exterior doors on **exterior** side of door.

Floor Stop: Install on floor to permit maximum swing of door and to prevent knob from hitting wall, column, equipment. Place within 3 inches from latch edge of door.

Overhead Stops: Install accurately in accord with manufacturer's template. Indicate degree of openings on final hardware schedules.

MISCELLANEOUS INSTALLATION

Cut thresholds to fit profile of jamb. Set in a bed of sealant to completely fill concealed voids and exclude moisture from every source. Do not plug drain holes or block weeps. Remove excess sealant.

After installation, turn over to Owner representative templates, instruction sheets, and installation details when the building is accepted. Include five each of any special adjusting and/or installation tools furnished with the hardware by the manufacturers.

FIELD QUALITY CONTROL

Include provisions for hardware supplier to make two job visits of six hours each, plus travel, to assist the GC during installation of hardware.

ADJUSTING AND CLEANING

Adjust and check each operating item of hardware to ensure correct operation and function. Replace units that cannot be adjusted to operate as intended.

Final Adjustment: Prior to Substantial Completion make final check and adjustment of all hardware items. Clean hardware to restore operation, function, and finish.

Adjust door closers and other door control devices to compensate for final operation of heating and ventilating equipment.

PROTECTION

Use all means to protect hardware located in areas subject to damage during construction by handling, cleaning, etc., (eg. painting, cleaning of bricks).

SCHEDULE

Door, Frame & Hardware Schedule is bound in this Project Manual. See Table of Contents.

HARDWARE GROUPS

General: One each per group unless otherwise noted.

Hardware Group No. 01

Qty		Description
3	EA	HINGE 4.5X5.5
1	EA	EXIT DEVICE 33A-L-360L
1	EA	CLOSER 1460 PARALLEL ARM
1	EA	ELECTRIC STRIKE
1	EA	KICKPLATE
1	SET	THRESHOLD AND WEATHERSTRIPPING

Card reader by Electronic Safety and Security Contractor. Presenting valid credential releases electric strike and door can be opened. Door is always free egress.

Hardware Group No. 02

Qty		Description
3	EA	HINGE 4.5X5.5
1	EA	LOCK L9040 (P)
1	EA	STOP

Hardware Group No. 03. Provide each pair doors with the following:

Qty		Description
6	EA	HINGE 4.5X5.5
1	EA	LOCK L9080 (S)
1	EA	CLOSER 1460 PARALLEL ARM
1	EA	OVERHEAD HOLDER
1	SET	MANUAL FLUSH BOLTS
1	EA	DUST PROOF STRIKE
1	EA	POWER TRANSFER DEVICE
1	EA	ELECTRIC STRIKE
2	EA	KICKPLATE
1	SET	ASTRAGAL
1	SET	THRESHOLD AND WEATHERSTRIPPING

Card reader by Electronic Safety and Security Contractor. Presenting valid credential releases electric strike and door can be opened. Door is always free egress.

End of Section

SECTION 08 80 00 - GLAZING

PART 1 - GENERAL

1.1 Summary

- A. Included in this section:
 - 1. Fire Rated Interior glazing.
 - 2. Mirrors.
- B. Related work and requirements
 - 1. Section 08 16 13: Fiberglass Doors and Frames

1.2 REFERENCES

- A. Standards:
 - 1. ASTM C 1036 - Standard Specification for Flat Glass
 - 2. AAMA 800 - Voluntary Specifications and Test Methods for Sealants
 - 3. CPSC - Consumer Product Safety Commission 16 CFR 1201 "Safety Standard for Architectural Glazing Materials".
 - 4. GANA - Glass Association of North America, "Glazing Manual".

1.3 PERFORMANCE REQUIREMENTS

- A. General: Provide glazing systems capable of withstanding normal service without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, and installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.
- B. Glass Design: Glass thickness designations indicated are minimums and are for detailing only. Confirm glass thicknesses by analyzing Project loads and in-service conditions. Provide glass lites in the thickness designations indicated for various size openings, but not less than thicknesses and in strengths (annealed or heat treated) required to meet or exceed the following criteria:
 - 1. Glass Thicknesses: Select minimum glass thicknesses to comply with ASTM E 1300, according to the following requirements:

1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's technical data for each glazing material and fabricated glass product specified.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who has completed glazing similar in material, design, and extent to that indicated for this Project; whose work has resulted in glass installations with a record of successful in-service performance.
- B. Single Source Responsibility for Glass: To ensure consistent quality of appearance and performance, provide materials produced by a single manufacturer or fabricator for each kind and condition of glass indicated and composed of primary glass obtained from a single source for each type and class required.
- C. Glazing Standard: Comply with recommendations of Glass Association of North America (GANA) "Glazing Manual" except where more stringent requirements are indicated. Refer to publication for definitions of glass and glazing terms not otherwise defined in this Section or other referenced standards.

- D. Fabricator Qualification:
 1. Insulating Glass Units (IGU): Fabricated by Insulating Glass Certification Council (IGCC) certified fabricator.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect glass and glazing materials during delivery, storage and handling to comply with manufacturer's directions and as required to prevent edge damage to glass.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Basis-of-Design Glass Products: Subject to compliance with requirements, provide products indicated or equivalent products by one of the following:
 1. Cardinal Glass Industries
 2. Guardian Industries Corp.
 3. Oldcastle Building Envelope
 4. Pilkington North America
 5. PPG Industries, Inc.
 6. Vetrotech Saint-Gobain
 7. Viracon, Inc.

2.2 GLASS PRODUCTS, GENERAL

- A. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass lites in thicknesses as needed to comply with requirements indicated.

2.3 MONOLITHIC GLASS TYPES

<u>Type</u>	<u>Description</u>
1	Fire-rated, non-impact, vision glass, equivalent to Technical Glass Products "Premium FireLite", 5/16-inch thick; labeled and listed by UL for use in 60 minute UL labeled doors and frames.
2	Mirror glass, Type I, Class 1, Quality Q2, 1/4-inch thick.

2.4 GLAZING GASKETS

- A. Dense Compression Gaskets: Molded or extruded dense EPDM or neoprene gaskets, complying with ASTM C 864, of profile and hardness required to maintain watertight seal.

2.5 GLAZING TAPES

- A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based elastomeric tape with a solids content of 100 percent; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; packaged on rolls with a release paper backing; and complying with ASTM C 1281 and AAMA 800 for products indicated below:
 1. Glazing Products for Fire-Resistive Glazing Products: Identical to product used in test assemblies to obtain fire-protection rating.

2.6 MISCELLANEOUS GLAZING MATERIALS

- A. General: Provide products of material, size, and shape complying with referenced glazing standard, requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.
- B. Cleaners, Primers and Sealers: Types recommended by sealant or gasket manufacturer.
- C. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.
- D. Spacers: Elastomeric blocks or continuous extrusions with a Shore, Type A durometer hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
- E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).
- F. Mirror Mounting Hardware: Equivalent to C.R. Laurence Co., Inc. No. 64114 adjustable mirror clip sets. Finish: Nickel-plated.

2.7 FABRICATION

- A. Fabricate glass and other glazing products in sizes required to glaze openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.

PART 3 - EXECUTION

A. COORDINATION

- 1. Coordinate the work of this Section with Section 08 16 13 contractor; and the Prime Contractor relative to mirror installation.

3.2 EXAMINATION

- A. Examine framing glazing, with Installer present, for compliance with the following:
 - 1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
 - 2. Minimum required face or edge clearances.
 - 3. Effective sealing between joints of glass-framing members.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 PREPARATION

- A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.

3.4 INSTALLATION

- A. General:
 - 1. Comply with "Glazing Manual" by Glass Association of North America (GANA), except as specifically recommended otherwise by manufacturers of the glass and glazing materials. Completed installation shall be water and air tight.
 - 2. Location and glazing types are indicated on Drawings and Schedules.

3.5 GLAZING

A. General:

1. Comply with combined written instructions of manufacturers of glass, sealants, gaskets and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.
2. Glazing channel dimensions as indicated on Drawings are intended to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances. Adjust as required by job conditions at time of installation.
3. Protect glass edges from damage during handling and installation. Remove damaged glass from project site and legally dispose of off-site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.
4. Apply primers to joint surfaces where required for adhesion of sealants.
5. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
6. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
7. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.

3.6 TAPE GLAZING

A. Dry/Dry:

- B. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.
- C. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.
- D. Cover vertical framing joints by applying tapes to heads and sills first and then to jambs. Cover horizontal framing joints by applying tapes to jambs and then to heads and sills.
- E. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.
- F. Do not remove release paper from tape until just before each glazing unit is installed.
- G. Center glass lites in openings on setting blocks and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.

3.7 MIRRORS

- A. Install mirrors on walls with adjustable clip sets at top and bottom. Provide adhesive recommended by manufacturer for substrate, of type not to cause visual defects of mirror, and to provide firm backing and cushion for mirror.

3.8 GLAZING SCHEDULE

<u>PRODUCT</u>	<u>SECTION</u>	<u>GLAZING METHOD</u>
Fiberglass doors and frames (interior)	08 16 13	Tape Dry/Dry

3.9 PROTECTION AND CLEANING

- A. Use all means to protect glass from breakage immediately upon installation. Do not apply markers to glass surface. Remove nonpermanent labels, and clean surfaces.
- B. Remove and replace glass that is broken, chipped, cracked, abraded, or damaged in any way, including natural causes, accidents, and vandalism, during construction period.
- C. Maintain glass in a reasonably clean condition during construction, so that it will not be damaged by corrosive action and will not contribute (by wash-off) to the deterioration of glazing materials, and any other surfaces.
- D. Wash and polish glass on both faces not more than seven (7) days prior to Substantial Completion. Wash glass as recommended by glass manufacturer.

End of Section

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SECTION 08 91 19 - FIXED LOUVERS

1.1 PART ONE - GENERAL

1.2 DESCRIPTION

- A. Fixed wall louvers.

1.3 RELATED WORK AND REQUIREMENTS

- A. Section 07 92 00: Joint Sealants
- B. Division 23: Heating Ventilating and Air Conditioning

1.4 SYSTEM DESCRIPTION

- A. Structural Performance:
- B. General: Design, engineer, fabricate, and install exterior wall louvers to withstand the effects of loads and stresses from wind and normal thermal movement, without evidencing permanent deformation of louver components including blades, frames, and supports; noise or metal fatigue caused by louver blade rattle or flutter; and permanent damage to fasteners and anchors.
- C. Wind Load: Uniform pressure (velocity pressure) of 25 lbs. per sq. ft. acting inwards or outwards.
- D. Normal Thermal Movement: Defined as that resulting from the following maximum change (range) in ambient temperature. Base design calculations on actual surface temperatures of metal due to both solar heat gain and nighttime sky heat loss.
 - 1. Temperature Change (Range): 100 deg. F (55.5 deg. C).
- E. Air Performance, Water Penetration, and Air Leakage Ratings: Provide louvers complying with performance requirements indicated as demonstrated by testing manufacturers stock units, of height and width indicated, according to Air Movement and Control Association (AMCA) Standard 500.

1.5 SUBMITTALS

- A. Shop Drawings: Submit shop drawings of louver units and accessories. Include plans, elevations, sections, and details showing profiles, angles, spacing of louver blades; unit dimensions related to wall openings and construction; free areas for each size indicated; and profiles of frames at jambs, heads and sills.
- B. Samples: Submit samples for initial selection purposes in form of manufacturer's color charts showing full range of colors available for those units with factory-applied color finishes.

1.6 PROJECT CONDITIONS

- A. Field Measurements: Verify actual louver openings by accurate field measurements before fabrication; show recorded measurements on final shop drawings. Coordinate fabrication schedule with construction progress to avoid delay of the Work.

1.7 QUALITY ASSURANCE

- A. SMACNA Standard: Comply with SMACNA "Architectural Sheet Metal Manual" recommendations for fabrication; construction details, and installation procedures.
- B. AMCA Standard: Comply with AMCA Standard 500 and certified ratings program. Units shall bear AMCA seal.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Aluminum Extrusions: ASTM B 221, Alloy 6063-T5, T6 or T-52.
- B. Aluminum Sheet: ASTM B 209, Alloy 3003 or 5005 with temper as required for forming, or as otherwise recommended by metal producer for required finish.
- C. Galvanized Steel Sheet: ASTM A 653/A 653M, G90 zinc coating, mill phosphatized.
- D. Fasteners: Provide stainless steel or aluminum fasteners, unless otherwise indicated. Do not use metals that are corrosive or incompatible with materials joined.
 - 1. Provide types, gages, and lengths of fasteners to suit unit installation conditions.
 - 2. Provide phillips flat-head machine screws for exposed fasteners, unless otherwise indicated.
- E. Anchors and Inserts: Provide type, size, and material required for type of loading and installation indicated. Use nonferrous metal or hot-dip galvanized anchors and inserts for exterior installations and elsewhere as required for corrosion resistance. Use toothed steel or expansion bolt devices for drilled-in-place anchors.
- F. Bituminous Paint: SSPC-Paint 12 (cold-applied asphalt mastic).
- G. Sealant: Provide Type 1 as specified in Section 07 92 00.

2.2 FABRICATION

- A. General:
 - 1. Fabricate louvers to comply with requirements indicated for design, dimensions, materials, joinery, and performance.
 - 2. Preassemble louvers in shop to minimize field splicing and assembly. Disassemble units as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

3. Maintain equal louver blade spacing, including separation between blades and frames at head and sill, to produce uniform appearance.
4. Fabricate frames, including integral sills, to fit in openings of size indicated on Drawings, with allowances made for fabrication and installation tolerances of louvers, adjoining construction, and perimeter sealant joints.
5. Include supports, anchorages, and accessories required for complete assembly.
6. Provide sill extensions and loose sills made of same material as louvers, where indicated, or required for drainage to exterior and to prevent water penetrating to interior.

2.3 FIXED EXTRUDED ALUMINUM WALL LOUVERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Airolite Company, LLC; Model K6744 or equivalent product by one of the following:
 1. Air Flow Company, Inc.
 2. American Warming & Ventilating, Inc.
 3. Arrow United Industries
 4. Construction Specialties, Inc.
 5. Greenheck Fan Corporation
 6. Industrial Louvers, Inc.
 7. Ruskin Company
- B. Continuous Horizontal Fixed Blade Louvers: Extruded aluminum frames and louver blades with supporting framework concealed from view from outside face of louver by placing braces, mullions, and brackets on inside face; with close fitting, field-made splice joints in blades designed to permit expansion and contraction without deforming blades or framework; and complying with the following requirements:
 1. Louver Depth: 4 inches.
 2. Frame Type: Channel.
 3. Frame and Louver Blade Thickness: 0.081-inch.
 4. Louver Blade Profile: Drainable blade.
 5. Louver Blade Angle: 37-1/2 or 45 degrees.
- C. Performance Requirements: As follows, determined by testing units 48 inches wide by 48 inches high per AMCA Standard 500:
 1. Louver Free Area: Not less than 8.0 sq. ft.
 2. Air Performance: Not more than 0.10-inch water gage static pressure drop at airflow of 750 fpm free area intake velocity.
 3. Water Penetration: Not more than 0.014 oz. per sq. ft. of free area at airflow of 850 fpm free area velocity when tested for 15 minutes.
- D. AMCA Seal: Mark units with AMCA Certified Ratings Seal.
- E. Exterior Corners: Prefabricated corner units with mitered and welded blades aligned with straight sections, with concealed bracing.

2.4 LOUVER SCREENS

- A. Screening Type: 1/2-inch square mesh formed with .063-inch diameter aluminum wire bird screen. Bird screening shall be standard mill finish and replaceable within screen frames.

- B. Screen Frames: Fabricate screen frames from same material as louver with mitered corners, and to louver sizes indicated. Screen frame finish shall match louvers.
- C. Secure louver screens to inside face of louver frames with stainless steel machine screws, spaced at each corner and at 12 inches o.c. between.

2.5 ALUMINUM FINISHES

- A. Paint Coating: Fluoropolymer paint coating conforming to requirements of AAMA 2605. Color: Kynar 500 Sierra Tan.

2.6 GALVANIZED STEEL SHEET FINISHES

- A. Finish louvers after assembly.
- B. Surface Preparation: Clean surfaces with nonpetroleum solvent so surfaces are free of oil and other contaminants. After cleaning, apply a conversion coating suited to the organic coating to be applied over it. Clean welds, mechanical connections, and abraded areas and repair according to ASTM A 780.
- C. Fluoropolymer Finish: Immediately after cleaning and pretreating, apply manufacturer's standard 2-coat, baked-on 70 percent Kynar 500 fluoropolymer finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for applying and baking to achieve a minimum dry film thickness of 2 mils.

PART 3 - EXECUTION

3.1 COORDINATION

- A. Coordinate with installation of other Contractor's work as required to ensure that each element of the work performs properly.
- B. Coordinate fixed louver sizes with Division 23 Contractor.

3.2 INSTALLATION

- A. Locate and place louver units plumb, level, and in proper alignment with adjacent work.
- B. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weathertight connection.
- C. Form closely fitted joints with exposed connections accurately located and secured.
- D. Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.
- E. Repair finishes damaged by cutting, welding, soldering, and grinding operations required for fitting and jointing. Restore finishes so there is no evidence of corrective work. Return items

that cannot be refinished in field to shop, make required alterations and refinish entire unit, or provide new units.

- F. Protect galvanized and nonferrous metal surfaces from corrosion or galvanic action by application of a heavy coating of bituminous paint on surfaces that will be in contact with concrete, masonry, or dissimilar metals.
- G. Install concealed gaskets, flashings, joint fillers, and insulation as louver installation progresses, where weathertight louver joints are required. Comply with Section 07 92 00 for sealants applied during louver installation.

3.3 PROTECTION AND CLEANING

- A. Protect louvers from damage of any kind during construction period including use of temporary protective coverings where needed and approved by louver manufacturer. Remove protective covering at time of Substantial Completion.
- B. Restore louvers damaged during installation and construction period, so that no evidence remains of correction work. If results of restoration are unsuccessful, as judged by A/E, remove damaged units and replace with new units.
- C. Clean and touch-up minor abrasions in finishes with air-dried coating that matches color and gloss of, and is compatible with, factory-applied finish coating.
- D. Prior to final inspection, clean exposed surfaces with water and with a mild soap or detergent not harmful to finishes. Rinse thoroughly and dry surface.

End of Section

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SECTION 092400 - CEMENT PLASTERING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior portland cement plasterwork on unit masonry.

1.2 ACTION SUBMITTALS

- ##### A. Product Data: For each type of product indicated.

1.3 QUALITY ASSURANCE

- ##### A. Preinstallation Conference: Conduct conference at Project site.

1.4 DELIVERY, STORAGE, AND HANDLING

- ##### A. Store materials inside under cover and keep them dry and protected against damage from weather, direct sunlight, surface contamination, corrosion, construction traffic, and other causes.

1.5 PROJECT CONDITIONS

- ##### A. Comply with ASTM C 926 requirements.

- ##### B. Interior Plasterwork: Maintain room temperatures at greater than **40 deg F** for at least 48 hours before plaster application, and continuously during and after application.

1. Avoid conditions that result in plaster drying out during curing period. Distribute heat evenly; prevent concentrated or uneven heat on plaster.
2. Ventilate building spaces as required to remove water in excess of that required for hydrating plaster in a manner that prevents drafts of air from contacting surfaces during plaster application and until plaster is dry.

- ##### C. Factory-Prepared Finishes: Comply with manufacturer's written recommendations for environmental conditions for applying finishes.

PART 2 - PRODUCTS

2.1 ACCESSORIES

- ##### A. General: Comply with ASTM C 1063 and coordinate depth of trim and accessories with thicknesses and number of plaster coats required.

B. Metal Accessories:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ClarkDietrich Building Systems.
 - b. Marino\WARE.
 - c. Phillips Manufacturing Co.

2.2 MISCELLANEOUS MATERIALS

- A. Water for Mixing: Potable and free of substances capable of affecting plaster set or of damaging plaster, lath, or accessories.
- B. Fiber for Base Coat: Alkaline-resistant glass or polypropylene fibers, **1/2 inch** long, free of contaminants, manufactured for use in portland cement plaster.
- C. Bonding Compound: ASTM C 932.
- D. Steel Drill Screws: For metal-to-metal fastening, ASTM C 1002 or ASTM C 954, as required by thickness of metal being fastened; with pan head that is suitable for application; in lengths required to achieve penetration through joined materials of no fewer than three exposed threads.
- E. Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, not less than **0.0475-inch** diameter, unless otherwise indicated.

2.3 PLASTER MATERIALS

- A. Portland Cement: ASTM C 150, Type I.
 1. Color for Finish Coats: Gray.
- B. Masonry Cement: ASTM C 91, Type N.
 1. Color for Finish Coats: Gray.
- C. Lime: ASTM C 206, Type S; or ASTM C 207, Type S.
- D. Sand Aggregate: ASTM C 897.
 1. Color for Job-Mixed Finish Coats: White.
- E. Perlite Aggregate: ASTM C 35.
- F. Ready-Mixed Finish-Coat Plaster: Mill-mixed portland cement, aggregates, coloring agents, and proprietary ingredients.
 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

- a. [Bonsal American, an Oldcastle company](#); Marblesil Stucco Mix.
- b. [Parex USA, Inc](#); Premium Stucco Finish.
- c. [SonoWall, BASF Corp](#); Thoro Stucco.
- d. [United States Gypsum Company](#); Oriental Exterior Finish Stucco.

2. Color: Match Architect's sample To be painted.

2.4 PLASTER MIXES

A. General: Comply with ASTM C 926 for applications indicated.

1. Fiber Content: Add fiber to base-coat mixes after ingredients have mixed at least two minutes. Comply with fiber manufacturer's written instructions for fiber quantities in mixes, but do not exceed **1 lb of fiber/cu. yd.** of cementitious materials.

B. Base-Coat Mixes: Single base coats for two-coat plasterwork as follows:

1. Portland Cement Mix: For cementitious material, mix 1 part portland cement and 0 to 3/4 part lime. Use 2-1/2 to 4 parts aggregate per part of cementitious material.

C. Base-Coat Mixes: Single base coats for two-coat plasterwork as follows:

1. Portland Cement Mix: For cementitious material, mix 1 part portland cement and 3/4 to 1-1/2 parts lime. Use 2-1/2 to 4 parts aggregate per part of cementitious material.

D. Factory-Prepared Finish-Coat Mixes: For ready-mixed finish-coat plasters, comply with manufacturer's written instructions.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Protect adjacent work from soiling, spattering, moisture deterioration, and other harmful effects caused by plastering.

B. Prepare solid substrates for plaster that are smooth or that do not have the suction capability required to bond with plaster according to ASTM C 926.

3.3 INSTALLING ACCESSORIES

A. Install according to ASTM C 1063 and at locations indicated on Drawings.

3.4 PLASTER APPLICATION

A. General: Comply with ASTM C 926.

1. Do not deviate more than plus or minus **1/4 inch in 10 feet** from a true plane in finished plaster surfaces, as measured by a **10-foot** straightedge placed on surface.
2. Finish plaster flush with metal frames and other built-in metal items or accessories that act as a plaster ground unless otherwise indicated. Where casing bead does not terminate plaster at metal frame, cut base coat free from metal frame before plaster sets and groove finish coat at junctures with metal.
3. Provide plaster surfaces that are ready to receive field-applied finishes indicated.

B. Bonding Compound: Apply on unit masonry plaster bases.

C. Ceilings; Base-Coat Mixes for Use over Metal Lath: Scratch and brown coats for three-coat plasterwork; **3/4 inch** thick on concrete.

1. Portland cement mixes.

D. Walls; Base-Coat Mix: Scratch coat for two-coat plasterwork, **3/8 inch** thick on concrete masonry.

1. Portland cement mixes.

E. Ceilings; Base-Coat Mix: Scratch coat for two-coat plasterwork, **1/4 inch** thick on concrete.

1. Portland cement mixes.

F. Plaster Finish Coats: Apply to provide float finish to match Architect's sample.

G. Acrylic-Based Finish Coatings: Apply coating system, including primers, finish coats, and sealing topcoats, according to manufacturer's written instructions.

H. Concealed Interior Plasterwork:

1. Where plaster application will be concealed behind built-in cabinets, similar furnishings, and equipment, apply finish coat.

3.5 PLASTER REPAIRS

A. Repair or replace work to eliminate cracks, dents, blisters, buckles, crazing and check cracking, dry outs, efflorescence, sweat outs, and similar defects and where bond to substrate has failed.

3.6 PROTECTION

A. Remove temporary protection and enclosure of other work. Promptly remove plaster from door frames, windows, and other surfaces not indicated to be plastered. Repair floors, walls, and other surfaces stained, marred, or otherwise damaged during plastering.

End of section

SECTION 09 30 16 - QUARRY TILING

PART 1 - GENERAL

1.1 Summary

- A. Included in this section:
 - 1. Quarry tile preparation and installation.

1.2 REFERENCES

- A. Standards:
 - 1. American National Standards Institute (ANSI) – Installation and Material Specifications.
 - 2. Tile Council of America (TCA) - Handbook for Ceramic Tile Installation (Current Edition).

1.3 SUBMITTALS

- A. Product Data: Submit manufacturer's product data and installation instructions for each type of product specified.
- B. Samples: Submit samples for verification purposes for each color and texture of tile, trim, grout, and sealant selections indicated.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an installer with a minimum 5 years experience in work of this Section and who has successfully completed tile installations similar in material, design, and extent to that indicated for this Project.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirement of ANSI A137.1 for labeling sealed tile packages.
- B. Store tile and cementitious materials on elevated platforms, under cover, and in a dry location.
- C. Prevent damage or contamination to materials by water, freezing, foreign matter, and other causes.

1.6 PROJECT CONDITIONS

- A. Maintain environmental conditions and protect work during and after installation to comply with referenced standards and manufacturer's printed recommendations.
- B. Vent temporary heaters to exterior to prevent damage to tile work from carbon dioxide buildup.

- C. Maintain temperatures at 50 degrees F (10 degrees C) or more in tiled areas during installation and for 7 days after completion, unless higher temperatures are required by referenced installation standard or manufacturer's instructions.

1.7 EXTRA MATERIALS

- A. Deliver extra materials to Owner. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels clearly describing contents.
- B. Tile and Trim Units: Furnish quantity of full size units equal to 3 percent of amount installed, for each type, composition, color, pattern, and size.

PART 2 - PRODUCTS

- A. QUARRY TILE
- B. ANSI Ceramic Tile Standard: Provide tile that complies with ANSI A137.1, "Specifications for Ceramic Tile," for types, compositions, and other characteristics indicated.

<u>Finish Code</u>	<u>Manufacturer/Product/Color and Pattern</u>
--------------------	---

- | | |
|-----|---|
| F7a | As scheduled in the Room Finish Symbols Legend. |
| B1a | As scheduled in the Room Finish Symbols Legend. |

2.2 FLOOR SETTING BEDS

- A. Quarry Tile: Polymer modified dry-set mortar system, ANSI A118.4, consisting of "Kerabond" dry-set mortar with "Keralastic" polymer additive as manufactured by Mapei Corporation or equivalent.

2.3 GROUT

- A. Floor and Base: Epoxy grout, ANSI A118.3; Mapei "Kerapoxy" grout or equivalent. Color: Architect will select 1 color from manufacturer's color selection of not less than 10 colors.

2.4 SEALANT

- A. Multi-component, Pourable Urethane Sealant: ASTM C 920, Type M, Grade P, Class 25, Uses T, M, A, and, as applicable to joint substrates indicated, O. Color to be selected by Architect to match grout color. Provide joint primers, bond breaker tape and backer rods as recommended by sealant manufacturer for the specific application.

2.5 WATER

- A. Clean, fresh, and free of deleterious substances.

2.6 MISCELLANEOUS MATERIALS

- A. Trowelable Underlayments and Patching Compounds: Latex-modified, portland cement based formulation provided or approved by manufacturer of tile setting materials for installations indicated.
- B. Metal Edge Strips: Provide anodized aluminum strips, 1/8-inch wide at top edge with integral provision for anchorage to setting bed or substrate. Height to match tile thickness. Equivalent to CTC Edge as manufactured by Ceramic Tool Company, 1-800-236-5230.
- C. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers.

2.7 MIXING MORTARS AND GROUT

- A. Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturer's written instructions.
- B. Add materials, water, and additives in accurate proportions.
- C. Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.

PART 3 - EXECUTION

3.1 INSPECTION OF FLOORS AND WALLS

- A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of installed tile.
- B. Verify that substrates for setting tile are firm, dry, clean, free of oil, waxy films, and curing compounds and within flatness tolerances required by referenced ANSI A108 Series of tile installation standards for installations indicated.
- C. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile have been completed before installing tile.
- D. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust joint locations in consultation with Architect.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Remove coatings, including curing compounds and other substances that contain soap, wax, oil, or silicone, that are incompatible with tile setting materials.

- B. Provide concrete substrates for tile floors installed with thin-set mortar that comply with flatness tolerances specified in referenced ANSI A108 Series of tile installation standards.
 - 1. Fill cracks, holes, and depressions with trowelable leveling and patching compound according to tile setting material manufacturer's written instructions. Use product specifically recommended by tile setting material manufacturer.
 - 2. Remove protrusions, bumps, and ridges by sanding or grinding.

3.3 INSTALLATION

- A. Layout floors and walls with equal border units, not less than 1/2 tile width.
- B. Install metal edge strips at locations indicated or where exposed edge of tile flooring meets resilient tile or other hard flooring that finishes flush with top of tile.
- C. Comply with ANSI A108 Series or A108.6 and TCA Handbook for quarry tile installation standards that apply to type of setting and grouting materials and methods indicated.
- D. Quarry tile flooring shall be installed in accordance with TCA Handbook Method F113.
- E. Extend tile work into recesses and under or behind equipment and fixtures to form a complete covering without interruptions, unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.
- F. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, drains, and other penetrations so that plates, collars, or covers overlap tile.
- G. Ensure square floor drains are adjusted to align with walls and tile joints.
- H. Ensure tile joints are uniform in width, subject to normal variance in tolerance allowed in tile size. Ensure joints are watertight, without voids, cracks, excess mortar, or grout.
- I. Sound tile after setting. Remove and replace hollow sounding units.
- J. Allow tile to set for a minimum of 48 hours prior to grouting.

3.4 EXPANSION, CONTROL, ISOLATION JOINTS

- A. Locate joints in tile surfaces directly above joints in substrates and in accordance with recommendations of TCA EJ171 to prevent cracking of finished tile floor. Confer with and obtain Architect's approval prior to installation. After grout has cured, prepare joints for sealant by applying primer (if required by sealant manufacturer) to exposed edges of tile. Install bond breaker tape continuously to substrate in joint. Mix and install sealant in joint as recommended by sealant manufacturer.
- B. Do not saw cut joints after installation of tile flooring.

3.5 GROUTING

- A. Refer to ANSI specifications for grouting details and follow grout manufacturer's instructions. Grout surface slightly below surface of tile.

- B. Cure completed installation as recommended by grout manufacturer.

3.6 CLEANING

- A. On completion of placement and grouting, clean all quarry tile surfaces so they are free of foreign matter.
- B. Remove mortar and grout residue from tile as soon as possible.
- C. Clean grout smears and haze from tile according to tile and grout manufacturer's written instructions. Use only cleaners recommended by tile and grout manufacturers and only after determining that cleaners are safe to use by testing on samples of tile and other surfaces to be cleaned. Protect metal surfaces and plumbing fixtures from effects of cleaning. Flush surfaces with clean water before and after cleaning.
- D. When recommended by tile manufacturer, apply coat of neutral protective cleaner to completed tile wall and floors.

3.7 PROTECTION

- A. Protect installed tile work with kraft paper or other heavy covering during the construction period to prevent staining, damage, and wear.

End of Section

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SECTION 09 90 00 - PAINTING AND COATING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Interior and exterior painting and surface preparation.

1.2 SUBMITTALS

- A. Product Data: Submit manufacturer's technical information and application instructions for each material proposed for use.
- B. Samples: Submit paint and stain samples of each color for Architect's approval. Resubmit until required sheen and color are achieved.
- C. Submit schedule for paint and finishing activity.

1.3 DELIVERY, STORAGE AND HANDLING

- A. Deliver all paints, varnishes, enamels, lacquers, stains and similar materials in the original containers with the seals unbroken and label intact and with the manufacturer's instructions printed thereon.
- B. Store all materials used on the job in protected areas designated by the Prime Contractor. Keep storage place neat and clean, and make good all damage thereto or its surroundings. Remove used rags, waste and trash from the building every night and take every precaution to avoid the danger of fire.

1.4 PROJECT CONDITIONS

- A. Moisture in concrete block and plaster shall be substantially dissipated prior to their being painted. Test with moisture meter to ensure moisture level does not exceed paint manufacturer's recommendations.
- B. Before painting is started in any area, broom clean and remove excessive dust.
- C. After painting operations begin in a given area, broom cleaning will not be allowed; cleaning shall then be done only with commercial vacuum cleaning equipment.
- D. Provide adequate illumination in all areas where painting operations are in progress.
- E. Schedule and coordinate the work of this Section with other trades and do not proceed until other work and/or job conditions are as required to achieve satisfactory results.
- F. Examine the Contract Documents for various other trades and thoroughly familiarize yourself with all their provisions regarding painting.

1.5 EXTRA MATERIALS

- A. Furnish extra paint materials from the same production run as the materials applied in the quantities indicated below. Package paint materials in unopened, factory-sealed containers for storage and identify with labels describing contents. Deliver extra materials to Owner designated storage room.
 - 1. Quantity: Not less than 1 gallon of each material and color applied.

PART 2 - PRODUCTS

2.1 ACCEPTABLE PAINT, STAIN, AND VARNISH MANUFACTURERS

- A. Provide products by one of the following manufacturers:
 - 1. Benjamin Moore
 - 2. Coronado Paint Company
 - 3. Diamond Vogel Paints
 - 4. Hallman/Lindsay
 - 5. Glidden Professional
 - 6. Mautz Paint Company
 - 7. Pratt & Lambert
 - 8. Sherwin-Williams

2.2 MATERIALS

- A. Provide all painting materials of the best quality and approved by the Owner. They shall bear identifying labels on the containers with the manufacturer's instructions printed thereon. Paint containers not bearing manufacturer's identifying labels or bearing identifying labels of other manufacturers not approved by Owner will not be permitted on the project site.
- B. Paint shall not be badly settled, caked, or thickened in the container, shall be readily dispersed with a paddle to a smooth consistency and shall have excellent application properties.
- C. Deliver paint to the job color-mixed except for tinting of undercoats and possible thinning.
- D. Tinting materials shall be recommended by the manufacturer for the particular material tinted.
- E. Ensure that all mixed colors match the color selection made by the A/E prior to application of the coating.
- F. Application Equipment:
 - 1. Application equipment is not required to be new, but shall be adequate for the work and workmanship required herein.
- G. Accessory Material:
 - 1. Include all required ladders, scaffolding, drop cloths, maskings, scrapers, tools, dusters, cleaning solvents, and waste, as required to perform the Work and achieve the results herein specified.

2.3 COLORS

- A. Colors and finishes are listed on the Drawings and in the Room Finish Symbols Legend. Colors by other listed acceptable manufacturers shall match the listed colors in all respects.
- B. See Schedule of paints and finishes at end of this Section.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Before starting any work, carefully examine surfaces to receive paint finishes for defects which cannot be corrected by the procedures specified herein under "PREPARATION OF SURFACES" and which might prevent satisfactory painting results. Do not proceed until such damages are corrected. The commencing of work in a specific area shall be construed as acceptance of the surfaces, and thereafter the painting contractor shall be fully responsible for satisfactory work as required herein.

3.2 PREPARATION OF SURFACES

- A. General Procedures:
 - 1. Remove and protect hardware, accessories, device plates, lighting fixtures, factory finished work and similar items, or provide ample in-place protection. Upon completion of each space, carefully replace all removed items.
 - 2. Remove electrical panel box covers and doors before painting walls. Paint separately and reinstall after all paint is dry.
- B. Surface Preparation:
 - 1. Clean and prepare surfaces to be painted in accordance with the manufacturer's instructions for each particular substrate condition and as specified.
- C. Clean surfaces before applying paint or surface treatments. Remove oil and grease prior to cleaning. Schedule cleaning and painting so that dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.
- D. Provide barrier coats over incompatible primers or remove and reprime. Notify A/E in writing of problems anticipated with using the specified finish coat material with substrates primed by others.
- E. Cementitious Surfaces:
 - 1. Prepare concrete, and cement plaster surfaces to be painted. Remove efflorescence, chalk, dust, dirt, grease, oils, and release agents. Roughen as required to remove glaze. If hardeners or sealers have been used to improve curing, use mechanical methods of surface preparation.
 - 2. Use abrasive blast cleaning methods if recommended by the paint manufacturer.
- F. Determine alkalinity and moisture content of surfaces by performing appropriate tests. If surfaces are sufficiently alkaline to cause blistering and burning of finish paint, correct this condition before application. Do not paint surfaces where moisture content exceeds that permitted in manufacturer's printed directions.

- G. Ferrous Metal Surfaces:
1. Clean nongalvanized ferrous metal surfaces that have not been shop coated; remove oil, grease, dirt, loose mill scale, and other foreign substances. Use solvent or mechanical cleaning methods that comply with recommendations of the Steel Structures Painting Council (SSPC).
 2. Blast steel surfaces clean as recommended by the paint system manufacturer and in accordance with requirements of SSPC specification SSPC-SP 6.
 3. Remove rust, mill scale and defective shop applied primer paint down to sound surfaces or bare metal using scraper, sandpaper or wire brush as necessary. Grind disc sand, etc., if necessary to remove shoulders at edge of sound paint to prevent them from photographing through finish coats. Clean with solvents recommended by the paint manufacturer and wipe dry with clean cloths.
 4. Touch up all bare metal and damaged shop applied prime coats with the same primer as the shop coat.

3.3 APPLICATION - WORKMANSHIP

- A. Apply paint in accordance with manufacturer's directions. Use applicators and techniques best suited for substrate and type of material being applied. Employ only skilled mechanics.
- B. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film.
- C. Apply materials under adequate illumination, evenly spread and flowed on smoothly to avoid runs, sags, holidays, brush marks, air bubbles, and excessive roller stipple.
- D. Apply materials at not less than the manufacturer's recommend spreading rate. Provide a total dry film thickness of the entire system as recommended by the manufacturer.
- E. Coverage and hide shall be complete. When color, stain, dirt or undercoats show through final coat of paint, the surface shall be covered by additional coats until the paint film is of uniform finish, color, appearance and coverage, at no additional cost to the Owner.
- F. All coats shall be dry to manufacturer's recommendations before applying succeeding coats.
- G. All suction spots or "hot spots" in plaster and/or cement after the application of the first coat shall be touched up before applying the second coat.
- H. Where spray painting is specified the contractor shall finish 100 square feet by spraying the sample of the finish upon the request of the A/E. This shall be finished with materials specified or approved.
- I. Ferrous Metal Surfaces: Prime and finish all new ferrous metal surfaces.
1. Exterior Painting: Exterior painting shall not be done when the surface temperature is below 50 degrees F., while the surface is damp, or during cold, rainy or frosty weather. The substrate temperature must be 5 degrees F. or more above the dew point temperature while painting and during the coatings cure. Avoid painting surfaces while they are exposed to hot sun.

3.4 FINISHING OF SURFACES AT EXISTING BUILDINGS

- A. Where patching of existing finishes occur, paint to match existing unless new colors are scheduled. See Section 02 41 19.
- B. Paint new surfaces in existing buildings as listed in Room Finish Schedule.
- C. Where new wall and ceiling surfaces occur in existing buildings, and where existing painted surfaces remain in the same room, completely paint existing surfaces to match finish on new surfaces

3.5 TOUCH-UP, CLEANING, AND REPAIRS

- A. Touch-up all marred, scratched or patched surfaces to affect a uniform appearing surface.
- B. As work progresses, promptly remove paint where spilled, splashed, or spattered.
- C. Repair to "like new" condition, all surfaces which are damaged due to paint removal, or replace with new work.
- D. During progress of work, keep premises free from unnecessary accumulation of tools, equipment, rubbish, cans, rags, etc.
- E. Upon completion of work in any area, leave premises neat and clean and free of rubbish.

3.6 PROTECTION

- A. Protect work at all times, and protect all adjacent work and materials by suitable covering or other method during progress of Work.
- B. Provide "wet paint" signs to protect newly painted finishes. Remove temporary protective wrappings provided by others for protection of their work after completion of painting operations.

3.7 PAINTS AND COATINGS SCHEDULE

- A. Sherwin-Williams products listed for quality standard, unless otherwise indicated.
- B. Surfaces to be painted are listed in the Room Finish Schedule, and indicated on the Drawings.

3.8 EXTERIOR WORK

- A. Concrete:
 - 1. 2 coats Loxon XP Textured Waterproofing System A24 Series
 - 2. Apply 2 coats with a total dry film thickness of 14 to 18 mils with 10 or less pinholes per square feet.

3.9 INTERIOR WORK

- A. CMU and Concrete:
 - 1. 1 coat PrepRite Blockfiller B25W25, tinted
 - 2. 2 coats Water Based Catalyzed Epoxy S/G B70/B60V25
- B. Plaster:
 - 1. 1 coat High Build Primer B28W8601
 - 2. 2 coats Water Based Catalyzed Epoxy S/G B70/B60V25
- C. Ferrous Metals, Primed Metal, Galvanized, and Non-Ferrous Metal:
 - 1. 1 coat Pro-Cyrl Universal Metal Primer B66-310 Series
 - 2. 2 coats ProClassic Interior Waterbased Acrylic-Alkyd Semi-Gloss B34W850 Series

3.10 SCHEDULE OF MISCELLANEOUS FINISHES

- A. General:
 - 1. Finish mechanical piping and electrical conduits, boxes; sprinkler piping and brackets; ductwork and accessories exposed in rooms and areas scheduled to receive wall and ceiling finishes with 2 spray finish coats of same material and color as adjacent surface, over appropriate primer.
 - 2. Examine Drawings and Specifications for miscellaneous items indicated to be finished.
 - 3. Include the following:
 - a. New hollow metal doors and frames.
 - b. Surface raceways "Wiremold" specified in Division 26.
 - c. Electrical panel board covers specified in Division 26.
 - d. Obtain mechanical and electrical items noted above from respective contractors and spray paint prior to installation.
- B. Apply 2 spray coats ProClassic XP Interior Alkyd Semi-Gloss B34 Series over appropriate primer to all miscellaneous finish work except as noted otherwise.

End of Section

SECTION 09 91 50

SHOP PAINTING

PART 1 GENERAL

1.01 SUMMARY

- A. Provide shop painting of steel work, miscellaneous metals, and equipment as specified and shown on Drawings.
- B. Related Sections:
 - 1. Section 09 97 20 - Coating Systems for Industrial Facilities

1.02 REFERENCES

- A. ASTM: American Society of Testing Materials
- B. International Association of Corrosion Engineers (NACE)
- C. National Association of Pipe Fabricators(NAPF)
- D. Society for Protective Coatings (SSPC):
 - 1. Volume 1 - Good Painting Practice
 - 2. Volume 2 - Systems and Specifications

1.03 SUBMITTALS

- A. Refer to Section 01 33 00.
- B. Product Data:
 - 1. Submit data sheet for each coating system.
 - 2. Provide Certificate of Compliance stating the surface preparation and coating application is in accordance with this Section.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Delivery:
 - 1. Deliver all materials in original, factory-sealed containers bearing manufacturer's intact and legible label with the following information:
 - a. Material identification by name or number.
 - b. Manufacturer's stock number, batch number, and date of manufacture.
 - c. Color name and number.
- B. Storage:
 - 1. Store materials in an environmentally controlled location as recommended by paint manufacturer's product information guidelines.
 - 2. Store materials not in actual use in tightly covered containers.
 - 3. Comply with health and fire regulations of governing authorities having jurisdiction.
- C. Handling:
 - 1. Handle materials in a manner that precludes the possibility of contamination or incorrect product catalyzation.
 - 2. Do not open containers or mix components until surface preparation has been completed and approved by the coating inspector.

3. Maintain containers used for storage, mixing, and application in a clean condition, free of foreign materials and residue.
- D. Allow painted items to fully cure before shipping or handling.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Standard of Quality: Unless indicated otherwise, design is based on:
1. Sherwin Williams Company www.sherwin-williams.com
 2. Tnemec Company www.tnemec.com
 3. Manufacturer of comparable products submitted in compliance with Section 01 25 13.
- B. Approved Substitutions:
1. Submit request for substitution in accordance with Section 01 25 13.
 2. Substitutions: Substitutions that decrease film thickness, or that are of other generic types, will not be approved for this Project.

2.02 MATERIALS

- A. Regulatory Requirements:
1. Products shall comply with the United States Clean Air Act for maximum VOC content.
 2. Products shall comply with state environmental and health standards.
 3. All products shall be lead, chromate, mercury and heavy metals free.
- B. Thinners: Use thinners approved by coating manufacturer and within their recommended limits.
- C. Abrasives:
1. Abrasive materials must be in compliance with state environmental and health standards.
 2. Properly size abrasives to provide the specified surface profile.

PART 3 EXECUTION

3.01 PREPARATION

- A. Visually evaluate surface preparation by comparison with pictorial standards of SSPC-VIS-1.
- B. Remove all surface contaminants in accordance with SSPC-SP1 Solvent Cleaning.
- C. Clean and remove all rust, slag, weld splatter, weld scabs, mill scale, and loose paint.
- D. Mask-off 4-inch strip from edges of heat affected areas to provide for field welding.
- E. Surface profile shall be in accordance with manufacturer's product recommendation.
- F. Re-blast all surfaces:
1. Where rusting has recurred.
 2. That do not meet the requirements of these specifications.
- G. Interior and Exterior Steel:
1. Moderate Service: Use the following surface preparation for steel that is subject to normal exposure and moderate humidity.
 - a. Includes:
 - 1) Interior structural steel.
 - 2) Miscellaneous metals.
 - 3) Doors.

- 4) Frames.
 - b. Enclosed or protected: SSPC-SP3 - Power Tool Cleaning.
 - c. Exposed to view: SSPC-SP6 - Commercial Blast Cleaning.
- 2. Severe Service: Use the following surface preparation for steel that is subject to frequent splashing, spilling, and exposure to high humidity and condensation.
 - a. Includes:
 - 1) Interior and exterior structural steel.
 - 2) Miscellaneous metals.
 - 3) All piping, valves, and equipment.
 - b. SSPC-SP6 "Commercial Blast Cleaning".
 - c. Ductile Iron: NAPF 500-03-03 Abrasive Blast Cleaning.
- 3. Immersion Service: Use the following surface preparation for steel that is subject to immersion, or constant exposure to high humidity and condensation.
 - a. Includes:
 - 1) Structural steel.
 - 2) Miscellaneous metals.
 - 3) Piping, valves, equipment, and supports.
 - b. SSPC-SP10 "Near White Blast Cleaning".
 - c. Ductile iron: NAPF 500-03-04 Abrasive Blast Cleaning.

3.02 SHOP PAINTING

- A. Materials: Mix, thin, and apply according to the manufacturer's written instructions.
- B. Stripe coat all edges, corners, crevices, bolts, and welds.
- C. Coating Schedule:

Service	Sherwin Williams	Tnemec
Moderate	Kem Bond Universal Primer Color: Gray DFT: 2.5 to 3.5	377H78 Chem Prime HS Color: Gray DFT: 2.5 to 3.5
Severe	Galvapac DFT: 2.5 to 3.5 or Copoly Primer DFT: 3.0 to 5.0	HydroZinc DFT: 2.5 to 3.5 or N140 Pota-Pox DFT: 3.0 to 5.0
Immersion	Copoly Primer Color: Gold DFT: 3.0 to 5.0	N140 Pota-Pox DFT: 3.0 to 5.0

3.03 SOURCE QUALITY CONTROL

- A. Measure dry film thickness with a magnetic film thickness gage in accordance with SSPC-PA2.
- B. Visually inspect dried film for runs, sags, dry spray, overspray, embedded particles and missed areas.
- C. Repair defective or damaged areas.
- D. Provide Certificate of Compliance stating the surface preparation and coating application is in accordance with this Section.

END OF SECTION

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SECTION 09 97 20

COATING SYSTEMS FOR INDUSTRIAL FACILITIES

PART 1 GENERAL

1.01 SUMMARY

- A. Provide surface preparation and application of high performance industrial coatings.
- B. Related Sections:
 - 1. Section 03 30 00 - Cast-in-Place Concrete
 - 2. Section 04 20 00 - Unit Masonry Assemblies
 - 3. Section 05 12 00 - Structural Steel Framing
 - 4. Section 05 50 00 - Metal Fabrications
 - 5. Section 06 10 00 - Rough Carpeting
 - 6. Section 08 11 13 - Hollow Metal Doors and Frames (Commercial)
 - 7. Section 09 29 00 - Gypsum Board
 - 8. Section 09 91 50 - Shop Painting

1.02 REFERENCES

- A. ASTM - American Society for Testing Materials
- B. International Association of Corrosion Engineers (NACE)
- C. International Concrete Repair Institute (ICRI)
- D. NSF - ANSI/NSF Standard 61 - Drinking Water System Components
- E. Society for Protective Coatings (SSPC):
 - 1. Volume 1: Good Painting Practice
 - 2. Volume 2: Systems and Specifications

1.03 DEFINITIONS

- A. Applicator: Person applying the product in the field at Site.
- B. Dry Film Thickness (DFT): Minimum dry coating thickness.
- C. SFPG: Square feet per gallon.
- D. VOC: Volatile Organic Compounds.
- E. Regional: The state in which the Project is located and surrounding states.
- F. LEL: Lower Explosion Limit.
- G. Containment: Equipment, supports, screens, tarps, or shrouds that prevent airborne debris generated during surface preparation and coating application from entering the environment, and also facilitates controlled collection of debris for disposal in compliance with current regional and federal regulations.
- H. Moderate Service: Surfaces subject to normal exposure and moderate humidity. Includes concrete, concrete masonry, structural steel, miscellaneous metals, doors, and frames.
- I. Severe Service: Surfaces subject to frequent splashing, spilling, and exposure to high humidity and condensation. Includes structural steel, miscellaneous metals, piping, valves, and equipment.

- J. Immersion Service: Surfaces subject to immersion, or constant exposure to high humidity and condensation.

1.04 SUBMITTALS

- A. Manufacturers' current Product Data sheets.
 - 1. Coatings
 - 2. Abrasive(s)
 - 3. Additives (as applicable)
- B. Material Safety Data Sheets (MSDS) for each product specified.
- C. Samples:
 - 1. Color chips of available colors.
 - 2. Recommended colors for color code marking.
- D. Post-construction Contract Closeout: Daily application records using Engineer's provided format, or Contractor's form pre-approved by Engineer.

1.05 QUALITY ASSURANCE

- A. Single Source Responsibility: Provide coating products from a single manufacturer.
- B. Qualifications:
 - 1. Applicator shall have minimum of 5 years application experience on projects of similar size and scope.
 - 2. Provide written statement from coating manufacturer's authorized representative attesting that Applicator has been instructed on proper preparation, mixing, and application procedures for coating specified.
 - 3. Provide regional references for coating contractor for a minimum of 5 different projects of similar size and scope completed in the last 5 years, including:
 - a. Contact person and phone number.
 - b. Project location.
 - c. Cost of coating work.
 - d. Start/finish dates.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to Site in original, factory-sealed containers bearing manufacturer's intact name and legible label with the following information.
 - 1. Material identification by name or number.
 - 2. Manufacturer's stock number, batch number, and date of manufacture.
 - 3. Color name and number.
- B. Storage:
 - 1. Store materials in an environmentally controlled location as recommended by coating manufacturer's product information guidelines.
 - 2. Store materials not in actual use in tightly covered containers.
 - 3. Comply with health and fire regulations of governing authorities having jurisdiction.
- C. Handling:
 - 1. Handle materials in a manner that precludes the possibility of contamination or incorrect product catalyzation.
 - 2. Do not open containers or mix components until surface preparation has been completed and approved by Engineer.
 - 3. Maintain containers used for storage, mixing, and application in a clean condition, free of foreign materials and residue.

1.07 PROJECT CONDITIONS

- A. Site Facilities:
 - 1. As necessary to maintain required ambient conditions and contract scheduling, the contractor shall provide all required equipment for supplemental heating, dehumidification and power.
 - 2. Maintain environmental conditions, including temperature, dew point and humidity within range recommended by coating manufacturer.
 - 3. Do not use heat sources that emit carbon dioxide or carbon monoxide into areas being coated.
 - 4. Properly locate and vent all such heat sources to the exterior such that coating systems are unaffected by exhaust products.
 - 5. Provide lighting to the satisfaction of Engineer to illuminate the complete workspace during blasting, coating, and inspection operations.

- B. Environmental Conditions:
 - 1. Coating shall not be applied in rain, snow, fog, or mist.
 - 2. Conduct surface preparation and coating operations only when the following conditions are met.
 - a. Ambient air temperature is within limits recommended by coating manufacturer.
 - b. Steel surface temperature is more than 5 degrees above the dew point of the ambient air.
 - c. Surfaces to be painted are clean and completely dry.
 - 3. Immersion Service: Continuous forced ventilation in accordance with manufacturer's recommendation.
 - a. At a minimum provide 3 to 5 air exchanges per hour for 12 hours after application of the prime coat and for the first 24 hours following final finish coat application.
 - b. Maintain exhaust in compliance with state standards.
 - c. Provide containment during abrasive blasting operations to prevent emission of abrasives, existing coatings, and contaminants onto adjacent property, street, structures, or equipment

- C. Drawings do not purport to show actual field dimensions, but are intended only to establish location and scope of Work. Field-verify dimensions and assume full responsibility for their accuracy.

1.08 SEQUENCING AND SCHEDULING

- A. Schedule blasting, cleaning, and painting so that contaminants from cleaning process will not come in contact with wet, newly painted surfaces.

- B. Do not apply coatings until surface preparation has been approved by Engineer.

- C. Do not apply finish coats until:
 - 1. All prime coat application is completed.
 - 2. All surfaces have been cleaned.
 - 3. All surfaces have been approved for coating by Engineer.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Coatings:
 - 1. Acceptable Manufacture: Subject to compliance with specified requirements, acceptable manufacturers and products are:
 - a. Sherwin Williams (SWC) www.sherwin.com
 - b. Tnemec (TCI) www.tnemec.com

- B. Sealant Caulking:
 - 1. Sika-Flex 1A by Sika Corporation www.sikausa.com

- C. Substitutions: Manufacturer of comparable products submitted in compliance with Section 01 25 13.

- D. Substitution of fast-cure products or acceleration additives must receive prior approval by Engineer.

2.02 MATERIALS

- A. Regulatory Requirements:
 - 1. Products shall comply with the United States Clean Air Act for maximum VOC content.
 - 2. Products shall comply with state environmental and health standards.
 - 3. All products shall be lead, chromate, mercury and heavy metals free.
- B. Thinners: Use thinners approved by coating manufacturer and within their recommended limits.
- C. Abrasives:
 - 1. Abrasive materials must be in compliance with state environmental and health standards.
 - 2. Properly size abrasives to provide the specified surface profile.
 - 3. The use of abrasives exceeding 1 percent free silica is prohibited.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine substrates, areas, and conditions for compliance with requirements for application and notify Engineer in writing of conditions detrimental to proper and timely completion of Work. Do not proceed with Work until unsatisfactory conditions have been corrected.
- B. Notify Engineer in writing of anticipated problems using specified systems with substrates primed by others.
- C. Prepare existing materials or substrates to be coated to meet the requirements of specified coating system.
- D. Starting of painting Work will be construed as Contractor's acceptance of surfaces and conditions within any particular area.

3.02 PREPARATION

- A. Remove hardware, hardware accessories, machined surfaces, plates, lighting fixtures, and similar items not to be painted, or provide surface-applied protection prior to surface preparation and painting. Following completion of painting, reinstall removed items.
- B. Clean and remove all rust, slag, weld splatter, weld scabs, mill scale, loose paint, and surface contaminants
- C. Chip or grind off flux, spatter, slag or other laminations left from welding. Grind welds and other sharp projects smooth.
- D. Re-blast all Surfaces:
 - 1. Where rusting has recurred.
 - 2. That do not meet the requirements of this Section.
- E. Feather edges of existing coating to form a smooth transition prior to spot priming.
- F. Scarify previously applied coatings in accordance with coating manufacturer's recommendations.
- G. All substrates: Prepare surface profiles in accordance with manufacturer's recommendations.
- H. Prime all bare metal and touch-up damaged shop-applied prime coat with specified primer. Prepare and coat in accordance with this Section.

- I. Concrete:
 - 1. Allow new concrete to cure 28 days.
 - 2. Verify dryness by testing in accordance with ASTM D4263.
 - a. Floors: If moisture is detected, perform Moisture Vapor Emission Testing in accordance with ASTM F1869.
 - b. Moisture content not to exceed 3 pounds per 1,000 square feet in a 24-hour period.
- J. Fill cracks and voids according to coating manufacturer's recommendations.
- K. Surface Preparation Classifications:
 - 1. P1: SSPC-SP1 - Solvent Cleaning.
 - a. Scarify surface by sanding.
 - b. Brush blast if recommended by coating manufacturer.
 - 2. P2: SSPC-SP2 - Hand Tool Cleaning.
 - 3. P3: SSPC-SP3 - Power Tool Cleaning
 - 4. P4:
 - a. Prepare concrete, concrete block, cement plaster, and drywall by removing all efflorescence, chalk, dust, dirt, grease, and other oils, and by roughening as required to remove glaze.
 - b. Scrap and grind fins and protrusions flush with surface.
 - c. Rake mortar joints clean.
 - d. Brush blast if recommended by coating manufacturer.
 - 5. P5: SSPC-SP5 - White Metal Blast Cleaning.
 - 6. P6: SSPC-SP6 - Commercial Blast Cleaning.
 - 7. P7: SSPC-SP7 - Brush Off Blast Cleaning.
 - 8. P9:
 - a. Clean wood surfaces to be painted of all dirt, oil, or other foreign substances with scrapers, mineral spirits, and sandpaper, as required.
 - b. Sandpaper smooth those finished surfaces exposed to view.
 - 9. P10: SSPC-SP10 - Near White Blast Cleaning.
 - 10. P11: SSPC-SP11 - Power Tool Cleaning to Bare Metal.
 - 11. P12: SSPC-SP12 - LP-WC/WJ-4: Pressure Wash
 - 12. P13: SSPC-SP13 - Surface Preparation of Concrete:
 - a. 4.3.1.: Abrasive Blast.
 - b. 4.3.2.: High Pressure Water Cleaning.
- L. Re-blast all Surfaces:
 - 1. Where rusting has recurred.
 - 2. That do not meet the above requirements.

3.03 MATERIALS PREPARATION

- A. Mix and prepare materials in accordance with manufacturer's directions.
- B. Maintain containers used in mixing and application in a clean condition, free of foreign materials and residue.
- C. The following is prohibited:
 - 1. Field mixing of partial containers.
 - 2. Field mixing of lead abatement additive.
 - 3. Field tinting.

3.04 APPLICATION

- A. Surface preparation and coating system are as indicated in the "Coating Schedule" at the end of this Section, or noted on Drawings.
- B. Use equipment and techniques best suited for substrate and type of material being applied.

- C. Apply in accordance with manufacturer's directions.
 1. Do not apply in snow, rain, fog, mist, or damp surfaces.
 2. Allow wet surfaces to dry thoroughly and attain the temperature and conditions specified before proceeding with or continuing the painting operation.
 3. Work may continue during inclement weather only if areas and surfaces are enclosed and temperatures within the area can be maintained within limits specified during application and drying periods.
- D. Avoid degradation and contamination of surfaces and avoid intercoat contamination.
 1. Surfaces shall be free from grease, oil, abrasives, and other contaminants that may have an adverse affect on coating application, bonding, curing, or performance.
 2. Clean contaminated surfaces before applying next coat.
 3. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions otherwise detrimental to formation of a durable system.
- E. Brush-apply primer or intermediate on all welds and edges prior to general application of finish coat.
- F. Apply caulking to flange interfaces, gaps, and intermittent weld seams.
- G. Provide finish coats that are compatible with primers used. Prime and intermediate coats shall be lighter than subsequent coat.
- H. Provide application thickness to specific mil requirements. Mil thicknesses referenced are in dry mil thickness.
- I. All paint systems are "full coverage." Where discrepancies between manufacturer's square foot coverage and mil thickness occur, use mil thickness requirements.
- J. Where voids are present exposing the substrate or undercoats, apply additional coats until a uniform color and finish is obtained. Give special attention to insure that surfaces, including edges, corners, crevices, welds, and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces.
- K. Do not apply additional coats until Engineer has had the opportunity to inspect and approve previous coat.
- L. Unless otherwise indicated, match color of adjacent walls or equipment when painting conduit, miscellaneous brackets, hangers, and supports.
- M. Smooth out runs or sags immediately, or remove and recoat entire surface.
- N. Allow preceding coats to dry before recoating. Recoat within time limits specified by coating manufacturer.
- O. Do not apply coatings to the following surfaces:
 1. Factory or installer-finished items.
 2. Anodized aluminum, stainless steel, or other pre-finished metal.
 3. Moving parts of operating devices.
 4. Sprinkler heads or other fire detection/suppression elements.
 5. Code required labels or equipment nameplates.

3.05 COLOR CODING

- A. Pipes Exposed or Concealed in Accessible Pipe Spaces:
 1. Provide with color band and arrow indicating direction of flow, and legend adjacent to valves, at not more than 20-foot spacing on straight pipe runs, adjacent to change in direction, and on both sides where pipes pass through walls or floors.
 2. Color-coding shall be based on pipe contents in accordance with the "Pipe Color Schedule" at the end of this Section, or noted on Drawings.

- B. Bands: Color and of width indicated.
- C. Arrows: Install adjacent to each band and legend to indicate direction of flow in pipe.
- D. Legends:
 - 1. Print in uppercase letters and letter sizes as listed in this Section to match "arrow".

3.06 QUALITY CONTROL

- A. Contractor shall provide all necessary equipment to monitor and record the information required on the Daily Application Record.
 - 1. Equipment shall be in good condition.
 - 2. Operational within its design range.
 - 3. Calibrated as required by the specified standard for use of each device.
- B. Maintain a copy of the following information at the site:
 - 1. Product Data Sheets.
 - 2. Material Safety Data Sheets (MSDS).
 - 3. Contract Document and submittals.
 - 4. Daily Application Record.
 - a. Record information (in English) on form located at the end of this Section.
- C. Owner's representative may be on site to observe the application of each coating, and the preparation of each substrate.
- D. Provide safe and complete access to all surfaces for observation by Owner and/or Engineer.
- E. Prepare rigging so that all surfaces are within arm's reach of observer.
- F. Measure wet paint with wet film thickness gages.
- G. Provide DFT measurements for all coatings in accordance with SSPC-PA2.
- H. Perform Holiday testing in accordance with NACE RPO 188 as directed by Engineer.
- I. Correct any deficiencies observed or detected by field testing as directed by Engineer.

3.07 CLEANING AND PROTECTION

- A. During progress of Work, remove discarded materials, rubbish, cans, and rags at end of each workday from the Site.
- B. Furnish drop cloths, shields, and protective methods to prevent spray or droppings from disfiguring other surfaces.
- C. Upon completion of Work:
 - 1. Clean window glass and spattered surfaces.
 - 2. Remove spattered paint by washing and scraping, using care not to scratch or otherwise damage finished surfaces.
- D. Protect Work of other trades against damage. Correct any damage by cleaning, repairing or replacing, and repainting.
- E. Provide "Wet Paint" signs as required to protect newly-painted finishes. Remove temporary protective wrappings provided for protection of Work, after completion of painting operations.
- F. At completion of Work of other trades, touch-up and restore damaged or defaced surfaces.

3.08 SCHEDULES

A. See the following pages.

Coating Schedule

SYSTEM NUMBER	TYPE	SUBSTRATE / SERVICE	SURFACE PREP	MFG	FIRST COAT	DFT (Mils)	SECOND COAT	DFT (Mils)	FINISH COAT	DFT (Mils)	NOTES
C1	Epoxy	Concrete Immersion Severe (Non-Potable)	P13 4.3.1	SWC	Macropoxy 646	6.0 - 8.0	Macropoxy 646	6.0 - 8.0			Fill bugholes and voids with Steel Seam VSE.
				TCI	N69	6.0 - 8.0	N69	6.0 - 8.0		Fill bugholes and voids with 63-1500	
C2	Epoxy	Concrete Immersion Severe (Potable/Treated Water)	P13 4.3.1	SWC	Macropoxy 646 PW	6.0 - 8.0	Macropoxy 646 PW	6.0 - 8.0			Fill bugholes and voids with Steel Seam VSE. .
				TCI	N140	6.0 - 8.0	N140	6.0 - 8.0		Fill bugholes and voids with 63-1500	
C3	Urethane (Flexible)	Concrete Immersion Severe Secondary Containment	P13 4.3.1	CIM	61BG	6.0 - 8.0	1061	80.0 -100.0			Fill bugholes and voids with CIM 1000 T.G.
				TCI	N140	6.0 - 8.0	264	80.0 -100.0		Fill bugholes and voids with Series 265.	
C4	Epoxy	Concrete Immersion Severe Secondary Containment	P13 4.3.1	GPC	Corobond 100	4.0 - 6.0	Core-Cote SC	15.0 - 20.0	Core-Cote SC	15.0 - 20.0	Fill bugholes and voids with Steel Seam VSE.
				TCI	201	4.0 - 6.0	435	15.0 - 20.0	435	15.0 - 20.0	Fill bugholes and voids with 218 Mortar Clad.
C5	WB Epoxy	Concrete Interior Severe Poured,, Precast, CMU	P4	SWC	Porous Substrates-Heavy Duty Block Filler	60 - 80 SFPG	Hi Bild WB Epoxy	4.0 - 6.0	Hi Bild WB Epoxy	4.0 - 6.0	
				TCI	Porous Substrates-130	60 - 80 SFPG	113/114	4.0 - 6.0	113/114	4.0 - 6.0	
C6	Acrylic	Concrete Interior Moderate Poured, Precast, CMU	P4	SWC	Porous Substrates-Heavy Duty Block Filler	60 - 80 SFPG	Sher-Cryl HPA	2.5 - 4.0	Sher-Cryl HPA	2.5 - 4.0	
				TCI	Porous Substrates-130	60 - 80 SFPG	1028/1029	2.0 - 3.0	1028/1029	2.0 - 3.0	
C7	Acrylic	Concrete Exterior Poured, Precast, CMU	P4	SWC	Porous Substrates-Heavy Duty Block Filler	60 - 80 SFPG	Ultra-Crete	4.0 - 8.0	Ultra-Crete	4.0 - 8.0	
				TCI	Porous Substrates-130	60 - 80 SFPG	180/181	4.0 - 8.0	180/181	4.0 - 8.0	
S1	Epoxy	Steel-Immersion	P10	SWC	Macropoxy 646	4.0 - 6.0	Macropoxy 646	4.0 - 6.0			Use Tank Clad HS for potable water applications.
				TCI	N69	4.0 - 6.0	N69	4.0 - 6.0		Use Series N140 for potable water applications.	
S2	Epoxy	Steel Interior Severe	P6	SWC	Macropoxy 646	4.0 - 6.0	Macropoxy 646	4.0 - 6.0			
				TCI	N69	4.0 - 6.0	N69	4.0 - 6.0			
S3	Polyurethane	Steel Exterior Severe	P6	SWC	Macropoxy 646	4.0 - 6.0	Acrolon 218	2.0 - 3.0			
				TCI	N69	4.0 - 6.0	1074U/1075U	2.0 - 3.0			

Coating Schedule

SYSTEM NUMBER	TYPE	SUBSTRATE / SERVICE	SURFACE PREP	MFG	FIRST COAT	DFT (Mils)	SECOND COAT	DFT (Mils)	FINISH COAT	DFT (Mils)	NOTES
S4	Acrylic	Steel Interior & Exterior Moderate	P1	SWC	Sher-Cryl HPA	2.5 - 4.0	Sher-Cryl HPA	2.5 - 4.0			Factory primed metal deck and joists: Prepare surfaces according to manufacturer recommendation.
				TCI	1028/1029	2.0 - 3.0	1028/1029	2.0 - 3.0			
S5	Epoxy	Non-Ferrous Galvanized Metals Interior Severe	P7	SWC	Macropoxy 646	4.0 - 6.0	Macropoxy 646	4.0 - 6.0			
				TCI	N69	4.0 - 6.0	N69	4.0 - 6.0			
S6	Acrylic	Non-Ferrous /Galvanized Interior & Exterior Moderate	P1	SWC	Sher-Cryl HPA	2.5 - 4.0	Sher-Cryl HPA	2.5 - 4.0			
				TCI	1028/1029	2.0 - 3.0	1028/1029	2.0 - 3.0			
S7	Polyurethane	Doors and Frames (Factory Primed)	P1	SWC	See Notes		Acrolon 218	2.0 - 3.0			First Coat: Compatible tie coat as recommended by coating manufacturer.
				TCI	See Notes		1074U / 1075U	2.0 - 3.0			
M1	Latex	Drywall	P9	SWC	Prep Rite Latex Primer	2.0 - 3.0	ProClassic Waterborne	2.0 - 3.0	ProClassic Waterborne	2.0 - 3.0	
				TCI	51-792	2.0 - 3.0	28 / 29	2.0 - 3.0	28 / 29	2.0 - 3.0	
M2	Latex	Wood	P9	SWC	Prep Rite Latex Primer	2.0 - 3.0	ProClassic Waterborne	2.0 - 3.0	ProClassic Waterborne	2.0 - 3.0	
				TCI	10-99W	2.0 - 3.0	28 / 29	2.0 - 3.0	28 / 29	2.0 - 3.0	
M3	Acrylic	Insulated Piping	P1	SWC	Sher-Cryl HPA	2.5 - 4.0	Sher-Cryl HPA	2.5 - 4.0			
				TCI	28 / 29	2.0 - 3.0	28 / 29	2.0 - 3.0			
F1	Sealer Clear	Floors	P4	SWC	Loxon 40	150 - 200 SFPG			Loxon 40	150 - 200 SFPG	Remove any film-forming curing compounds or sealers prior to application.
				TCI	624 Phylon	150 - 200 SFPG			624 Phylon	150 - 200 SFPG	
F2	Sealer/ Hardener Clear	Floors	P4	LMC	Seal Hard	150 - 200 SFPG			Seal Hard	150 - 200 SFPG	Remove any film-forming curing compounds or sealers prior to application.

**Water Treatment Plants and Pumping Stations
Piping Color Code**

USAGE	COMMODITY	COLOR STANDARD	SHERWIN WILLIAMS COLOR #	TNEMEC COLOR #
Water Lines	Raw	Olive Green	4024	112GN
	Settled or Clarified	Aqua	4061	10GN
	Finished or Potable	Dark Blue	4064	27BL
Chemical Lines	Alum or Primary Coagulant	Orange	4083	04SF
	Ammonia	White	Ultra White	11WH
	Carbon Slurry	Black	Black	35GR
	Caustic	Yellow with Green Band	4084/4071	02SF/08SF
	Chlorine	Yellow	4084	02SF
	Chlorine Dioxide	Yellow with Violet Band	4084/4080	02SF/14SF
	Fluoride	Light Blue with Red Band	4061/4081	37BL/06SF
	Lime Slurry	Light Green	4069	52GN
	Ozone	Yellow with Orange Band	4084/4083	02SF/04SF
	Phosphate Compounds	Light Green with Red Band	4069/4081	52GN/06SF
	Polymers or Coagulant Aids	Orange with Green Band	4083/4071	04SF/08SF
	Potassium Permanganate	Violet	4080	14SF
	Soda Ash	Light Green with Orange Band	4069/4083	52GN/04SF
	Sulfuric Acid	Yellow with Red Band	4084/4081	02SF/06SF
	Sulfur Dioxide	Light Green with Yellow Band	4069/4084	52GN/02SF
Waste Lines	Backwash Waste	Light Brown	4001	40BR
	Sludge	Dark Brown	4009	84BR
	Sewer	Dark Gray	4025	55BL
Other	Compressed Air	Dark Green	4071	08SF
	Gas	Red	4081	06SF
	Other Lines	Light Gray	4026	32GR

**WASTEWATER TREATMENT PLANTS
Piping Color Code**

PIPE CONTENT	COLOR STANDARD	SHERWIN WILLIAMS COLOR #	TNEMEC COLOR #
Raw Sludge Line	Brown with Black Band	4009/Black	85BR/35GR
Sludge Recirculation Suction Line	Brown with Yellow Band	4009/4084	85BR/02SF
Sludge Draw-Off Line	Brown with Orange Band	4009/4083	85BR/04SF
Sludge Recirculation Discharge Line	Brown	4009	85BR
Sludge Gas Line	Orange (Or Red)	4083	04SF
Natural Gas Line	Orange (Or Red) with Black Band	4083/Black	04SF/35GR
Non Potable Water Line	Blue with Black Band	4064/Black	27BL/35GR
Potable Water Line	Blue	4064	27BL
Chlorine Line	Yellow	4084	02SF
Sulfur Dioxide	Yellow with Red Band	4084/4081	02SF/06SF
Sewage (Wastewater) Line	Gray	4025	55BL
Compressed Air	Green	4071	08SF
Water Lines For Heating Digesters Or Buildings	Blue with Red Band (6nin. wide By 30-Inch Spacing)	4064/4081	27BL/06SF

END OF SECTION

DAILY APPLICATION RECORD

DATE			-----RECORD EVERY 3 HOURS-----					Weather Conditions
			Surface Temperature (Deg. F.)	Air Temperature (Deg. F.)	Material Temperature (Deg. F.)	Relative Humidity (%)	Dew Point (Deg. F.)	
TIME START	AM	PM						
	AM	PM						
	AM	PM						
	AM	PM						
	AM	PM						
TIME STOP	AM	PM						

Area Prepared	
Area Coated	
Type of Material & Quantity Applied:	

SIGNED

PROJECT NAME:	SEH FILE #:
OWNER:	CONTRACTOR:

SECTION 10 28 13 - TOILET ACCESSORIES

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Section Includes:
 - 1. Toilet room accessories.
 - 2. Rough-in frames supplied to other sections.
 - 3. Attachment hardware.
- B. Related Requirements:
 - 4. Section 06 10 00: Rough Carpentry
 - 5. Section 08 80 00: Glazing; for frameless mirrors

1.2 SUBMITTALS

- 1. Product Data: Include construction details, material descriptions and thicknesses, dimensions, profiles, fastening and mounting methods, specified options, and finishes for each type of accessory specified.
- 2. Samples: If requested by A/E, submit each accessory item to verify design, operation, and finish requirements. Approved full-size samples will be returned and may be used in the Work.
- 3. Setting Drawings: For cutouts required in other work; include templates, substrate preparation instructions, and directions for preparing cutouts and installing anchoring devices.
- 4. Maintenance Data: Provide lists of replacement parts and service recommendations.

1.3 QUALITY ASSURANCE

- A. Source Limitations: Units may be provided by more than one manufacturer, except each type of unit shall be by a single manufacturer throughout the project.
- B. Product Options: Accessory requirements, including those for materials, finishes, dimensions, capacities, and performance, are established by specific products indicated in the Toilet Accessory Schedule.
 - 1. Products of other manufacturers listed in Part Two with equal characteristics, as judged solely by A/E, may be provided.
 - 2. Do not modify aesthetic effects, as judged solely by A/E, except with A/E's approval. Where modifications are proposed, submit comprehensive explanatory data to A/E for review.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver accessories to site until rooms in which they are to be installed are ready to receive them.

- B. Pack accessories individually in a manner to protect accessory and its finish.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Toilet Accessories:
 - 1. American Specialties, Inc. (ASI)
 - 2. Bobrick Washroom Equipment, Inc.
 - 3. Bradley Corporation

2.2 PRODUCTS

- A. See Toilet Accessory Schedule on Drawings.

2.3 MATERIALS

- A. Stainless Steel: ASTM A 666, Type 304, with No. 4 satin finish.
- B. Sheet Steel: ASTM A 366/A 366M, cold rolled, commercial quality, surface preparation and metal pretreatment as required for applied finish.
- C. Galvanized Steel Sheet: ASTM A 653/A 653M, G60.
- D. Chromium Plating: ASTM B 456, Service Condition Number SC 2 (moderate service), nickel plus chromium electrodeposited on base metal.
- E. Galvanized Steel Mounting Devices: ASTM A 153/A 153M, hot-dip galvanized after fabrication.
- F. Fasteners: Screws, bolts, and other devices of same material as accessory unit, tamper and theft resistant when exposed, and of galvanized steel when concealed.
- G. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner's representative.

2.4 FABRICATION

- A. General: Fabricate units with tight seams and joints and exposed edges rolled and finished smooth without sharp edges. Hang doors and access panels with full-length, continuous hinges. Equip units for concealed anchorage and with corrosion-resistant backing plates.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Deliver inserts and rough-in frames to jobsite at appropriate time for building-in. Provide templates and rough-in measurements as required.

- B. Before starting work, coordinate accessory locations with other work to prevent interference with clearances required for access by disabled persons, proper installation, adjustment, operation, cleaning, and servicing of accessories. Notify A/E in writing of any conflicts detrimental to installation or operation of units.
- C. Verify with A/E exact location and mounting heights of accessories.

3.2 INSTALLATION

- A. Install accessories according to manufacturer's written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer.
- B. Install units level, plumb, and firmly anchored in locations and at mounting heights indicated. Use security type fasteners.
- C. Install grab bars to withstand a downward load of at least 250 lbf, when tested according to method in ASTM F 446.
- D. Protect adjacent or adjoining finished surfaces and work from damage during installation of work of this section.

3.3 ADJUSTING AND CLEANING

- A. Adjust accessories for unencumbered, smooth operation and verify that mechanisms function properly. Replace damaged or defective items.
- B. Remove temporary labels and protective coatings.
- C. Clean and polish exposed surfaces according to manufacturer's written recommendations.

End of Section

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SECTION 21 05 00

BASIC FIRE SUPPRESSION REQUIREMENTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Requirements applicable to all Division 21 Sections. Also refer to Division 1 - General Requirements.
- B. All materials and installation methods shall conform to the applicable standards, guidelines and codes referenced in the specification section.

1.2 SCOPE OF WORK

- A. This Specification and the associated drawings govern the furnishing, installing, testing and placing into satisfactory operation the Mechanical Systems.
- B. Each Contractor shall provide all new materials indicated on the drawings and/or in these specifications, and all items required to make his portion of the Mechanical Work a finished and working system.
- C. Scope of Work:
 - 1. Plumbing Work shall include, but is not necessarily limited to:
 - a. Furnish and install all items listed in the Plumbing Material List.
 - b. Furnish and install a new domestic water service to the building.
 - c. Furnish and install water meter and domestic water backflow preventer as required by Code.
 - d. Furnish and install a complete domestic water piping system including cold and hot water piping within the building. Reconnect to existing exterior hose bibbs. Insulate all piping as specified.
 - e. Furnish and install gas piping system including all meter requirements.
 - f. Furnish and install water heaters.
 - g. Furnish and install a new fire protection service to the building including backflow preventer as required by Code.
 - h. Furnish and install all fire hydrants and associated piping, valves, and supports including connection to the water main.
 - i. Furnish and install a complete storm water drainage system.
 - j. Furnish and install a complete sanitary sewer and vent system.
 - k. Furnish and install firestopping systems for penetrations of fire-rated construction associated with this Contractor's work.

2. Heating, Ventilating and Air Conditioning Work shall include, but is not necessarily limited to:
 - a. Furnish and install a complete chilled water system including piping, insulation, air control equipment, terminal cooling equipment, and specialties. Make final connections to coils, including those furnished by others.
 - b. Furnish and install a complete terminal heating system including unit heaters, piping, flues, and controls.
 - c. Furnish and install condensate drain piping from cooling related equipment such as air handlers and cooling coil drain pans.
 - d. Furnish and install firestopping systems for penetrations of fire-rated construction associated with this Contractor's work.

3. Air Conditioning and Ventilating Work shall include, but is not necessarily limited to:
 - a. Furnish and install package indoor air handling units complete with dampers, filters, coils, fans, and motors.
 - b. Furnish and install complete supply air ductwork systems including all fittings, insulation, and outlets.
 - c. Furnish and install complete return air ductwork systems including all fittings, insulation, and inlets.
 - d. Furnish and install complete exhaust ductwork systems including all fittings, insulation, inlets, and fans.
 - e. Furnish and install chemical room ventilation systems including louvers, dampers, ductwork, insulation, and fans.
 - f. Furnish and install gas flues, stacks, and breechings.
 - g. Furnish and install all temperature control systems.
 - h. Furnish and install all fire dampers.
 - i. Furnish and install firestopping systems for penetrations of fire-rated construction associated with this Contractor's work.

4. Temperature Control Work shall include, but is not necessarily limited to:
 - a. Temperature control system shall consist of a full Direct Digital Control (DDC) system including all accessories, sensors, and programming.
 - b. Furnish automatic control valves and dampers for installation by others.
 - c. Furnish and install firestopping systems for penetrations of fire-rated construction associated with this Contractor's work.

5. Fire Protection Work shall include, but is not necessarily limited to:
 - a. Furnish and install a complete wet pipe sprinkler system for areas noted on the drawings.
 - b. Furnish and install all items listed on the Fire Protection Material List.
 - c. Furnish all hydraulic calculations and working sprinkler drawings.
 - d. Furnish and install firestopping systems for penetrations of fire-rated construction associated with this Contractor's work.
6. Testing, Adjusting, and Balancing Work shall include, but is not necessarily limited to:
 - a. Furnish complete testing, adjusting, and balancing as specified in Section 23 05 93, including, but not limited to, air systems, hydronic systems, plumbing systems, and verification of control systems.

1.3 DIVISION OF WORK BETWEEN MECHANICAL, ELECTRICAL & CONTROL CONTRACTORS

A. Definitions:

1. "Mechanical Contractors" refers to the following:
 - a. Plumbing Contractor.
 - b. Heating, Air Conditioning, and Ventilating Contractor.
 - c. Temperature Control Contractor.
 - d. Fire Protection Contractor.
 - e. Testing, Adjusting, and Balancing Contractor.
2. Control devices such as start-stop push buttons, thermostats, pressure switches, flow switches, relays, etc., generally represent the types of equipment associated with motor control wiring.
3. Motor control wiring is single phase and usually 120 volts. In some instances, the voltage will be the same as the motor power wiring. Generally, where the motor power wiring exceeds 120 volts, a control transformer is used to give a control voltage of 120 volts.
4. Temperature Control Wiring: The wiring associated with the operation of a motorized damper, solenoid valve or motorized valve, etc., either modulating or two-position, as opposed to wiring which directly powers or controls a motor used to drive equipment such as fans, pumps, etc.
 - a. This wiring will be from a 120 volt source and may continue as 120 volt, or be reduced in voltage (24 volt) in which case a control transformer shall be furnished as part of the temperature control wiring.
5. Control Motor: An electric device used to operate dampers, valves, etc. It may be two-position or modulating. Conventional characteristics of such a motor are 24 volts, 60 cycles, 1 phase, although other voltages may be encountered.

B. General:

1. The purpose of these Specifications is to outline the Electrical and Mechanical Contractor's responsibilities related to electrical work required for items such as temperature controls, mechanical equipment, fans, chillers, compressors and the like. The exact wiring requirements for much of the equipment cannot be determined until the systems have been selected and submittals reviewed. Therefore, the electrical drawings show only known wiring related to such items. All wiring not shown on the electrical drawings, but required for mechanical systems, is the responsibility of the Mechanical Contractor.
2. Where the drawings require the Electrical Contractor to wire between equipment furnished by the Mechanical Contractor, such wiring shall terminate at terminals provided in the equipment. The Mechanical Contractor shall provide complete wiring diagrams and supervision to the Electrical Contractor and designate the terminal numbers for correct wiring.
3. All electrical work shall conform to the National Electrical Code. All provisions of the Electrical Specifications concerning wiring, protection, etc., apply to wiring provided by the Mechanical Contractor unless noted otherwise.
4. All Contractors shall establish utility elevations prior to fabrication and shall coordinate their material and equipment with other trades. When a conflict arises, priority is as follows:
 - a. Light fixtures.
 - b. Gravity flow piping.
 - c. Electrical busduct.
 - d. Sheet metal.
 - e. Electrical cable trays, including access space.
 - f. Sprinkler piping and other piping.
 - g. Electrical conduits and wireway.

C. Mechanical Contractor's Responsibility:

1. Assumes responsibility for internal wiring of all equipment provided by the Mechanical Contractor, for example:
 - a. Electric Unit Heaters.
 - b. Gas Trains.
 - c. Package Air Handling Units.
2. Assumes all responsibility for the Temperature Control wiring, when the Temperature Control Contractor is a Subcontractor to the Mechanical Contractor.
3. Temperature Control Subcontractor's Responsibility:
 - a. Wiring of all devices needed to make the Temperature Control System functional.
 - b. Verifying any control wiring on the electrical drawings as being by the Electrical Contractor. All wiring required for the Control System, but not shown on the electrical drawings, is the responsibility of the Temperature Control Subcontractor.

- c. Coordinating equipment locations (such as relays, transformers, etc.) with the Electrical Contractor, where wiring of the equipment is by the Electrical Contractor.
 4. This Contractor is responsible for coordination of utilities with all other Contractors. If any field coordination conflicts are found, the Contractor shall coordinate with other Contractors to determine a viable layout.
- D. Electrical Contractor's Responsibility:
 1. Provides all combination starters, manual starters and disconnect devices shown on the Electrical Drawings or indicated to be by the Electrical Contractor on the Mechanical Drawings or Specifications.
 2. Installs and wires all remote control devices furnished by the Mechanical Contractor or Temperature Control Subcontractor when so noted on the Electrical Drawings.
 3. Provides motor control and temperature control wiring, where so noted on the drawings.
 4. Coordinate with the Mechanical Contractor for size of motors and/or other electrical devices involved with repair or replacement of existing equipment.
 5. Furnishes, installs and connects all relays, etc., for automatic shutdown of certain fans upon actuation of the Fire Alarm System as indicated and specified in Division 28.
 6. This Contractor is responsible for coordination of utilities with all other Contractors. If any field coordination conflicts are found, the Contractor shall coordinate with other Contractors to determine a viable layout.

1.4 COORDINATION DRAWINGS

A. Definitions:

1. Coordination Drawings: A compilation of the pertinent layout and system drawings that show the sizes and locations, including elevations, of system components and required access areas to ensure that no two objects will occupy the same space.
 - a. Mechanical trades shall include, but are not limited to, mechanical equipment, ductwork, fire protection systems, plumbing piping, medical gas systems, hydronic piping, steam and steam condensate piping, and any item that may impact coordination with other disciplines.
 - b. Electrical trades shall include, but are not limited to, electrical equipment, conduit 1.5" and larger, conduit racks, cable trays, pull boxes, transformers, raceway, busway, lighting, ceiling-mounted devices, and any item that may impact coordination with other disciplines.
 - c. Technology trades shall include, but are not limited to, technology equipment, racks, conduit 1.5" and larger, conduit racks, cable trays, ladder rack, pull boxes, raceway, ceiling-mounted devices, and any item that may impact coordination with other disciplines.

- d. Maintenance clearances and code-required dedicated space shall be included.
 - e. The coordination drawings shall include all underground, underfloor, in-floor, in chase, and vertical trade items.
2. The contractors shall use the coordination process to identify the proper sequence of installation of all utilities above ceilings and in other congested areas, to ensure an orderly and coordinated end result, and to provide adequate access for service and maintenance.

B. General:

- 1. Coordination drawings are not shop drawings and shall not be submitted as such.
- 2. The contract drawings are schematic in nature and do not show every fitting and appurtenance for each utility. Each contractor is expected to have included in his/her bid sufficient fittings, material, and labor to allow for adjustments in routing of utilities made necessary by the coordination process and to provide a complete and functional system.
- 3. The contractors will not be allowed additional costs or time extensions due to participation in the coordination process.
- 4. The contractors will not be allowed additional costs or time extensions for additional fittings, reroutings or changes of duct size, that are essentially equivalent sizes to those shown on the drawings and determined necessary through the coordination process.
- 5. The A/E reserves the right to determine space priority of equipment in the event of spatial conflicts or interference between equipment, piping, conduit, ducts, and equipment provided by the trades.
- 6. Changes to the contract documents that are necessary for systems installation and coordination shall be brought to the attention of the A/E.
- 7. Access panels shall preferably occur only in gypsum board walls or plaster ceilings where indicated on the drawings.
 - a. Access to mechanical, electrical, technology, and other items located above the ceiling shall be through accessible lay-in ceiling tile areas.
 - b. Potential layout changes shall be made to avoid additional access panels.
 - c. Additional access panels shall not be allowed without written approval from the A/E at the coordination drawing stage.
 - d. Providing additional access panels shall be considered after other alternatives are reviewed and discarded by the A/E and the Owner's Representative.
 - e. When additional access panels are required, they shall be provided without additional cost to the Owner.

1.5 QUALITY ASSURANCE

A. Contractor's Responsibility Prior to Submitting Pricing Data:

1. The Contractor is responsible for constructing complete and operating systems. The Contractor acknowledges and understands that the Contract Documents are a two-dimensional representation of a three-dimensional object, subject to human interpretation. This representation may include imperfect data, interpreted codes, utility guidelines, three-dimensional conflicts, and required field coordination items. Such deficiencies can be corrected when identified prior to ordering material and starting installation. The Contractor agrees to carefully study and compare the individual Contract Documents and report at once in writing to the Design Team any deficiencies the Contractor may discover. The Contractor further agrees to require each subcontractor to likewise study the documents and report at once any deficiencies discovered.
2. The Contractor shall resolve all reported deficiencies with the Architect/Engineer prior to awarding any subcontracts, ordering material, or starting any work with the Contractor's own employees. Any work performed prior to receipt of instructions from the Design Team will be done at the Contractor's risk.

B. Qualifications:

1. Only products of reputable manufacturers are acceptable.
2. All Contractors and subcontractors shall employ only workers skilled in their trades.

C. Compliance with Codes, Laws, Ordinances:

1. Conform to all requirements of the City of Madison, Wisconsin Codes, Laws, Ordinances and other regulations having jurisdiction.
2. Conform to all State Codes.
3. If there is a discrepancy between the codes and regulations and these specifications, the Architect/Engineer shall determine the method or equipment used.
4. If the Contractor notes, at the time of bidding, any parts of the drawings or specifications that do not comply with the codes or regulations, he shall inform the Architect/Engineer in writing, requesting a clarification. If there is insufficient time for this procedure, he shall submit with his proposal a separate price to make the system comply with the codes and regulations.
5. All changes to the system made after letting of the contract, to comply with codes or requirements of Inspectors, shall be made by the Contractor without cost to the Owner.
6. If there is a discrepancy between manufacturer's recommendations and these specifications, the manufacturer's recommendations shall govern.
7. All rotating shafts and/or equipment shall be completely guarded from all contact. Partial guards and/or guards that do not meet all applicable OSHA standards are not acceptable. Contractor is responsible for providing this guarding if it is not provided with the equipment supplied.

D. Permits, Fees, Taxes, Inspections:

1. Procure all applicable permits and licenses.
2. Abide by all laws, regulations, ordinances, and other rules of the State or Political Subdivision where the work is done, or as required by any duly constituted public authority.
3. Pay all charges for permits or licenses.
4. Pay all fees and taxes imposed by the State, Municipal and/or other regulatory bodies.
5. Pay all charges arising out of required inspections by an authorized body.
6. Pay all charges arising out of required contract document reviews associated with the project and as initiated by the Owner or authorized agency/consultant.

E. Examination of Drawings:

1. The drawings for the fire protection work are completely diagrammatic, intended to convey the scope of the work and to indicate the general arrangements and locations of equipment, outlets, etc., and the approximate sizes of equipment.
2. Contractor shall determine the exact locations of equipment and rough-ins, and the exact routing of pipes and ducts to best fit the layout of the job.
3. Scaling of the drawings is not sufficient or accurate for determining these locations.
4. Where job conditions require reasonable changes in indicated arrangements and locations, such changes shall be made by the Contractor at no additional cost to the Owner.
5. Because of the scale of the drawings, certain basic items, such as fittings, boxes, valves, unions, etc., may not be shown, but where required by other sections of the specifications or required for proper installation of the work, such items shall be furnished and installed.
6. If an item is either on the drawings or in the specifications, it shall be included in this contract.
7. Determination of quantities of material and equipment required shall be made by the Contractor from the documents. Where discrepancies arise between drawings, schedules and/or specifications, the greater number shall govern.
8. Where used in fire protection documents, the word "furnish" shall mean supply for use, the word "install" shall mean connect complete and ready for operation, and the word "provide" shall mean to supply for use and connect complete and ready for operation.
 - a. Any item listed as furnished shall also be installed, unless otherwise noted.
 - b. Any item listed as installed shall also be furnished, unless otherwise noted.

F. Field Measurements:

1. Verify all pertinent dimensions at the job site before ordering any materials or fabricating any supports, pipes or ducts.

G. Electronic Media/Files:

1. Construction drawings for this project have been prepared utilizing Revit.
2. Contractors and Subcontractors may request electronic media files of the contract drawings and/or copies of the specifications. Specifications will be provided in PDF format.
3. Upon request for electronic media, the Contractor shall complete and return a signed "Electronic File Transmittal" form provided by KJWW.
4. If the information requested includes floor plans prepared by others, the Contractor will be responsible for obtaining approval from the appropriate Design Professional for use of that part of the document.
5. The electronic contract documents can be used for preparation of shop drawings and as-built drawings only. The information may not be used in whole or in part for any other project.
6. The drawings prepared by KJWW for bidding purposes may not be used directly for ductwork layout drawings or coordination drawings.
7. The use of these CAD documents by the Contractor does not relieve them from their responsibility for coordination of work with other trades and verification of space available for the installation.
8. The information is provided to expedite the project and assist the Contractor with no guarantee by KJWW as to the accuracy or correctness of the information provided. KJWW accepts no responsibility or liability for the Contractor's use of these documents.

1.6 SUBMITTALS

- A. Submittals shall be required for the following items, and for additional items where required elsewhere in the specifications or on the drawings.

1. Submittals list:

<u>Referenced Specification Section</u>	<u>Submittal Item</u>
21 13 00	Sprinkler System

- B. General Submittal Procedures: In addition to the provisions of Division 1, the following are required:

1. Transmittal: Each transmittal shall include the following:
 - a. Date
 - b. Project title and number
 - c. Contractor's name and address
 - d. Division of work (e.g., plumbing, heating, ventilating, etc.)
 - e. Description of items submitted and relevant specification number

- f. Notations of deviations from the contract documents
 - g. Other pertinent data
2. Submittal Cover Sheet: Each submittal shall include a cover sheet containing:
- a. Date
 - b. Project title and number
 - c. Architect/Engineer
 - d. Contractor and subcontractors' names and addresses
 - e. Supplier and manufacturer's names and addresses
 - f. Division of work (e.g., plumbing, heating, ventilating, etc.)
 - g. Description of item submitted (using project nomenclature) and relevant specification number
 - h. Notations of deviations from the contract documents
 - i. Other pertinent data
 - j. Provide space for Contractor's review stamps
3. Composition:
- a. Submittals shall be submitted using specification sections and the project nomenclature for each item.
 - b. Individual submittal packages shall be prepared for items in each specification section. All items within a single specification section shall be packaged together where possible. An individual submittal may contain items from multiple specifications sections if the items are intimately linked (e.g., pumps and motors).
 - c. All sets shall contain an index of the items enclosed with a general topic description on the cover.
4. Content: Submittals shall include all fabrication, erection, layout, and setting drawings; manufacturers' standard drawings; schedules; descriptive literature, catalogs and brochures; performance and test data; wiring and control diagrams; dimensions; shipping and operating weights; shipping splits; service clearances; and all other drawings and descriptive data of materials of construction as may be required to show that the materials, equipment or systems and the location thereof conform to the requirements of the contract documents.
5. Contractor's Approval Stamp:
- a. The Contractor shall thoroughly review and approve all shop drawings before submitting them to the Architect/Engineer. The Contractor shall stamp, date and sign each submittal certifying it has been reviewed.
 - b. Unstamped submittals will be rejected.
 - c. The Contractor's review shall include, but not be limited to, verification of the following:
 - 1.) Only approved manufacturers are used.
 - 2.) Addenda items have been incorporated.
 - 3.) Catalog numbers and options match those specified.
 - 4.) Performance data matches that specified.
 - 5.) Electrical characteristics and loads match those specified.

- 6.) Equipment connection locations, sizes, capacities, etc. have been coordinated with other affected trades.
 - 7.) Dimensions and service clearances are suitable for the intended location.
 - 8.) Equipment dimensions are coordinated with support steel, housekeeping pads, openings, etc.
 - 9.) Constructability issues are resolved (e.g., weights and dimensions are suitable for getting the item into the building and into place, sinks fit into countertops, etc.).
- d. The Contractor shall review, stamp and approve all subcontractors' submittals as described above.
 - e. **The Contractor's approval stamp is required on all submittals. Approval will indicate the Contractor's review of all material and a complete understanding of exactly what is to be furnished. Contractor shall clearly mark all deviations from the contract documents on all submittals. If deviations are not marked by the Contractor, then the item shall be required to meet all drawing and specification requirements.**
6. Submittal Identification and Markings:
 - a. The Contractor shall clearly mark each item with the same nomenclature applied on the drawings or in the specifications.
 - b. The Contractor shall clearly indicate the size, finish, material, etc.
 - c. Where more than one model is shown on a manufacturer's sheet, the Contractor shall clearly indicate exactly which item and which data is intended.
 - d. All marks and identifications on the submittals shall be unambiguous.
 7. Schedule submittals to expedite the project. Coordinate submission of related items.
 8. Identify variations from the contract documents and product or system limitations that may be detrimental to the successful performance of the completed work.
 9. Reproduction of contract documents alone is not acceptable for submittals.
 10. Incomplete submittals will be rejected without review. Partial submittals will only be reviewed with prior approval from the Architect/Engineer.
 11. Submittals not required by the contract documents may be returned without review.
 12. The Architect/Engineer's responsibility shall be to review one set of shop drawing submittals for each product. If the first submittal is incomplete or does not comply with the drawings and/or specifications, the Contractor shall be responsible to bear the cost for the Architect/Engineer to recheck and handle the additional shop drawing submittals.
 13. Submittals shall be reviewed and approved by the Architect/Engineer **before** releasing any equipment for manufacture or shipment.

14. Contractor's responsibility for errors, omissions or deviation from the contract documents in submittals is not relieved by the Architect/Engineer's approval.

C. Electronic Submittal Procedures:

1. Distribution: Email submittals as attachments to all parties designated by the Architect/Engineer, unless a web-based submittal program is used.
2. Transmittals: Each submittal shall include an individual electronic letter of transmittal.
3. Format: Electronic submittals shall be in PDF format only. Scanned copies, in PDF format, of paper originals are acceptable. Submittals that are not legible will be rejected. Do not set any permission restrictions on files; protected, locked, or secured documents will be rejected.
4. File Names: Electronic submittal file names shall include the relevant specification section number followed by a description of the item submitted, as follows. Where possible, include the transmittal as the first page of the PDF instead of using multiple electronic files.
 - a. Submittal file name: 21 XX XX.description.YYYYMMDD
 - b. Transmittal file name: 21 XX XX.description.YYYYMMDD
5. File Size: Electronic file size shall be limited to a maximum of 4MB. Larger files shall be transmitted via a pre-approved method.

1.7 EQUIPMENT SUPPLIERS' INSPECTION

- A. The following equipment shall not be placed in operation until a competent installation and service representative of the manufacturer has inspected the installation and certified that the equipment is properly installed, adjusted and lubricated; that preliminary operating instructions have been given; and that the equipment is ready for operation:
 1. Fire Seal Systems
- B. Contractor shall arrange for and obtain supplier's on-site inspection(s) at proper time(s) to assure each phase of equipment installation and/or connection is in accordance with the manufacturer's instructions.
- C. Submit copies of start-up reports to the Architect/Engineer and include copies of Owner's Operation and Maintenance Manuals.

1.8 PRODUCT DELIVERY, STORAGE, HANDLING & MAINTENANCE

- A. Exercise care in transporting and handling to avoid damage to materials. Store materials on the site to prevent damage. Keep materials clean, dry and free from harmful conditions. Immediately remove any materials that become wet or that are suspected of becoming contaminated with mold or other organisms.
- B. Keep all bearings properly lubricated and all belts properly tensioned and aligned.

- C. Coordinate the installation of heavy and large equipment with the General Contractor and/or Owner. If the Mechanical Contractor does not have prior documented experience in rigging and lifting similar equipment, he/she shall contract with a qualified lifting and rigging service that has similar documented experience. Follow all equipment lifting and support guidelines for handling and moving.
- D. Contractor is responsible for moving equipment into the building and/or site. Contractor shall review site prior to bid for path locations and any required building modifications to allow movement of equipment. Contractor shall coordinate his/her work with other trades.

1.9 WARRANTY

- A. Provide one-year warranty, unless otherwise noted, to the Owner for all fixtures, equipment, materials, and workmanship.
- B. The warranty period for all work in this Division of the specifications shall commence on the date of final acceptance, unless a whole or partial system or any separate piece of equipment or component is put into use for the benefit of any party other than the installing contractor with prior written authorization. In this instance, the warranty period shall commence on the date when such whole system, partial system or separate piece of equipment or component is placed in operation and accepted in writing by the Owner.
- C. Warranty requirements shall extend to correction, without cost to the Owner, of all Work found to be defective or nonconforming to the contract documents. The Contractor shall bear the cost of correcting all damage resulting from defects or nonconformance with contract documents.

1.10 INSURANCE

- A. Contractor shall maintain insurance coverage as set forth in Division 0 of these specifications.

1.11 MATERIAL SUBSTITUTION

- A. Where several manufacturers' names are given, the manufacturer for which a catalog number is given is the basis for job design and establishes the quality required.
- B. Equivalent equipment manufactured by the other named manufacturers may be used. Contractor shall ensure that all items submitted by these other manufacturers meet all requirements of the drawings and specifications, and fits in the allocated space.
- C. Any material, article or equipment of other unnamed manufacturers which will adequately perform the services and duties imposed by the design and is of a quality equal to or better than the material, article or equipment identified by the drawings and specifications may be used if approval is secured in writing from the Architect/Engineer not later than ten days prior to the bid opening.
- D. This Contractor assumes all costs incurred as a result of using the offered material, article or equipment, on his part or on the part of other Contractors whose work is affected.
- E. This Contractor may list voluntary add or deduct prices for alternate materials on the bid form. These items will not be used in determining the low bidder.

- F. All material substitutions requested later than ten (10) days prior to bid opening must be listed as voluntary changes on the bid form.

PART 2 - PRODUCTS

NOT APPLICABLE

PART 3 - EXECUTION

3.1 JOBSITE SAFETY

- A. Neither the professional activities of the Architect/Engineer, nor the presence of the Architect/Engineer or his or her employee and subconsultants at a construction site, shall relieve the Contractor and other entity of their obligations, duties and responsibilities including, but not limited to, construction means, methods, sequence, techniques or procedures necessary for performing, superintending or coordinating all portions of the work of construction in accordance with the contract documents and any health or safety precautions required by any regulatory agencies. The Architect/Engineer and his or her personnel have no authority to exercise any control over any construction contractor or other entity or their employees in connection with their work or any health or safety precautions. The Contractor is solely responsible for jobsite safety. The Architect/Engineer and the Architect/Engineer's consultants shall be indemnified and shall be made additional insureds under the Contractor's general liability insurance policy.

3.2 EXCAVATION, FILL, BACKFILL, COMPACTION

- A. General:
 - 1. Prior to the commencement of any excavation or digging, the Contractor shall verify all underground utilities with the regional utility locator. Provide prior notice to the locator before excavations. Contact information for most regional utility locaters can be found by calling 811.
 - 2. The Contractor shall do all excavating, filling, backfilling and compacting associated with his work.
- B. Excavation:
 - 1. Make all excavations to accurate, solid, undisturbed earth, and to proper dimensions.
 - 2. Where excavations are made in error below foundations, concrete of same strength as specified for the foundations or thoroughly compacted sand-gravel fill, as determined by the Architect/Engineer, shall be placed in such excess excavations. Place thoroughly compacted, clean, stable fill in excess excavations under slabs on grade, at the Contractor's expense.
 - 3. Trim bottom and sides of excavations to grades required for foundations.
 - 4. Protect excavations against frost and freezing.
 - 5. Take care in excavating not to damage surrounding structures, equipment or buried pipe. Do not undermine footing or foundation.

6. Perform all trenching in a manner to prevent cave-ins and risk to workmen.
 7. Where original surface is pavement or concrete, the surface shall be saw cut to provide clean edges and assist in the surface restoration.
 8. Where satisfactory bearing soil for foundations is not found at the indicated levels, the Architect/Engineer or their representative shall be notified immediately, and no further work shall be done until further instructions are given by the Architect/Engineer or their representative.
- C. Dewatering:
1. Contractor shall furnish, install, operate and remove all dewatering pumps and pipes needed to keep trenches and pits free of water.
- D. Underground Obstructions:
1. Known underground piping, foundations, and other obstructions in the vicinity of construction are shown on the drawings. Use great care in making installations near underground obstruction.
 2. If objects not shown on the drawings are encountered, remove, relocate, or perform extra work as directed by the Architect/Engineer.
- E. Fill and Backfilling:
1. No rubbish or waste material is permitted for fill or backfill.
 2. Provide all necessary sand for backfilling.
 3. Dispose of the excess excavated earth as directed.
 4. Backfill materials shall be suitable for required compaction, clean and free of perishable materials and stones greater than 4 inches in diameter. Water shall not be permitted to rise in unbackfilled trenches. No material shall be used for backfilling that contains frozen earth, debris or earth with a high void content.
 5. Backfill all trenches and excavations immediately after installing pipes, or removal of forms, unless other protection is provided.
 6. Around piers and isolated foundations and structures, backfill and fill shall be placed and consolidated simultaneously on all sides to prevent wedge action and displacement. Fill and backfill materials shall be spread in 6 inch uniform horizontal layers with each layer compacted separately to required density.
 7. Lay all piping on a compacted bed of sand at least 3 inches deep. Backfill around pipes with sand, 6 inch layers, and compact each layer.
 8. Use sand for backfill up to grade for all piping under slabs or paved areas. All other piping shall have sand backfill to 6 inches above the top of the pipe.
 9. Place all backfill above the sand in uniform layers not exceeding 6 inches deep. Each layer shall be placed, then carefully and uniformly tamped, to eliminate lateral or vertical displacement.

10. Where the fill and backfill will ultimately be under a building, floor or paving, each layer of fill shall be compacted to 95% of the maximum density determined by AASHTO Designation T-99 or ASTM Designation D-698. Moisture content of soil at time of compaction shall not exceed plus or minus 2% of optimum moisture content determined by AASHTO T-99 or ASTM D-698 test.

F. Surface Restoration:

1. Where trenches are cut through graded, planted or landscaped areas, the areas shall be restored to the original condition. Replace all planting removed or damaged to its original condition. A minimum of 6 inches of topsoil shall be applied where disturbed areas are to be seeded or sodded.
2. Concrete or asphalt type pavement, seal coat, rock, gravel or earth surfaces removed or damaged shall be replaced with comparable materials and restored to original condition.

3.3 PROJECT CLOSEOUT

A. The following paragraphs supplement the requirements of Division 1.

B. Final Jobsite Observation:

1. In order to prevent the Final Jobsite Observation from occurring too early, the Contractor is required to review the completion status of the project and certify that the job is ready for the final jobsite observation.
2. Attached to the end of this section is a typical list of items that represent the degree of job completeness expected prior to requesting a review.
3. Upon Contractor certification that the project is complete and ready for a final observation, the Contractor shall sign the attached certification and return it to the Architect/Engineer so that the final observation can be scheduled.
4. It is understood that if the Architect/Engineer finds the job not ready for the final observation and that additional trips and observations are required to bring the project to completion, the costs incurred by the Architect/Engineer's additional time and expenses will be deducted from the Contractor's contract retainage prior to final payment at the completion of the job.

C. Before final payment is authorized, this Contractor must submit the following:

1. Operation and maintenance manuals with copies of approved shop drawings.
2. Record documents including reproducible drawings and specifications.
3. A report documenting the instructions given to the Owner's representatives complete with the number of hours spent in the instruction. The report shall bear the signature of an authorized agent of This Contractor and shall be signed by the Owner's representatives.
4. Inspection report by the State Fire Marshal of the fire protection system.
5. Start-up reports on all equipment requiring a factory installation inspection or start-up.

6. Provide spare parts, maintenance, and extra materials in quantities specified in individual specification sections. Deliver to and place in location as directed; receipt by Architect/Engineer required prior to final payment approval.

3.4 OPERATION AND MAINTENANCE MANUALS

A. General:

1. Provide an electronic copy of the O&M manuals as described below for Architect/Engineer's review and approval. The electronic copy shall be corrected as required to address the Architect/Engineer's comments. Once corrected, electronic copies and paper copies shall be distributed as directed by the Architect/Engineer.
2. Approved O&M manuals shall be completed and in the Owner's possession prior to Owner's acceptance and at least 10 days prior to instruction of operating personnel.

B. Electronic Submittal Procedures:

1. Distribution: Email the O&M manual as attachments to all parties designated by the Architect/Engineer.
2. Transmittals: Each submittal shall include an individual electronic letter of transmittal.
3. Format: Electronic submittals shall be in PDF format only. Scanned copies, in PDF format, of paper originals are acceptable. Submittals that are not legible will be rejected. Do not set any permission restrictions on files; protected, locked, or secured documents will be rejected.
4. File Names: Electronic submittal file names shall include the relevant specification section number followed by a description of the item submitted, as follows. Where possible, include the transmittal as the first page of the PDF instead of using multiple electronic files.
 - a. O&M file name: O&M.div21.contractor.YYYYMMDD
 - b. Transmittal file name: O&Mtransmittal.div21.contractor.YYYYMMDD
5. File Size: Electronic file size shall be limited to a maximum of 4MB. Larger files shall be divided into files that are clearly labeled as "1 of 2", "2 of 2", etc.
6. Provide the Owner with an approved copy of the O&M manual on compact discs (CD), digital video discs (DVD), or flash drives with a permanently affixed label, printed with the title "Operation and Maintenance Instructions", title of the project and subject matter of disc/flash drive when multiple disc/flash drives are required.
7. All text shall be searchable.
8. Bookmarks shall be used, dividing information first by specification section, then systems, major equipment and finally individual items. All bookmark titles shall include the nomenclature used in the construction documents and shall be an active link to the first page of the section being referenced.

- C. Operation and Maintenance Instructions shall include:
1. Title Page: Include title page with project title, Architect, Engineer, Contractor, all subcontractors, and major equipment suppliers, with addresses, telephone numbers, website addresses, email addresses and point of contacts. Website URLs and email addresses shall be active links in the electronic submittal.
 2. Table of Contents: Include a table of contents describing specification section, systems, major equipment, and individual items.
 3. Copies of all final approved shop drawings and submittals. Include Architect's/Engineer's shop drawing review comments. Insert the individual shop drawing directly after the Operation and Maintenance information for the item(s) in the review form.
 4. Copy of final approved test and balance reports.
 5. Copies of all factory inspections and/or equipment startup reports.
 6. Copies of warranties.
 7. Schematic wiring diagrams of the equipment that have been updated for field conditions. Field wiring shall have label numbers to match drawings.
 8. Dimensional drawings of equipment.
 9. Capacities and utility consumption of equipment.
 10. Detailed parts lists with lists of suppliers.
 11. Operating procedures for each system.
 12. Maintenance schedule and procedures. Include a chart listing maintenance requirements and frequency.
 13. Repair procedures for major components.
 14. List of lubricants in all equipment and recommended frequency of lubrication.
 15. Instruction books, cards, and manuals furnished with the equipment.

3.5 INSTRUCTING THE OWNER'S REPRESENTATIVES

- A. Adequately instruct the Owner's designated representatives in the maintenance, care, and operation of all systems installed under this contract.
- B. Provide verbal and written instructions to the Owner's representatives by FACTORY PERSONNEL in the care, maintenance, and operation of the equipment and systems.
- C. The Owner has the option to make a video recording of all instructions. Coordinate schedule of instructions to facilitate this recording.
- D. The instructions shall include:
 1. Maintenance of equipment.
 2. Start-up procedures for all major equipment.

3. Explanation of seasonal system changes.
- E. The Architect/Engineer shall be notified of the time and place instructions will be given to the Owner's representatives so he or his representative can attend if desired.
- F. Minimum hours of instruction for each item shall be:
 1. Sprinkler System(s) - 2 hours.
- G. Operating Instructions:
 1. Contractor is responsible for all instructions to the Owner's representatives for the fire protection and control systems.
 2. If the Contractor does not have staff that can adequately provide the required instructions he shall include in his bid an adequate amount to reimburse the Owner for the Architect/Engineer to perform these services.

3.6 SYSTEM COMMISSIONING

- A. The fire protection systems shall be complete and operating. System start-up, testing, balancing, and satisfactory system performance is the responsibility of the Contractor. This includes calibration and adjustments of all controls, noise level adjustments and final comfort adjustments as required.
- B. All operating conditions and control sequences shall be tested during the start-up period. Test all interlocks, safety shutdowns, controls, and alarms.
- C. The Contractor, subcontractors, and equipment suppliers shall have skilled technicians to ensure that all systems perform properly. If the Architect/Engineer is requested to visit the job site for trouble shooting, assisting in start-up, obtaining satisfactory equipment operation, resolving installation and/or workmanship problems, equipment substitution issues or unsatisfactory system performance, including call backs during the warranty period, through no fault of the design; the Contractor shall reimburse the Owner on a time and materials basis for services rendered at the Architect/Engineer's standard hourly rates in effect when the services are requested. The Contractor shall pay the Owner for services required that are product, installation or workmanship related. Payment is due within 30 days after services are rendered.

3.7 RECORD DOCUMENTS

- A. The following paragraph supplements Division 1 requirements:

Contractor shall maintain at the job site a separate and complete set of fire protection drawings and specifications on which he shall clearly and permanently mark in complete detail all changes made to the fire protection systems.
- B. Mark drawings to indicate revisions to piping size and location, both exterior and interior; including locations of other control devices, and other units requiring periodic maintenance or repair; actual equipment locations, dimensioned from column lines; actual inverts and locations of underground piping; concealed equipment, dimensioned from column lines; mains and branches of piping systems, with valves and control devices located and numbered, concealed unions located, and with items requiring maintenance located; Change Orders; concealed control system devices.

- C. Upon completing the job, and before final payment is made, give the marked-up drawings to the Architect/Engineer.

3.8 PAINTING

- A. Paint all equipment that is marred or damaged prior to the Owner's acceptance. Paint and color shall match original equipment paint and shall be obtained from the equipment supplier if available.
- B. Equipment in finished areas that will be painted to match the room decor will be painted by others. Should this Contractor install equipment in a finished area after the area has been painted, he shall have the equipment and all its supports, hangers, etc., painted to match the room decor.
- C. Equipment cabinets, casings, covers, metal jackets, etc., in equipment rooms or concealed spaces, shall be furnished in standard or prime finish, free from scratches, abrasions, chips, etc.
- D. Paint all equipment in unfinished areas furnished by this Contractor. Equipment furnished with a factory coat of paint and enamel need not be painted, provided the factory applied finish is not marred or spattered. If so, equipment shall be refinished with the same paint as was factory applied.

3.9 ADJUST AND CLEAN

- A. Thoroughly clean all equipment and systems prior to the Owner's final acceptance of the project. Clean all foreign paint, grease, oil, dirt, labels, stickers, and other foreign material from all equipment.
- B. Clean all areas where moisture is present. Immediately report any mold, biological growth, or water damage.
- C. Remove all rubbish, debris, etc., accumulated during construction from the premises.

END OF SECTION

SECTION 21 05 29

FIRE SUPPRESSION SUPPORTS AND ANCHORS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Hangers, Supports, and Associated Anchors.
- B. Equipment Bases and Supports.
- C. Sleeves and Seals.
- D. Flashing and Sealing of Equipment and Pipe Stacks.
- E. Cutting of Openings.
- F. Escutcheon Plates and Trim.

1.2 QUALITY ASSURANCE

- A. Support Sprinkler Piping in conformance with NFPA 13.

1.3 WORK FURNISHED BUT INSTALLED UNDER OTHER SECTIONS

- A. Furnish sleeves and hanger inserts to General Contractor for placement into formwork.

PART 2 - PRODUCTS

2.1 HANGER RODS

- A. Hanger rods for single rod hangers shall conform to the following:

Pipe Size	Hanger Rod Diameter	
	Column #1	Column #2
2" and smaller	3/8"	3/8"
2-1/2" through 3-1/2"	1/2"	1/2"
4" and 5"	5/8"	1/2"
6"	3/4"	5/8"
8" through 12"	7/8"	3/4"

Column #1: Steel pipe.

Column #2: Copper and plastic pipe.

- B. Rods for double rod hangers may be reduced one size. Minimum rod diameter is 3/8 inches.
- C. Hanger rods and accessories used in mechanical spaces or otherwise dry areas shall have ASTM B633 electro-plated zinc finish.
- D. All hanger rods, nuts, washers, clevises, etc., in damp areas shall have ASTM A123 hot-dip galvanized finish applied after fabrication. This applies to all areas.

2.2 PIPE HANGERS AND SUPPORTS

- A. All pipe hangers, clamps, and supports shall conform to Manufacturers Standardization Society MSS-SP-58 and 127 (where applicable).

B. Hangers in direct contact with copper pipe shall be coated with plastic with appropriate temperature range. HYDRA-ZORB clamps are permitted for this application for bare pipes within their temperature limits of -65°F to +275°F.

C. Unless otherwise indicated, hangers shall be as follows:

1. Clevis Type:

Service: Bare Metal Pipe
Rigid Plastic Pipe

Acceptable Products:	Bare Steel, Plastic or Insulated Pipe	Bare Copper Pipe
Anvil	Fig. 260	Fig. CT65
Cooper/B-Line	Fig. 3100	Fig. B3104CT
Erico	Model 400	Model 402
Nibco/Tolco	Fig. 1	Fig. 81

2. Adjustable Swivel Ring Type:

Service: Bare Metal Pipe - 4 inches and Smaller

Acceptable Products:	Bare Steel Pipe	Bare Copper Pipe
Anvil	Fig. 69	Fig. CT69
Cooper/B-Line	Fig. B3170NF	Fig. B170CT
Erico	Model FCN	
Nibco/Tolco	Fig. 200	Fig. 202

D. Support may be fabricated from U-Channel strut or similar shapes. Piping less than 4" in diameter shall be secured to strut with clamps of proper design and capacity as required to maintain spacing and alignment. Strut shall be independently supported from hanger drops or building structure. Size and support shall be per manufacturer's installation requirements for structural support of piping. Clamps shall not interrupt piping insulation.

1. Strut used in mechanical spaces or otherwise dry areas shall have ASTM B633 electro-plated zinc finish.
2. Strut used in damp areas listed in hanger rods shall have ASTM A123 hot-dip galvanized finish applied after fabrication.

E. Unless otherwise indicated, pipe supports for use with struts shall be as follows:

1. Clamp Type:

Service: Bare Metal Pipe
Rigid Plastic Pipe

- a. Clamps in direct contact with copper pipe shall be plastic coated.
- b. Pipes subject to expansion and contraction shall have clamps slightly oversized to allow limited pipe movement.

Acceptable Products:	Bare Steel, Plastic or Insulated Pipe	Bare Copper Pipe
Unistrut	Fig. P1100 or P2500	
Cooper/B-Line	Fig. B2000 or B2400	Fig. BVT
Nibco/Tolco	Fig. A-14 or 2STR	

- F. Unless otherwise shown, upper attachments for hanger rods or support struts shall be as follows:
1. Beam Clamps:

<u>Acceptable Products:</u>	
Anvil	Fig. 228, 292
Cooper/B-Line	Fig. B3054
Erico	Model 360
Nibco/Tolco	Fig. 329
 2. Concrete Anchors: Fasten to concrete using cast-in or post-installed anchors designed per the requirements of Appendix D of ACI 318-08. Post-installed anchors shall be qualified for use in cracked concrete by ACI-355.2.
 3. Masonry Anchors: Fasten to concrete masonry units with expansion anchors or self-tapping masonry screws. For expansion anchors into hollow concrete block, use sleeve-type anchors designed for the specific application. Do not fasten in masonry joints. Do not use powder actuated fasteners, wooden plugs, or plastic inserts.
- G. Wall supports shall be used where vertical height of structure exceeds minimum spacing requirements. Install wall supports at same spacing as hangers or strut supports along vertical length of pipe runs.
- H. Welding:
1. Unless otherwise noted, hangers, clips, and auxiliary support steel may be welded in lieu of bolting, clamping, or riveting to the building structural frame. Take adequate precautions during all welding operations for fire prevention and for protecting walls and ceilings from being damaged by smoke.

2.3 SUPPORTS

A. Supports:

1. Provide sufficient clips, inserts, hangers, racks, rods, and auxiliary steel to securely support all suspended material, equipment and conduit without sag.
2. Hang heavy equipment from concrete floors or ceilings with Architect-approved concrete inserts, furnished and installed by the Contractor whose work requires them, except where indicated otherwise.

B. Grout:

1. Grout shall be non-shrinking premixed (Master Builders Company "Embecco"), unless otherwise indicated on the drawings or approved by the Architect/Engineer.
2. Use Mix No. 1 for clearances of 1" or less, and Mix No. 2 for all larger clearances.
3. Grout under equipment bases, around pipes, at pipe sleeves, etc., and where shown on the drawings.

2.4 OPENINGS IN FLOORS, WALLS AND CEILINGS

- A. Exact locations of all openings for the installation of materials shall be determined by the Contractor and given to the General Contractor for installation or construction as the structure is built.
- B. Coordinate all openings with other Contractors.
- C. Hire the proper tradesman and furnish all labor, material and equipment to cut openings in or through existing structures, or openings in new structures that were not installed, or additional openings. Repair all spalling and damage to the satisfaction of the Architect/Engineer. Make saw cuts before breaking out concrete to ensure even and uniform opening edges.
- D. Said cutting shall be at the complete expense of each Contractor. Failure to coordinate openings with other Contractors shall not exempt the Contractor from providing openings at his expense.
- E. Do not cut structural members without written approval of the Architect or Structural Engineer.

2.5 PIPE SLEEVES AND LINTELS

- A. Each Contractor shall provide pipe sleeves and lintels for all openings required for the Contractor's work in masonry walls and floors, unless specifically shown as being by others.
- B. Fabricate all sleeves from standard weight black steel pipe or as indicated on the drawings. Provide continuous sleeve. Cut or split sleeves are not acceptable.
- C. Fabricate all lintels for masonry walls from structural steel shapes or as indicated on the drawings. Have all lintels approved by the Architect or Structural Engineer.
- D. Sleeves through the floors on exposed risers shall be flush with the ceiling, with planed squared ends extending 1" above the floor in unfinished areas, and flush with the floor in finished areas, to accept spring closing floor plates.
- E. Sleeves shall not penetrate structural members or masonry walls without approval from the Structural Engineer. Sleeves shall then comply with the Engineer's design.
- F. Openings through unexcavated floors and/or foundation walls below the floor shall have a smooth finish with sufficient annular space around material passing through opening so slight settling will not place stress on the material or building structure.
- G. Install all sleeves concentric with pipes. Secure sleeves in concrete to wood forms. This Contractor is responsible for sleeves dislodged or moved when pouring concrete.
- H. Where pipes rise through concrete floors that are on earthen grade, provide 3/4" resilient expansion joint material (asphalt and cork) wrapped around the pipe, the full depth of concrete, at the point of penetration. Secure to prevent shifting during concrete placement and finishing.
- I. Size sleeves large enough to allow expansion and contraction movement. Provide continuous insulation wrapping.

2.6 ESCUTCHEON PLATES AND TRIM

- A. Fit escutcheons to all insulated or uninsulated exposed pipes passing through walls, floors, or ceilings of finished rooms.
- B. Escutcheons shall be heavy gauge, cold rolled steel, copper coated under a chromium plated finish, heavy spring clip, rigid hinge and latch.
- C. Install galvanized steel (unless otherwise indicated) trim strip to cover vacant space and raw construction edges of all rectangular openings in finished rooms. This includes duct and pipe openings.

2.7 PIPE PENETRATIONS

- A. Seal all pipe penetrations. Seal non-rated walls and floor penetrations with grout or caulk. Backing material may be used.
- B. Seal fire rated wall and floor penetrations with fire seal system as specified.

2.8 PIPE ANCHORS

- A. Provide all items needed to allow adequate expansion and contraction of all piping. All piping shall be supported, guided, aligned, and anchored as required.
- B. Repair all piping leaks and associated damage. Pipes shall not rub on any part of the building.

2.9 FINISH

- A. Prime coat exposed steel hangers and supports. Hangers and supports in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

PART 3 - EXECUTION

3.1 FIRE SUPPRESSION SUPPORTS AND ANCHORS

- A. General Installation Requirements:
 - 1. Install all items per manufacturer's instructions.
 - 2. Coordinate the location and method of support of piping systems with all installations under other Divisions and Sections of the Specifications.
 - 3. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.
- B. Supports Requirements:
 - 1. Install hangers and supports complete with lock nuts, clamps, rods, bolts, couplings, swivels, inserts and required accessories.
 - 2. Hangers for horizontal piping shall have adequate means of vertical adjustment for alignment.

C. Pipe Requirements:

1. Support all piping and equipment, including valves, strainers, and other specialties and accessories to avoid objectionable or excessive stress, deflection, swaying, sagging or vibration in the piping or building structure during erection, cleaning, testing and normal operation of the systems.
2. Do not, however, restrain piping to cause it to snake or buckle between supports or to prevent proper movement due to expansion and contraction.
3. Support piping at equipment and valves so they can be disconnected and removed without further supporting the piping.
4. Piping shall not introduce strains or distortion to connected equipment.
5. Parallel horizontal pipes may be supported on trapeze hangers made of structural shapes and hanger rods; otherwise, pipes shall be supported with individual hangers.
6. Trapeze hangers may be used where ducts interfere with normal pipe hanging.
7. Provide additional supports where pipe changes direction, adjacent to flanged valves and strainers, at equipment connections and heavy fittings.
8. Provide at least one hanger adjacent to each joint in grooved end steel pipe with mechanical couplings.

D. Do not exceed 25 lbs. per hanger and a minimum spacing of 2'-0" on center when attaching to metal roof decking (limitation not required with concrete on metal deck). This 25 lbs. load and 2'-0" spacing include adjacent electrical and architectural items hanging from deck. If the hanger restrictions cannot be achieved, supplemental framing off steel framing will need to be added.

E. Do not exceed the manufacturer's recommended maximum load for any hanger or support.

F. Spacing of Hangers shall not exceed the compressive strength of the insulation inserts, and in no case shall exceed the following:

	<u>Pipe Material</u>	<u>Maximum Spacing</u>
1.	Steel (Std. Weight or Heavier – Liquid Service):	
	1-1/4" & under	7'-0"
	1-1/2"	9'-0"
	2"	10'-0"
	2-1/2"	11'-0"
	3"	12'-0"
	4" & larger	12'-0"
2.	Installation of hangers shall conform to MSS SP-58 and applicable NFPA standards.	

END OF SECTION

SECTION 21 13 00

FIRE PROTECTION SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Pipe, Fittings, Valves, and Connections for Fire Protection System.
- B. Wet-Pipe Sprinkler System.

1.2 QUALITY ASSURANCE

- A. Welding Materials and Procedures: Conform to ASME Code.
- B. Equipment and Components: Bear UL/FM label or marking.
- C. Valves: Bear UL/FM label or marking. Provide manufacturer's name and pressure rating marked on valve body. Pressure rating shall match specified pipe system pressure rating. Remanufactured valves are not acceptable.
- D. Specialist Firm: Company specializing in sprinkler systems with minimum three years experience.
- E. Sprinkler design drawings submitted by the contractor shall be designed, certified, and shall include the NICET certification block or the Professional Engineer seal of the fire protection designer. Fire protection designer shall be NICET Level III or Level IV certified or be a licensed Professional Engineer.

1.3 EXTRA STOCK

- A. Provide metal storage cabinet, wrenches for each sprinkler type, and extra sprinklers per NFPA 13 and applicable building code.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Store valves and sprinklers in shipping containers, with labels in place.
- B. Provide temporary protective coating on iron and steel valves.
- C. Maintain temporary end caps and closures in place until installation.

1.5 WORK FURNISHED BUT INSTALLED UNDER OTHER SECTIONS

- A. Furnish sleeves to General Contractor for placement in walls and floors. Sleeve location to be determined by the Fire Protection Contractor prior to construction. If additional sleeves are required, they shall be core drilled by the Fire Protection Contractor.

1.6 SYSTEM DESCRIPTION

- A. System shall cover building areas noted.
- B. System shall interface with building fire alarm system. Provide all required wiring.

- C. Provide wet pipe sprinkler system to NFPA 13 and building code requirements as required by Owner's insurance company and as shown on the drawings.
- D. Provide a Fire Department connection.

1.7 REGULATORY REQUIREMENTS

- A. All material, equipment, and installation shall be approved by the Authorities Having Jurisdiction and the Owner's Insurance Company.
- B. The Authorities Having Jurisdiction and the Owner's Insurance Company shall have precedence over the drawings and specifications in case of discrepancies.
- C. The entire installation shall comply with all applicable codes.

1.8 SYSTEM DESIGN

- A. Design and install a complete, hydraulically calculated wet-pipe sprinkler system for the entire building.
- B. Provide all required equipment and accessories.
- C. System shall include a 5 psi allowance for future decrease in available pressure and an allowance for inside and outside hose streams.
- D. Provide monitor switches on all shutoff valves.
- E. Install sprinkler riser in location shown on drawings or as approved by the Architect/Engineer.
- F. Coordinate with Plumbing Contractor for installation of a floor drain with collection funnel below the backflow preventer.
- G. Provide service shutoff valve in the sprinkler main with a post indicator assembly.
- H. Provide pressure gauge with valve in the main riser.
- I. Provide main drain valve piped to outside the building. Locate so discharge does not damage lawn or other surfaces.
- J. Provide flow switch in the main riser and as indicated on drawings.
- K. Provide alarm bell and all required wiring.

1.9 COORDINATION DRAWINGS

- A. Reference Coordination Drawings article in Section 21 05 00 for required fire protection systems electronic CAD drawings to be provided to Coordinating Contractor for inclusion into composite coordination drawings.

1.10 OPERATION AND MAINTENANCE DATA

- A. Submit manufacturers' operation and maintenance data. Include written maintenance data on components of system, servicing requirements, and record drawings.

1.11 JOB CONDITIONS

- A. Fire Protection Contractor shall determine the flow and pressure available at the service connection. The Fire Protection Contractor is responsible to verify this information and make all tests required. Base all pipe sizing and hydraulic calculations on flow test data no older than 18 months.
- B. Pipe sizing shown on drawings for service entrance and main risers is preliminary for coordination purposes only. Contractor is responsible for final sizing from hydraulic calculations.

PART 2 - PRODUCTS

2.1 PIPE AND FITTINGS

- A. Steel Pipe (Inside Building-Above Grade):
 - 1. Pipe: 2" and Under - Schedule 40, black steel, ASTM A53. Threaded and coupled or flanged.
 - 2. Joints: 2" and under - screwed or flanged.
 - 3. Fittings: Screwed - cast iron, 125 lb., black, ANSI/ASME B16.4 or malleable iron, 150 lb., black, ANSI/ASME B16.3. Flanged-cast iron, 125 lb., ANSI/ASME B16.1.
- B. Steel Pipe (Inside Building-Above Grade):
 - 1. Pipe: 6" and Over - Schedule 10, black steel, grooved, ASTM A135.
 - 2. Pipe: 2-1/2" and Over - Schedule 40, black steel, grooved, ASTM A53.
 - 3. Joints: Mechanically coupled grooved.
 - 4. Fittings: 500 lb. WOG, black, malleable iron, ASTM A47.
 - 5. Plain end fittings and couplings are not acceptable.
- C. Fire Protection Service to Building (by others):
 - 1. Refer to Section 22 10 00.

2.2 UNIONS AND COUPLINGS

- A. Unions: 175 psi malleable iron for threaded ferrous piping.
- B. Mechanical Grooved Couplings: Malleable iron housing clamps to engage and lock, designed to permit some angular and longitudinal deflection; "C" shaped composition sealing gasket, steel bolts, nuts, and washers. 175 psi, ASTM A47. Plain end fittings and couplings are not acceptable. Rolled groove couplings for Schedule 10 pipe. Cut groove couplings for Schedule 40 pipe. Couplings shall be enamel coated for wet systems. Acceptable Manufacturers: Victaulic, ITT, Grinnell, Central, Anvil GruvLok, Star Fittings.
- C. Coupling gaskets for wet systems shall be Grade "E" EDPM Type A.

2.3 VALVE OPERATORS

- A. Provide handwheels for gate valves. Provide gear operators for butterfly valves.

2.4 VALVE CONNECTIONS

- A. Provide all connections to match pipe joints. Valves shall be same size as pipe.

2.5 BACKFLOW PREVENTERS

- A. Provide backflow preventers as required by code and as specified on the drawings.

2.6 EQUIPMENT

- A. Equipment shall be as scheduled on the drawings.

PART 3 - EXECUTION

3.1 INSTALLATION - PIPING

A. General Installation Requirements:

1. Coordinate piping and sprinkler locations with all other trades. Ductwork, diffusers and light fixture locations shall have priority over sprinkler piping and sprinklers.
2. Ream pipe and tube ends to full inside diameter. Remove burrs. Remove scale and foreign material, inside and outside, before assembly.
3. Die cut screw joints with full cut standard taper pipe threads.
4. Coat threads with pipe joint compound or wrap with Teflon tape.
5. Locate piping to minimize obstruction of other work.
6. Route piping in concealed spaces above finished ceiling.
7. Use full and double lengths of pipe wherever possible.
8. Slope all piping for complete drainage. Install auxiliary drains for all trapped piping per NFPA 13.
9. Reducers are generally not shown. Where pipe sizes change at tee, the tee shall be the size of the largest pipe shown connecting to it.
10. Comply with manufacturer's installation instructions.

B. Steel Piping:

1. In steel piping, main sized saddle branch connections or direct connection of branches to main is permitted if main is one pipe size larger than the branch for up to 6" mains and if main is two pipe sizes larger than branch for 8" and larger mains. Do not project branch pipes into main pipes.

- C. Wall/Floor Penetration:
 - 1. Provide sleeves when penetrating floors and walls.
 - 2. Seal pipes passing through exterior walls with a wall seal per Section 21 05 29. Provide Schedule 40 galvanized sleeve at least 2 pipe sizes larger than the pipe. Sleeves through floors shall extend minimum 1.5" above finished floor.
 - 3. Fire seal all pipe and sleeve penetrations (both wall and floor) to maintain fire separation required without restraining pipe.
- D. Installation Requirements in Electrical Rooms:
 - 1. Do not install piping or other equipment above electrical switchboards or panelboards. This includes a dedicated space extending 25 feet from the floor to the structural ceiling with width and depth equal to the equipment. Fire protection equipment dedicated to the electrical equipment room or space may be installed above equipment if other alternatives are not available.
- E. Hangers and Supports:
 - 1. Provide hangers and supports as required by NFPA 13 and UL/FM, with the following exceptions:
 - a. Do not use powder driven devices, explosive devices, wooden plugs, or plastic inserts.
 - b. Do not install fasteners to carry the load in tension, unless absolutely necessary.
- F. Exposed Piping:
 - 1. Install chrome plated steel escutcheons where exposed pipes penetrate walls or floors.

3.2 INSTALLATION - VALVES

- A. Install gate valves with stems upright or horizontal, not inverted.
- B. Backflow Preventer:
 - 1. Provide an air gap fitting and piping to drain. On 2-1/2" and larger units, install a tail piece from air gap fitting to drain to prevent water from spraying out of drain air gap receptor. Maintain air gap distance required by Code.
 - 2. Units shall be field tested and tagged in accordance with manufacturer's instructions by a certified tester before initial operation.
 - 3. Install unit between 12" and 60" above finish floor.
- C. Shutoff Valve:
 - 1. Install buried shutoff valves in valve boxes. Provide post indicators.
 - 2. Provide drain valves at main shutoff valves, low points of piping and apparatus.

3.3 INSTALLATION - EQUIPMENT

- A. Coordinate piping and sprinkler locations with all other trades. Ductwork, diffusers and light fixture locations shall have priority over system equipment and sprinklers.
- B. Fire Department Connection:
 - 1. Locate fire department connection in an accessible location as approved by the local fire department with sufficient clearance from walls, obstructions, and adjacent Siamese connectors to allow full swing of fire department wrench handle.
- C. Alarm Bell:
 - 1. Locate outside alarm bell on building wall as shown on drawings.
 - 2. Wire all bells, flow switches and supervisory switches to fire alarm system. All wiring shall be in conduit and meet the requirements of the electrical specifications.
- D. Test Valves:
 - 1. Install test valves where required. Pipe to outdoors or drain. Test connection shall have flow equivalent to the smallest K-factor sprinkler.
- E. Sprinklers:
 - 1. Locate sprinklers to clear lights, ducts and diffusers. Do not run sprinkler pipes through ducts. Ductwork has priority over sprinkler pipes. Offset pipes as needed.

END OF SECTION

SECTION 22 05 00

BASIC PLUMBING REQUIREMENTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Requirements applicable to all Division 22 Sections. Also refer to Division 1 - General Requirements.
- B. All materials and installation methods shall conform to the applicable standards, guidelines and codes referenced in the specification section.

1.2 SCOPE OF WORK

- A. This Specification and the associated drawings govern the furnishing, installing, testing and placing into satisfactory operation the Mechanical Systems.
- B. Each Contractor shall provide all new materials indicated on the drawings and/or in these specifications, and all items required to make his portion of the Mechanical Work a finished and working system.
- C. Scope of Work:
 - 1. Plumbing Work shall include, but is not necessarily limited to:
 - a. Furnish and install all items listed in the Plumbing Material List.
 - b. Furnish and install a new domestic water service to the building.
 - c. Furnish and install water meter and domestic water backflow preventer as required by Code.
 - d. Furnish and install a complete domestic water piping system including cold and hot water piping within the building. Reconnect to existing exterior hose bibbs. Insulate all piping as specified.
 - e. Furnish and install gas piping system including all meter requirements.
 - f. Furnish and install water heaters.
 - g. Furnish and install a new fire protection service to the building including backflow preventer as required by Code.
 - h. Furnish and install all fire hydrants and associated piping, valves, and supports including connection to the water main.
 - i. Furnish and install a complete storm water drainage system.
 - j. Furnish and install a complete sanitary sewer and vent system.
 - k. Furnish and install firestopping systems for penetrations of fire-rated construction associated with this Contractor's work.

2. Heating, Ventilating and Air Conditioning Work shall include, but is not necessarily limited to:
 - a. Furnish and install a complete chilled water system including piping, insulation, air control equipment, terminal cooling equipment, and specialties. Make final connections to coils, including those furnished by others.
 - b. Furnish and install a complete terminal heating system including unit heaters, piping, flues, and controls.
 - c. Furnish and install condensate drain piping from cooling related equipment such as air handlers and cooling coil drain pans.
 - d. Furnish and install firestopping systems for penetrations of fire-rated construction associated with this Contractor's work.

3. Air Conditioning and Ventilating Work shall include, but is not necessarily limited to:
 - a. Furnish and install package indoor air handling units complete with dampers, filters, coils, fans, and motors.
 - b. Furnish and install complete supply air ductwork systems including all fittings, insulation, and outlets.
 - c. Furnish and install complete return air ductwork systems including all fittings, insulation, and inlets.
 - d. Furnish and install complete exhaust ductwork systems including all fittings, insulation, inlets, and fans.
 - e. Furnish and install chemical room ventilation systems including louvers, dampers, ductwork, insulation, and fans.
 - f. Furnish and install gas flues, stacks, and breechings.
 - g. Furnish and install all temperature control systems.
 - h. Furnish and install all fire dampers.
 - i. Furnish and install firestopping systems for penetrations of fire-rated construction associated with this Contractor's work.

4. Temperature Control Work shall include, but is not necessarily limited to:
 - a. Temperature control system shall consist of a full Direct Digital Control (DDC) system including all accessories, sensors, and programming.
 - b. Furnish automatic control valves and dampers for installation by others.
 - c. Furnish and install firestopping systems for penetrations of fire-rated construction associated with this Contractor's work.

5. Fire Protection Work shall include, but is not necessarily limited to:
 - a. Furnish and install a complete wet pipe sprinkler system for areas noted on the drawings.
 - b. Furnish and install all items listed on the Fire Protection Material List.
 - c. Furnish all hydraulic calculations and working sprinkler drawings.
 - d. Furnish and install firestopping systems for penetrations of fire-rated construction associated with this Contractor's work.
6. Testing, Adjusting, and Balancing Work shall include, but is not necessarily limited to:
 - a. Furnish complete testing, adjusting, and balancing as specified in Section 23 05 93, including, but not limited to, air systems, hydronic systems, plumbing systems, and verification of control systems.

1.3 DIVISION OF WORK BETWEEN MECHANICAL, ELECTRICAL & CONTROL CONTRACTORS

A. Definitions:

1. "Mechanical Contractors" refers to the following:
 - a. Plumbing Contractor.
 - b. Heating, Air Conditioning, and Ventilating Contractor.
 - c. Temperature Control Contractor.
 - d. Fire Protection Contractor.
 - e. Testing, Adjusting, and Balancing Contractor.
2. Motor Control Wiring: The wiring associated with the remote operation of the magnetic coils of magnetic motor starters or relays, or the wiring that permits direct cycling of motors by means of devices in series with the motor power wiring. In the latter case the devices are usually single phase and are usually connected to the motor power wiring through a manual motor starter having "Manual-Off-Auto" provisions.
3. Control devices such as start-stop push buttons, thermostats, pressure switches, flow switches, relays, etc., generally represent the types of equipment associated with motor control wiring.
4. Motor control wiring is single phase and usually 120 volts. In some instances, the voltage will be the same as the motor power wiring. Generally, where the motor power wiring exceeds 120 volts, a control transformer is used to give a control voltage of 120 volts.
5. Temperature Control Wiring: The wiring associated with the operation of a motorized damper, solenoid valve or motorized valve, etc., either modulating or two-position, as opposed to wiring which directly powers or controls a motor used to drive equipment such as fans, pumps, etc.
 - a. This wiring will be from a 120 volt source and may continue as 120 volt, or be reduced in voltage (24 volt) in which case a control transformer shall be furnished as part of the temperature control wiring.

6. Control Motor: An electric device used to operate dampers, valves, etc. It may be two-position or modulating. Conventional characteristics of such a motor are 24 volts, 60 cycles, 1 phase, although other voltages may be encountered.

B. General:

1. The purpose of these Specifications is to outline the Electrical and Mechanical Contractor's responsibilities related to electrical work required for items such as temperature controls, mechanical equipment, fans, chillers, compressors and the like. The exact wiring requirements for much of the equipment cannot be determined until the systems have been selected and submittals reviewed. Therefore, the electrical drawings show only known wiring related to such items. All wiring not shown on the electrical drawings, but required for mechanical systems, is the responsibility of the Mechanical Contractor.
2. Where the drawings require the Electrical Contractor to wire between equipment furnished by the Mechanical Contractor, such wiring shall terminate at terminals provided in the equipment. The Mechanical Contractor shall provide complete wiring diagrams and supervision to the Electrical Contractor and designate the terminal numbers for correct wiring.
3. All electrical work shall conform to the National Electrical Code. All provisions of the Electrical Specifications concerning wiring, protection, etc., apply to wiring provided by the Mechanical Contractor unless noted otherwise.
4. All Contractors shall establish utility elevations prior to fabrication and shall coordinate their material and equipment with other trades. When a conflict arises, priority is as follows:
 - a. Light fixtures.
 - b. Gravity flow piping, including steam and condensate.
 - c. Electrical busduct.
 - d. Sheet metal.
 - e. Electrical cable trays, including access space.
 - f. Sprinkler piping and other piping.
 - g. Electrical conduits and wireway.

C. Mechanical Contractor's Responsibility:

1. Assumes responsibility for internal wiring of all equipment provided by the Mechanical Contractor, for example:
 - a. Electric Unit Heaters.
 - b. Gas Trains.
 - c. Package Air Handling Units.
2. Assumes all responsibility for the Temperature Control wiring, when the Temperature Control Contractor is a Subcontractor to the Mechanical Contractor.
3. Temperature Control Subcontractor's Responsibility:
 - a. Wiring of all devices needed to make the Temperature Control System functional.

- b. Verifying any control wiring on the electrical drawings as being by the Electrical Contractor. All wiring required for the Control System, but not shown on the electrical drawings, is the responsibility of the Temperature Control Subcontractor.
 - c. Coordinating equipment locations (such as relays, transformers, etc.) with the Electrical Contractor, where wiring of the equipment is by the Electrical Contractor.
4. This Contractor is responsible for coordination of utilities with all other Contractors. If any field coordination conflicts are found, the Contractor shall coordinate with other Contractors to determine a viable layout.

D. Electrical Contractor's Responsibility:

- 1. Provides all combination starters, manual starters and disconnect devices shown on the Electrical Drawings or indicated to be by the Electrical Contractor on the Mechanical Drawings or Specifications.
- 2. Installs and wires all remote control devices furnished by the Mechanical Contractor or Temperature Control Subcontractor when so noted on the Electrical Drawings.
- 3. Provides motor control and temperature control wiring, where so noted on the drawings.
- 4. Furnishes, installs and connects all relays, etc., for automatic shutdown of certain fans upon actuation of the Fire Alarm System as indicated and specified in Division 28.
- 5. This Contractor is responsible for coordination of utilities with all other Contractors. If any field coordination conflicts are found, the Contractor shall coordinate with other Contractors to determine a viable layout.

1.4 COORDINATION DRAWINGS

A. Definitions:

- 1. Coordination Drawings: A compilation of the pertinent layout and system drawings that show the sizes and locations, including elevations, of system components and required access areas to ensure that no two objects will occupy the same space.
 - a. Mechanical trades shall include, but are not limited to, mechanical equipment, ductwork, fire protection systems, plumbing piping, medical gas systems, hydronic piping, steam and steam condensate piping, and any item that may impact coordination with other disciplines.
 - b. Electrical trades shall include, but are not limited to, electrical equipment, conduit 1.5" and larger, conduit racks, cable trays, pull boxes, transformers, raceway, busway, lighting, ceiling-mounted devices, and any item that may impact coordination with other disciplines.

- c. Technology trades shall include, but are not limited to, technology equipment, racks, conduit 1.5" and larger, conduit racks, cable trays, ladder rack, pull boxes, raceway, ceiling-mounted devices, and any item that may impact coordination with other disciplines.
 - d. Maintenance clearances and code-required dedicated space shall be included.
 - e. The coordination drawings shall include all underground, underfloor, in-floor, in chase, and vertical trade items.
2. The contractors shall use the coordination process to identify the proper sequence of installation of all utilities above ceilings and in other congested areas, to ensure an orderly and coordinated end result, and to provide adequate access for service and maintenance.

B. Participation:

1. The contractors and subcontractors responsible for work defined above shall participate in the coordination drawing process.
2. One contractor shall be designated as the Coordinating Contractor for purposes of preparing a complete set of composite electronic CAD coordination drawings that include all applicable trades, and for coordinating the activities related to this process. The Coordinating Contractor for this project shall be the Mechanical Contractor.
 - a. The Coordinating Contractor shall utilize personnel familiar with requirements of this project and skilled as draftspersons/CAD operators, competent to prepare the required coordination drawings.
3. Electronic CAD drawings shall be submitted to the Coordinating Contractor for addition of work by other trades. KJWW will provide electronic file copies of ventilation drawings for contractor's use if the contractor signs and returns an "Electronic File Transfer" waiver provided by KJWW. KJWW will not consider blatant reproductions of original file copies an acceptable alternative for coordination drawings.

C. Drawing Requirements:

1. The file format and file naming convention shall be coordinated with and agreed to by all contractors participating in the coordination process and the Owner.
 - a. Scale of drawings:
 - 1) General plans: 1/4 Inch = 1'-0" (minimum).
 - 2) Mechanical, electrical, communication rooms, and including the surrounding areas within 10 feet: 1/2 Inch = 1'-0" (minimum).
 - 3) Shafts and risers: 1/2 Inch = 1'-0" (minimum).
 - 4) Sections of shafts and mechanical and electrical equipment rooms: 1/4 Inch = 1'-0" (minimum).
 - 5) Sections of congested areas: 1/2 Inch = 1'-0" (minimum).

2. Ductwork layout drawings shall be the baseline system for other components. Ductwork layout drawings shall be modified to accommodate other components as the coordination process progresses.
3. There may be more drawings required for risers, top and bottom levels of mechanical rooms, and shafts.
4. The minimum quantity of drawings will be established at the first coordination meeting and sent to the A/E for review. Additional drawings may be required if other areas of congestion are discovered during the coordination process.

D. General:

1. Coordination drawing files shall be made available to the A/E and Owner's Representative. The A/E will only review identified conflicts and give an opinion, but will not perform as a coordinator.
2. A plotted set of coordination drawings shall be available at the project site.
3. Coordination drawings are not shop drawings and shall not be submitted as such.
4. The contract drawings are schematic in nature and do not show every fitting and appurtenance for each utility. Each contractor is expected to have included in his/her bid sufficient fittings, material, and labor to allow for adjustments in routing of utilities made necessary by the coordination process and to provide a complete and functional system.
5. The contractors will not be allowed additional costs or time extensions due to participation in the coordination process.
6. The contractors will not be allowed additional costs or time extensions for additional fittings, reroutings or changes of duct size, that are essentially equivalent sizes to those shown on the drawings and determined necessary through the coordination process.
7. The A/E reserves the right to determine space priority of equipment in the event of spatial conflicts or interference between equipment, piping, conduit, ducts, and equipment provided by the trades.
8. Changes to the contract documents that are necessary for systems installation and coordination shall be brought to the attention of the A/E.
9. Access panels shall preferably occur only in gypsum board walls or plaster ceilings where indicated on the drawings.
 - a. Access to mechanical, electrical, technology, and other items located above the ceiling shall be through accessible lay-in ceiling tile areas.
 - b. Potential layout changes shall be made to avoid additional access panels.
 - c. Additional access panels shall not be allowed without written approval from the A/E at the coordination drawing stage.

- d. Providing additional access panels shall be considered after other alternatives are reviewed and discarded by the A/E and the Owner's Representative.
 - e. When additional access panels are required, they shall be provided without additional cost to the Owner.
- 10. Complete the coordination drawing process and obtain sign off of the drawings by all contractors prior to installing any of the components.
 - 11. Conflicts that result after the coordination drawings are signed off shall be the responsibility of the contractor or subcontractor who did not properly identify their work requirements, or installed their work without proper coordination.
 - 12. Updated coordination drawings that reflect as-built conditions may be used as record documents.

1.5 QUALITY ASSURANCE

A. Contractor's Responsibility Prior to Submitting Pricing Data:

- 1. The Contractor is responsible for constructing complete and operating systems. The Contractor acknowledges and understands that the Contract Documents are a two-dimensional representation of a three-dimensional object, subject to human interpretation. This representation may include imperfect data, interpreted codes, utility guidelines, three-dimensional conflicts, and required field coordination items. Such deficiencies can be corrected when identified prior to ordering material and starting installation. The Contractor agrees to carefully study and compare the individual Contract Documents and report at once in writing to the Design Team any deficiencies the Contractor may discover. The Contractor further agrees to require each subcontractor to likewise study the documents and report at once any deficiencies discovered.
- 2. The Contractor shall resolve all reported deficiencies with the Architect/Engineer prior to awarding any subcontracts, ordering material, or starting any work with the Contractor's own employees. Any work performed prior to receipt of instructions from the Design Team will be done at the Contractor's risk.

B. Qualifications:

- 1. Only products of reputable manufacturers are acceptable.
- 2. All Contractors and subcontractors shall employ only workers skilled in their trades.

C. Compliance with Codes, Laws, Ordinances:

- 1. Conform to all requirements of the City of Madison, Wisconsin Codes, Laws, Ordinances and other regulations having jurisdiction.
- 2. Conform to all State Codes.
- 3. Conform to Federal Act S.3874 requiring the reduction of lead in drinking water.

4. If there is a discrepancy between the codes and regulations and these specifications, the Architect/Engineer shall determine the method or equipment used.
5. If the Contractor notes, at the time of bidding, any parts of the drawings or specifications that do not comply with the codes or regulations, he shall inform the Architect/Engineer in writing, requesting a clarification. If there is insufficient time for this procedure, he shall submit with his proposal a separate price to make the system comply with the codes and regulations.
6. All changes to the system made after letting of the contract, to comply with codes or requirements of Inspectors, shall be made by the Contractor without cost to the Owner.
7. If there is a discrepancy between manufacturer's recommendations and these specifications, the manufacturer's recommendations shall govern.
8. All rotating shafts and/or equipment shall be completely guarded from all contact. Partial guards and/or guards that do not meet all applicable OSHA standards are not acceptable. Contractor is responsible for providing this guarding if it is not provided with the equipment supplied.

D. Permits, Fees, Taxes, Inspections:

1. Procure all applicable permits and licenses.
2. Abide by all laws, regulations, ordinances, and other rules of the State or Political Subdivision where the work is done, or as required by any duly constituted public authority.
3. Pay all charges for permits or licenses.
4. Pay all fees and taxes imposed by the State, Municipal and/or other regulatory bodies.
5. Pay all charges arising out of required inspections by an authorized body.
6. Pay all charges arising out of required contract document reviews associated with the project and as initiated by the Owner or authorized agency/consultant.
7. Where applicable, all fixtures, equipment and materials shall be listed by Underwriters' Laboratories, Inc. and approved by FM Global.

E. Utility Company Requirements:

1. Secure from the appropriate private or public utility company all applicable requirements.
2. Comply with all utility company requirements.
3. Make application for and pay for service connections, such as sewer, water, and gas.
4. Make application for and pay for all meters and metering systems required by the utility company.

F. Examination of Drawings:

1. The drawings for the plumbing work are completely diagrammatic, intended to convey the scope of the work and to indicate the general arrangements and locations of equipment, outlets, etc., and the approximate sizes of equipment.
2. Contractor shall determine the exact locations of equipment and rough-ins, and the exact routing of pipes and ducts to best fit the layout of the job.
3. Scaling of the drawings is not sufficient or accurate for determining these locations.
4. Where job conditions require reasonable changes in indicated arrangements and locations, such changes shall be made by the Contractor at no additional cost to the Owner.
5. Because of the scale of the drawings, certain basic items, such as fittings, boxes, valves, unions, etc., may not be shown, but where required by other sections of the specifications or required for proper installation of the work, such items shall be furnished and installed.
6. If an item is either on the drawings or in the specifications, it shall be included in this contract.
7. Determination of quantities of material and equipment required shall be made by the Contractor from the documents. Where discrepancies arise between drawings, schedules and/or specifications, the greater number shall govern.
8. Where used in mechanical documents, the word "furnish" shall mean supply for use, the word "install" shall mean connect complete and ready for operation, and the word "provide" shall mean to supply for use and connect complete and ready for operation.
 - a. Any item listed as furnished shall also be installed, unless otherwise noted.
 - b. Any item listed as installed shall also be furnished, unless otherwise noted.

G. Field Measurements:

1. Verify all pertinent dimensions at the job site before ordering any materials or fabricating any supports, pipes or ducts.

H. Electronic Media/Files:

1. Construction drawings for this project have been prepared utilizing Revit.
2. Contractors and Subcontractors may request electronic media files of the contract drawings and/or copies of the specifications. Specifications will be provided in PDF format.
3. Upon request for electronic media, the Contractor shall complete and return a signed "Electronic File Transmittal" form provided by KJWW.

4. If the information requested includes floor plans prepared by others, the Contractor will be responsible for obtaining approval from the appropriate Design Professional for use of that part of the document.
5. The electronic contract documents can be used for preparation of shop drawings and as-built drawings only. The information may not be used in whole or in part for any other project.
6. The drawings prepared by KJWW for bidding purposes may not be used directly for ductwork layout drawings or coordination drawings.
7. The use of these CAD documents by the Contractor does not relieve them from their responsibility for coordination of work with other trades and verification of space available for the installation.
8. The information is provided to expedite the project and assist the Contractor with no guarantee by KJWW as to the accuracy or correctness of the information provided. KJWW accepts no responsibility or liability for the Contractor's use of these documents.

1.6 SUBMITTALS

- A. Submittals shall be required for the following items, and for additional items where required elsewhere in the specifications or on the drawings.

1. Submittals List:

<u>Referenced Specification Section</u>	<u>Submittal Item</u>
22 05 00	Owner Training Agenda
Refer to drawings	Plumbing Material List Items

- B. General Submittal Procedures: In addition to the provisions of Division 1, the following are required:

1. Transmittal: Each transmittal shall include the following:

- a. Date
- b. Project title and number
- c. Contractor's name and address
- d. Division of work (e.g., plumbing, heating, ventilating, etc.)
- e. Description of items submitted and relevant specification number
- f. Notations of deviations from the contract documents
- g. Other pertinent data

2. Submittal Cover Sheet: Each submittal shall include a cover sheet containing:

- a. Date
- b. Project title and number
- c. Architect/Engineer
- d. Contractor and subcontractors' names and addresses
- e. Supplier and manufacturer's names and addresses
- f. Division of work (e.g., plumbing, heating, ventilating, etc.)
- g. Description of item submitted (using project nomenclature) and relevant specification number
- h. Notations of deviations from the contract documents

- i. Other pertinent data
 - j. Provide space for Contractor's review stamps
3. Composition:
- a. Submittals shall be submitted using specification sections and the project nomenclature for each item.
 - b. Individual submittal packages shall be prepared for items in each specification section. All items within a single specification section shall be packaged together where possible. An individual submittal may contain items from multiple specifications sections if the items are intimately linked (e.g., pumps and motors).
 - c. All sets shall contain an index of the items enclosed with a general topic description on the cover.
4. Content: Submittals shall include all fabrication, erection, layout, and setting drawings; manufacturers' standard drawings; schedules; descriptive literature, catalogs and brochures; performance and test data; wiring and control diagrams; dimensions; shipping and operating weights; shipping splits; service clearances; and all other drawings and descriptive data of materials of construction as may be required to show that the materials, equipment or systems and the location thereof conform to the requirements of the contract documents.
5. Contractor's Approval Stamp:
- a. The Contractor shall thoroughly review and approve all shop drawings before submitting them to the Architect/Engineer. The Contractor shall stamp, date and sign each submittal certifying it has been reviewed.
 - b. Unstamped submittals will be rejected.
 - c. The Contractor's review shall include, but not be limited to, verification of the following:
 - 1) Only approved manufacturers are used.
 - 2) Addenda items have been incorporated.
 - 3) Catalog numbers and options match those specified.
 - 4) Performance data matches that specified.
 - 5) Electrical characteristics and loads match those specified.
 - 6) Equipment connection locations, sizes, capacities, etc. have been coordinated with other affected trades.
 - 7) Dimensions and service clearances are suitable for the intended location.
 - 8) Equipment dimensions are coordinated with support steel, housekeeping pads, openings, etc.
 - 9) Constructability issues are resolved (e.g., weights and dimensions are suitable for getting the item into the building and into place, sinks fit into countertops, etc.).
 - d. The Contractor shall review, stamp and approve all subcontractors' submittals as described above.

- e. **The Contractor's approval stamp is required on all submittals. Approval will indicate the Contractor's review of all material and a complete understanding of exactly what is to be furnished. Contractor shall clearly mark all deviations from the contract documents on all submittals. If deviations are not marked by the Contractor, then the item shall be required to meet all drawing and specification requirements.**
- 6. Submittal Identification and Markings:
 - a. The Contractor shall clearly mark each item with the same nomenclature applied on the drawings or in the specifications.
 - b. The Contractor shall clearly indicate the size, finish, material, etc.
 - c. Where more than one model is shown on a manufacturer's sheet, the Contractor shall clearly indicate exactly which item and which data is intended.
 - d. All marks and identifications on the submittals shall be unambiguous.
 - 7. Schedule submittals to expedite the project. Coordinate submission of related items.
 - 8. Identify variations from the contract documents and product or system limitations that may be detrimental to the successful performance of the completed work.
 - 9. Reproduction of contract documents alone is not acceptable for submittals.
 - 10. Incomplete submittals will be rejected without review. Partial submittals will only be reviewed with prior approval from the Architect/Engineer.
 - 11. Submittals not required by the contract documents may be returned without review.
 - 12. The Architect/Engineer's responsibility shall be to review one set of shop drawing submittals for each product. If the first submittal is incomplete or does not comply with the drawings and/or specifications, the Contractor shall be responsible to bear the cost for the Architect/Engineer to recheck and handle the additional shop drawing submittals.
 - 13. Submittals shall be reviewed and approved by the Architect/Engineer **before** releasing any equipment for manufacture or shipment.
 - 14. Contractor's responsibility for errors, omissions or deviation from the contract documents in submittals is not relieved by the Architect/Engineer's approval.
- C. Electronic Submittal Procedures:
 - 1. Distribution: Email submittals as attachments to all parties designated by the Architect/Engineer, unless a web-based submittal program is used.
 - 2. Transmittals: Each submittal shall include an individual electronic letter of transmittal.

3. Format: Electronic submittals shall be in PDF format only. Scanned copies, in PDF format, of paper originals are acceptable. Submittals that are not legible will be rejected. Do not set any permission restrictions on files; protected, locked, or secured documents will be rejected.
4. File Names: Electronic submittal file names shall include the relevant specification section number followed by a description of the item submitted, as follows. Where possible, include the transmittal as the first page of the PDF instead of using multiple electronic files.
 - a. Submittal file name: 22 XX XX.description.YYYYYMMDD
 - b. Transmittal file name: 22 XX XX.description.YYYYYMMDD
5. File Size: Electronic file size shall be limited to a maximum of 4MB. Larger files shall be transmitted via a pre-approved method.

1.7 SCHEDULE OF VALUES

- A. The requirements herein are in addition to the provisions of Division 1.
- B. Format:
 1. Use AIA Document Continuation Sheets G703 or another similar form approved by the Owner and Architect/Engineer.
 2. Submit in Excel format.
 3. Support values given with substantiating data.
- C. Preparation:
 1. Itemize the cost for each of the following:
 - a. Overhead and profit.
 - b. Bonds.
 - c. Insurance.
 - d. General Requirements: Itemize all requirements.
 2. Itemize work required by each specification section and list all providers. All work provided by subcontractors and major suppliers shall be listed on the Schedule of Values. List each subcontractor and supplier by company name.
 - a. Contractor's own labor forces.
 - b. All subcontractors.
 - c. All major suppliers of products or equipment.
 3. Break down all costs into:
 - a. Material: Delivered cost of product with taxes paid.
 - b. Labor: Labor cost, excluding overhead and profit.
 4. For each line item having an installed cost of more than \$5,000, break down costs to list major products or operations under each item. At a minimum, provide material and labor cost line items for the following:
 - a. Excavation and backfill for underground piping systems inside the building.

- b. Underground piping systems inside the building (sanitary, storm, etc.) listed separately. Break down the material and labor for each piping system based on geography (building, floor, wing and/or phase).
- c. Each aboveground piping system (sanitary, storm, domestic water, etc.). Break down the material and labor for each piping system based on geography (building, floor, wing and/or phase).
- d. Pipe insulation with separate material and labor line items for each piping system listed above.
- e. Each piece of equipment requiring shop drawings (e.g., backflow preventer, water heater, water softener, etc.) using the project nomenclature (BFP-1, WH-1, WS-1, etc.).
- f. Each plumbing fixture (e.g., WC, lavatory, sink, etc.). Multiple units of the same type can be listed together, provided quantities are also listed so unit costs can be determined.
- g. Site utilities (5' beyond building)
- h. Seismic design
- i. Water balancing
- j. Commissioning
- k. Record drawings
- l. Punchlist and closeout

D. Update Schedule of Values when:

- 1. Indicated by Architect/Engineer.
- 2. Change of subcontractor or supplier occurs.
- 3. Change of product or equipment occurs.

1.8 CHANGE ORDERS

- A. A detailed material and labor takeoff shall be prepared for each change order, along with labor rates and markup percentages. Change orders with inadequate breakdown will be rejected.
- B. Change order work shall not proceed until authorized.

1.9 EQUIPMENT SUPPLIERS' INSPECTION

- A. The following equipment shall not be placed in operation until a competent installation and service representative of the manufacturer has inspected the installation and certified that the equipment is properly installed, adjusted and lubricated; that preliminary operating instructions have been given; and that the equipment is ready for operation:
 - 1. Fire Seal Systems
- B. Contractor shall arrange for and obtain supplier's on-site inspection(s) at proper time(s) to assure each phase of equipment installation and/or connection is in accordance with the manufacturer's instructions.
- C. Submit copies of start-up reports to the Architect/Engineer and include copies of Owner's Operation and Maintenance Manuals.

1.10 PRODUCT DELIVERY, STORAGE, HANDLING & MAINTENANCE

- A. Exercise care in transporting and handling to avoid damage to materials. Store materials on the site to prevent damage. Keep materials clean, dry and free from harmful conditions. Immediately remove any materials that become wet or that are suspected of becoming contaminated with mold or other organisms.
- B. Keep all bearings properly lubricated and all belts properly tensioned and aligned.
- C. Coordinate the installation of heavy and large equipment with the General Contractor and/or Owner. If the Mechanical Contractor does not have prior documented experience in rigging and lifting similar equipment, he/she shall contract with a qualified lifting and rigging service that has similar documented experience. Follow all equipment lifting and support guidelines for handling and moving.
- D. Contractor is responsible for moving equipment into the building and/or site. Contractor shall review site prior to bid for path locations and any required building modifications to allow movement of equipment. Contractor shall coordinate his/her work with other trades.

1.11 WARRANTY

- A. Provide one-year warranty, unless otherwise noted, to the Owner for all fixtures, equipment, materials, and workmanship.
- B. The warranty period for all work in this Division of the specifications shall commence on the date of final acceptance, unless a whole or partial system or any separate piece of equipment or component is put into use for the benefit of any party other than the installing contractor with prior written authorization. In this instance, the warranty period shall commence on the date when such whole system, partial system or separate piece of equipment or component is placed in operation and accepted in writing by the Owner.
- C. Warranty requirements shall extend to correction, without cost to the Owner, of all Work found to be defective or nonconforming to the contract documents. The Contractor shall bear the cost of correcting all damage resulting from defects or nonconformance with contract documents.

1.12 INSURANCE

- A. Contractor shall maintain insurance coverage as set forth in Division 0 of these specifications.

1.13 MATERIAL SUBSTITUTION

- A. Where several manufacturers' names are given, the manufacturer for which a catalog number is given is the basis for job design and establishes the quality required.
- B. Equivalent equipment manufactured by the other named manufacturers may be used. Contractor shall ensure that all items submitted by these other manufacturers meet all requirements of the drawings and specifications, and fits in the allocated space.
- C. Any material, article or equipment of other unnamed manufacturers which will adequately perform the services and duties imposed by the design and is of a quality equal to or better than the material, article or equipment identified by the drawings and specifications may be used if approval is secured in writing from the Architect/Engineer not later than ten days prior to the bid opening.

- D. This Contractor assumes all costs incurred as a result of using the offered material, article or equipment, on his part or on the part of other Contractors whose work is affected.
- E. This Contractor may list voluntary add or deduct prices for alternate materials on the bid form. These items will not be used in determining the low bidder.
- F. All material substitutions requested later than ten (10) days prior to bid opening must be listed as voluntary changes on the bid form.

PART 2 - PRODUCTS

NOT APPLICABLE

PART 3 - EXECUTION

3.1 JOBSITE SAFETY

- A. Neither the professional activities of the Architect/Engineer, nor the presence of the Architect/Engineer or his or her employee and subconsultants at a construction site, shall relieve the Contractor and other entity of their obligations, duties and responsibilities including, but not limited to, construction means, methods, sequence, techniques or procedures necessary for performing, superintending or coordinating all portions of the work of construction in accordance with the contract documents and any health or safety precautions required by any regulatory agencies. The Architect/Engineer and his or her personnel have no authority to exercise any control over any construction contractor or other entity or their employees in connection with their work or any health or safety precautions. The Contractor is solely responsible for jobsite safety. The Architect/Engineer and the Architect/Engineer's consultants shall be indemnified and shall be made additional insureds under the Contractor's general liability insurance policy.

3.2 EXCAVATION, FILL, BACKFILL, COMPACTION

- A. General:
 - 1. Prior to the commencement of any excavation or digging, the Contractor shall verify all underground utilities with the regional utility locator. Provide prior notice to the locator before excavations. Contact information for most regional utility locaters can be found by calling 811.
 - 2. The Contractor shall do all excavating, filling, backfilling and compacting associated with his work.
- B. Excavation:
 - 1. Make all excavations to accurate, solid, undisturbed earth, and to proper dimensions.
 - 2. Where excavations are made in error below foundations, concrete of same strength as specified for the foundations or thoroughly compacted sand-gravel fill, as determined by the Architect/Engineer, shall be placed in such excess excavations. Place thoroughly compacted, clean, stable fill in excess excavations under slabs on grade, at the Contractor's expense.

3. Trim bottom and sides of excavations to grades required for foundations.
 4. Protect excavations against frost and freezing.
 5. Take care in excavating not to damage surrounding structures, equipment or buried pipe. Do not undermine footing or foundation.
 6. Perform all trenching in a manner to prevent cave-ins and risk to workmen.
 7. Where original surface is pavement or concrete, the surface shall be saw cut to provide clean edges and assist in the surface restoration.
 8. Where satisfactory bearing soil for foundations is not found at the indicated levels, the Architect/Engineer or their representative shall be notified immediately, and no further work shall be done until further instructions are given by the Architect/Engineer or their representative.
- C. Dewatering:
1. Contractor shall furnish, install, operate and remove all dewatering pumps and pipes needed to keep trenches and pits free of water.
- D. Underground Obstructions:
1. Known underground piping, foundations, and other obstructions in the vicinity of construction are shown on the drawings. Use great care in making installations near underground obstruction.
 2. If objects not shown on the drawings are encountered, remove, relocate, or perform extra work as directed by the Architect/Engineer.
- E. Fill and Backfilling:
1. No rubbish or waste material is permitted for fill or backfill.
 2. Provide all necessary sand for backfilling.
 3. Dispose of the excess excavated earth as directed.
 4. Backfill materials shall be suitable for required compaction, clean and free of perishable materials and stones greater than 4 inches in diameter. Water shall not be permitted to rise in unbackfilled trenches. No material shall be used for backfilling that contains frozen earth, debris or earth with a high void content.
 5. Backfill all trenches and excavations immediately after installing pipes, or removal of forms, unless other protection is provided.
 6. Around piers and isolated foundations and structures, backfill and fill shall be placed and consolidated simultaneously on all sides to prevent wedge action and displacement. Fill and backfill materials shall be spread in 6 inch uniform horizontal layers with each layer compacted separately to required density.
 7. Lay all piping on a compacted bed of sand at least 3 inches deep. Backfill around pipes with sand, 6 inch layers, and compact each layer.

8. Use sand for backfill up to grade for all piping under slabs or paved areas. All other piping shall have sand backfill to 6 inches above the top of the pipe.
9. Place all backfill above the sand in uniform layers not exceeding 6 inches deep. Each layer shall be placed, then carefully and uniformly tamped, to eliminate lateral or vertical displacement.
10. Where the fill and backfill will ultimately be under a building, floor or paving, each layer of fill shall be compacted to 95% of the maximum density determined by AASHTO Designation T-99 or ASTM Designation D-698. Moisture content of soil at time of compaction shall not exceed plus or minus 2% of optimum moisture content determined by AASHTO T-99 or ASTM D-698 test.

F. Surface Restoration:

1. Where trenches are cut through graded, planted or landscaped areas, the areas shall be restored to the original condition. Replace all planting removed or damaged to its original condition. A minimum of 6 inches of topsoil shall be applied where disturbed areas are to be seeded or sodded.
2. Concrete or asphalt type pavement, seal coat, rock, gravel or earth surfaces removed or damaged shall be replaced with comparable materials and restored to original condition.

3.3 PROJECT CLOSEOUT

A. The following paragraphs supplement the requirements of Division 1.

B. Final Jobsite Observation:

1. In order to prevent the Final Jobsite Observation from occurring too early, the Contractor is required to review the completion status of the project and certify that the job is ready for the final jobsite observation.
2. Attached to the end of this section is a typical list of items that represent the degree of job completeness expected prior to requesting a review.
3. Upon Contractor certification that the project is complete and ready for a final observation, the Contractor shall sign the attached certification and return it to the Architect/Engineer so that the final observation can be scheduled.
4. It is understood that if the Architect/Engineer finds the job not ready for the final observation and that additional trips and observations are required to bring the project to completion, the costs incurred by the Architect/Engineer's additional time and expenses will be deducted from the Contractor's contract retainage prior to final payment at the completion of the job.

C. Before final payment is authorized, this Contractor must submit the following:

1. Operation and maintenance manuals with copies of approved shop drawings.
2. Record documents including reproducible drawings and specifications.

3. A report documenting the instructions given to the Owner's representatives complete with the number of hours spent in the instruction. The report shall bear the signature of an authorized agent of This Contractor and shall be signed by the Owner's representatives.
4. Start-up reports on all equipment requiring a factory installation inspection or start-up.
5. Provide spare parts, maintenance, and extra materials in quantities specified in individual specification sections. Deliver to and place in location as directed; receipt by Architect/Engineer required prior to final payment approval.

3.4 OPERATION AND MAINTENANCE MANUALS

A. General:

1. Provide an electronic copy of the O&M manuals as described below for Architect/Engineer's review and approval. The electronic copy shall be corrected as required to address the Architect/Engineer's comments. Once corrected, electronic copies and paper copies shall be distributed as directed by the Architect/Engineer.
2. Approved O&M manuals shall be completed and in the Owner's possession prior to Owner's acceptance and at least 10 days prior to instruction of operating personnel.

B. Electronic Submittal Procedures:

1. Distribution: Email the O&M manual as attachments to all parties designated by the Architect/Engineer.
2. Transmittal: Each submittal shall include an individual electronic letter of transmittal.
3. Format: Electronic submittals shall be in PDF format only. Scanned copies, in PDF format, of paper originals are acceptable. Submittals that are not legible will be rejected. Do not set any permission restrictions on files; protected, locked, or secured documents will be rejected.
4. File Names: Electronic submittal file names shall include the relevant specification section number followed by a description of the item submitted, as follows. Where possible, include the transmittal as the first page of the PDF instead of using multiple electronic files.
 - a. O&M file name: O&M.div22.contractor.YYYYMMDD
 - b. Transmittal file name: O&Mtransmittal.div22.contractor.YYYYMMDD
5. File Size: Electronic file size shall be limited to a maximum of 4MB. Larger files shall be divided into files that are clearly labeled as "1 of 2", "2 of 2", etc.
6. Provide the Owner with an approved copy of the O&M manual on compact discs (CD), digital video discs (DVD), or flash drives with a permanently affixed label, printed with the title "Operation and Maintenance Instructions", title of the project and subject matter of disc/flash drive when multiple disc/flash drives are required.
7. All text shall be searchable.

8. Bookmarks shall be used, dividing information first by specification section, then systems, major equipment and finally individual items. All bookmark titles shall include the nomenclature used in the construction documents and shall be an active link to the first page of the section being referenced.

C. Operation and Maintenance Instructions shall include:

1. Title Page: Include title page with project title, Architect, Engineer, Contractor, all subcontractors, and major equipment suppliers, with addresses, telephone numbers, website addresses, email addresses and point of contacts. Website URLs and email addresses shall be active links in the electronic submittal.
2. Table of Contents: Include a table of contents describing specification section, systems, major equipment, and individual items.
3. Copies of all final approved shop drawings and submittals. Include Architect's/Engineer's shop drawing review comments. Insert the individual shop drawing directly after the Operation and Maintenance information for the item(s) in the review form.
4. Copy of final approved test and balance reports.
5. Copies of all factory inspections and/or equipment startup reports.
6. Copies of warranties.
7. Schematic wiring diagrams of the equipment that have been updated for field conditions. Field wiring shall have label numbers to match drawings.
8. Dimensional drawings of equipment.
9. Capacities and utility consumption of equipment.
10. Detailed parts lists with lists of suppliers.
11. Operating procedures for each system.
12. Maintenance schedule and procedures. Include a chart listing maintenance requirements and frequency.
13. Repair procedures for major components.
14. List of lubricants in all equipment and recommended frequency of lubrication.
15. Instruction books, cards, and manuals furnished with the equipment.

3.5 INSTRUCTING THE OWNER'S REPRESENTATIVES

- A. Adequately instruct the Owner's designated representatives in the maintenance, care, and operation of all systems installed under this contract.
- B. Provide verbal and written instructions to the Owner's representatives by FACTORY PERSONNEL in the care, maintenance, and operation of the equipment and systems.
- C. The Owner has the option to make a video recording of all instructions. Coordinate schedule of instructions to facilitate this recording.

- D. The instructions shall include:
 - 1. Explanation of all system flow diagrams.
 - 2. Maintenance of equipment.
 - 3. Start-up procedures for all major equipment.
 - 4. Explanation of seasonal system changes.
- E. The Architect/Engineer shall be notified of the time and place instructions will be given to the Owner's representatives so he or his representative can attend if desired.
- F. Minimum hours of instruction for each item shall be:
 - 1. Domestic Hot Water System - 2 hours.
- G. The Contractor shall prepare a detailed, written training agenda and submit it to the Architect/Engineer a minimum of two four weeks prior to the formal training for approval. The written agenda shall include specific training points within the items described above. For example: how to adjust setpoints, troubleshooting, proper start-up, proper shut-down, seasonal changes, draining, venting, changing filters, changing belts, etc. Failure to provide and follow an approved training agenda may result in additional training required at the expense of the Contractor.
- H. Operating Instructions:
 - 1. Contractor is responsible for all instructions to the Owner's representatives for the mechanical and control systems.
 - 2. If the Contractor does not have staff that can adequately provide the required instructions he shall include in his bid an adequate amount to reimburse the Owner for the Architect/Engineer to perform these services.

3.6 SYSTEM COMMISSIONING

- A. The plumbing systems shall be complete and operating. System start-up, testing, balancing, and satisfactory system performance is the responsibility of the Contractor. This includes calibration and adjustments of all controls, noise level adjustments and final adjustments as required.
- B. Contractor shall adjust the plumbing systems and controls at season changes during the one year warranty period, as required, to provide satisfactory operation and to prove performance of all systems in all seasons.
- C. All operating conditions and control sequences shall be tested during the start-up period. Test all interlocks, safety shutdowns, controls, and alarms.
- D. The Contractor, subcontractors, and equipment suppliers shall have skilled technicians to ensure that all systems perform properly. If the Architect/Engineer is requested to visit the job site for trouble shooting, assisting in start-up, obtaining satisfactory equipment operation, resolving installation and/or workmanship problems, equipment substitution issues or unsatisfactory system performance, including call backs during the warranty period, through no fault of the design; the Contractor shall reimburse the Owner on a time and materials basis for services rendered at the Architect/Engineer's standard hourly rates in effect when the services are requested. The Contractor shall pay the Owner for services required that are product, installation or workmanship related. Payment is due within 30 days after services are rendered.

3.7 RECORD DOCUMENTS

- A. The following paragraph supplements Division 1 requirements:

Contractor shall maintain at the job site a separate and complete set of plumbing drawings and specifications on which he shall clearly and permanently mark in complete detail all changes made to the plumbing systems.

- B. Mark drawings to indicate revisions to piping size and location, both exterior and interior; including locations devices, requiring periodic maintenance or repair; actual equipment locations, dimensioned from column lines; actual inverts and locations of underground piping; concealed equipment, dimensioned from column lines; mains and branches of piping systems, with valves and control devices located and numbered, concealed unions located, and with items requiring maintenance located; Change Orders; concealed control system devices.

3.8 PAINTING

- A. This Contractor shall paint the following items:

1. Exterior Gas Piping.

- B. Paint all equipment that is marred or damaged prior to the Owner's acceptance. Paint and color shall match original equipment paint and shall be obtained from the equipment supplier if available.
- C. Equipment in finished areas that will be painted to match the room decor will be painted by others. Should this Contractor install equipment in a finished area after the area has been painted, he shall have the equipment and all its supports, hangers, etc., painted to match the room decor.
- D. Equipment cabinets, casings, covers, metal jackets, etc., in equipment rooms or concealed spaces, shall be furnished in standard or prime finish, free from scratches, abrasions, chips, etc.
- E. Equipment in occupied spaces, or if standard to the unit, shall have a baked primer with baked enamel finish coat free from scratches, abrasions, chips, etc. If color option is specified or is standard to the unit, this Contractor shall, before ordering, verify with the Architect/Engineer his color preference and furnish this color.
- F. Paint all equipment in unfinished areas such as boiler room, mechanical spaces, storage room, etc., furnished by this Contractor. Equipment furnished with a factory coat of paint and enamel need not be painted, provided the factory applied finish is not marred or spattered. If so, equipment shall be refinished with the same paint as was factory applied.
- G. Paint all outdoor uninsulated steel piping the color selected by Owner or Architect/Engineer.
- H. After surfaces have been thoroughly cleaned and are free of oil, dirt, and other foreign matter; paint all pipes and equipment with the following:
1. Bare Metal Surfaces - Apply one coat of primer suitable for the metal being painted. Finish with two coats of Alkyd base enamel paint.

2. Color of paint shall be as selected by Architect.

3.9 ADJUST AND CLEAN

- A. Thoroughly clean all equipment and systems prior to the Owner's final acceptance of the project. Clean all foreign paint, grease, oil, dirt, labels, stickers, and other foreign material from all equipment.
- B. Clean all areas where moisture is present. Immediately report any mold, biological growth, or water damage.
- C. Remove all rubbish, debris, etc., accumulated during construction from the premises.

3.10 SPECIAL REQUIREMENTS

- A. Contractor shall coordinate the installation of all equipment, valves, dampers, operators, etc., with other trades to maintain clear access area for servicing.
- B. All equipment shall be installed in such a way to maximize access to parts needing service or maintenance. Review the final field location, placement, and orientation of equipment with the Owner's designated representative prior to setting equipment.
- C. Installation of equipment or devices without regard to coordination of access requirements and confirmation with the Owner's designated representative will result in removal and reinstallation of the equipment at the Contractor's expense.

END OF SECTION

READINESS CERTIFICATION PRIOR TO FINAL JOBSITE OBSERVATION

In order to prevent the final job observation from occurring too early, we require that the Contractor review the completion status of the project and, by copy of this document, certify that the job is indeed ready for the final job observation. The following is a typical list of items that represent the degree of job completeness expected prior to your requesting a final job observation.

1. Penetrations fire sealed and labeled in accordance with specifications.
2. All plumbing fixtures installed and caulked.
3. Pipe insulation complete, pipes labeled and valves tagged.

Accepted by:

Prime Contractor _____

By _____ Date _____

Upon Contractor certification that the project is complete and ready for a final job observation, we require the Contractor to sign this agreement and return it to the Architect/Engineer so that the final observation can be scheduled.

It is understood that if the Architect/Engineer finds the job not ready for the final observation and that additional trips and observations are required to bring the project to completion, the costs incurred by the Architect/Engineers for additional time and expenses will be deducted from the Contractor's contract retainage prior to final payment at the completion of the job.

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SECTION 22 05 05

PLUMBING DEMOLITION FOR REMODELING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Mechanical demolition.
- B. Cutting and Patching.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

- A. Materials and equipment shall be as specified in individual Sections.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. THE DRAWINGS ARE INTENDED TO INDICATE THE GENERAL SCOPE OF WORK AND DO NOT SHOW EVERY PIPE, DUCT, OR PIECE OF EQUIPMENT THAT MUST BE REMOVED. THE CONTRACTOR SHALL VISIT THE SITE AND VERIFY CONDITIONS PRIOR TO SUBMITTING A BID.
- B. Where walls, ceilings, etc., are shown as being removed on general drawings, the Contractor shall remove all mechanical equipment, devices, fixtures, piping, ducts, systems, etc., from the removed area.
- C. Where ceilings, walls, partitions, etc., are temporarily removed and replaced by others, This Contractor shall remove, store, and replace equipment, devices, fixtures, pipes, ducts, systems, etc.
- D. Verify that abandoned utilities serve only abandoned equipment or facilities. Extend services to facilities or equipment that shall remain in operation following demolition.
- E. Coordinate work with all other Contractors and the Owner. Schedule removal of equipment to avoid conflicts.
- F. This Contractor shall verify all existing equipment sizes and capacities where equipment is scheduled to be replaced or modified, prior to ordering new equipment.
- G. Bid submittal shall mean the Contractor has visited the project site and verified existing conditions and scope of work.

3.2 PREPARATION

- A. Disconnect plumbing systems in walls, floors, and ceilings scheduled for removal.
- B. Provide temporary connections to maintain existing systems in service during construction. When work must be performed on operating equipment, use personnel experienced in such operations.

- C. Existing Plumbing System: Obtain permission from Owner at least 48 hours before shutting down system for any reason. Make changeover to new piping with minimum outage. Do not disconnect any roof drainage piping until new piping is in place and operational.

3.3 DEMOLITION AND EXTENSION OF EXISTING MECHANICAL WORK

- A. Demolish and extend existing plumbing work under provisions of Division 2 and this Section.
- B. Remove, relocate, and extend existing installations to accommodate new construction.
- C. Remove abandoned piping to source of supply and/or main lines.
- D. Remove exposed abandoned pipes, including abandoned pipes above accessible ceilings. Cut pipes above ceilings, below floors and behind walls. Cap remaining lines. Repair building construction to match original. Remove all clamps, hangers, supports, etc. associated with pipe and duct removal.
- E. Disconnect and remove mechanical devices and equipment serving equipment that has been removed.
- F. Repair adjacent construction and finishes damaged during demolition and extension work.
- G. Extend existing installations using materials and methods compatible with existing installations, or as specified.
- H. Remove unused sections of domestic water piping back to mains and cap. Capped pipe shall be less than 2 feet from main to prevent "dead legs".
- I. Temporarily cap all openings to the sanitary and vent system to prevent odor from entering the work area and building.

3.4 CUTTING AND PATCHING

- A. This Contractor is responsible for all penetrations of existing construction required to complete the work of this project. Refer to Section 22 05 29 for additional requirements.
- B. Penetrations in existing construction should be reviewed carefully prior to proceeding with any work.
- C. Penetrations shall be neat and clean with smooth and/or finished edges. Core drill where possible for clean opening.
- D. Repair existing construction as required after penetration is complete to restore to original condition. Use similar materials and match adjacent construction unless otherwise noted or agreed to by the Architect/Engineer prior to start of work.
- E. Floor slabs may contain conduit systems. This Contractor is responsible for taking any measures required to ensure no conduits or other services are damaged. This includes x-ray or similar non-destructive means.
- F. This Contractor is responsible for all costs incurred in repair, relocations, or replacement of any cables, conduits, or other services if damaged without proper investigation.

3.5 CLEANING AND REPAIR

- A. Clean and repair existing materials and equipment which remain or are to be reused.
- B. Clean all systems adjacent to project which are affected by the dust and debris caused by this construction.
- C. PLUMBING ITEMS REMOVED AND NOT RELOCATED REMAIN THE PROPERTY OF THE OWNER. CONTRACTOR SHALL PLACE ITEMS RETAINED BY THE OWNER IN A LOCATION COORDINATED WITH THE OWNER. THE CONTRACTOR SHALL DISPOSE OF MATERIAL THE OWNER DOES NOT WANT TO REUSE OR RETAIN FOR MAINTENANCE PURPOSES.

END OF SECTION

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SECTION 22 05 29

PLUMBING SUPPORTS AND ANCHORS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Hangers, Supports, and Associated Anchors.
- B. Equipment Bases and Supports.
- C. Sleeves and Seals.
- D. Flashing and Sealing of Equipment and Pipe Stacks.
- E. Cutting of Openings.
- F. Escutcheon Plates and Trim.

1.2 WORK FURNISHED BUT INSTALLED UNDER OTHER SECTIONS

- A. Furnish sleeves and hanger inserts to General Contractor for placement into formwork.

PART 2 - PRODUCTS

2.1 HANGER RODS

- A. Hanger rods for single rod hangers shall conform to the following:

Pipe Size	Hanger Rod Diameter	
	Column #1	Column #2
2" and smaller	3/8"	3/8"
2-1/2" through 3-1/2"	1/2"	1/2"
4" and 5"	5/8"	1/2"

Column #1: Cast iron pipe.

Column #2: Copper and plastic pipe.

- B. Rods for double rod hangers may be reduced one size. Minimum rod diameter is 3/8 inches.
- C. Hanger rods and accessories used in mechanical spaces or otherwise dry areas shall have ASTM B633 electro-plated zinc finish.
- D. All hanger rods, nuts, washers, clevises, etc., in damp areas shall have ASTM A123 hot-dip galvanized finish applied after fabrication. This applies to all areas.

2.2 PIPE HANGERS AND SUPPORTS

- A. All pipe hangers, clamps, and supports shall conform to Manufacturers Standardization Society MSS-SP-58 and 127 (where applicable).
- B. Oversize all hangers, clamps, and supports on insulated piping to allow insulation and jacket to pass through unbroken. This applies to both hot and cold pipes.

- C. Ferrous hot piping 2-1/2 inches and larger shall have steel saddles tack welded to the pipe at each support at a depth not less than the specified insulation. Factory fabricated inserts may be used.

Acceptable Products:

- Anvil - Fig. 160, 161, 162, 163, 164, 165
- Cooper/B-Line - Fig. 3160, 3161, 3162, 3163, 3164, 3165
- Erico - Model 630, 631, 632, 633, 634, 635
- Nibco/Tolco - Fig. 260-1, 261-1 1/2, 262-2, 263-2 1/2, 264-3, 265-4

- D. On all insulated piping, provide a semi-cylindrical metallic shield and fire resistant vapor barrier jacket.

- E. As an alternative to separate pipe insulation insert and saddle, properly sized integral rigid insulation sections may be used for this application.

Acceptable Products:

- Cooper/B-Line - Fig. B3380 through B3384
- Pipe Shields - A1000, A2000
- Erico - Model 124, 127

- F. Hangers in direct contact with copper pipe shall be coated with plastic with appropriate temperature range. HYDRA-ZORB clamps are permitted for this application for bare pipes within their temperature limits of -65°F to +275°F.

- G. Unless otherwise indicated, hangers shall be as follows:

1. Clevis Type:

- Service: Bare Metal Pipe
 Rigid Plastic Pipe
 Insulated Cold Pipe
 Insulated Hot Pipe - 3 inches & Smaller

Acceptable Products:	Bare Steel, Plastic or Insulated Pipe	Bare Copper Pipe
Anvil	Fig. 260	
Cooper/B-Line	Fig. 3100	Fig. B3100C
Erico	Model 400	
Nibco/Tolco	Fig. 1	Fig. 81PVC

2. Continuous Channel with Clevis Type:

- Service: Plastic Tubing
 Flexible Hose
 Soft Copper Tubing

Acceptable Products:

- Cooper/B-Line - Fig. B3106, with Fig. B3106V
- Erico - Model 104, with Model 104V
- Nibco/Tolco - Fig. 1V

3. Adjustable Swivel Ring Type:
 Service: Bare Metal Pipe - 4 inches and Smaller

Acceptable Products:	Bare Steel Pipe	Bare Copper Pipe
Anvil	Fig. 69	
Cooper/B-Line	Fig. B3170NF	Fig. B3170CTC
Erico	Model FCN	102A0 Series
Nibco/Tolco	Fig. 200	Fig. 203

H. Support may be fabricated from U-Channel strut or similar shapes. Piping less than 4" in diameter shall be secured to strut with clamps of proper design and capacity as required to maintain spacing and alignment. Strut shall be independently supported from hanger drops or building structure. Size and support shall be per manufacturer's installation requirements for structural support of piping. Clamps shall not interrupt piping insulation.

1. Strut used in mechanical spaces or otherwise dry areas shall have ASTM B633 electro-plated zinc finish.
2. Strut used in damp areas listed in hanger rods shall have ASTM A123 hot-dip galvanized finish applied after fabrication.

I. Unless otherwise indicated, pipe supports for use with struts shall be as follows:

1. Clamp Type:
 Service: Bare Metal Pipe
 Rigid Plastic Pipe
 Insulated Cold Pipe
 Insulated Hot Pipe - 3 inches and smaller

- a. Clamps in direct contact with copper pipe shall be plastic coated.
- b. Pipes subject to expansion and contraction shall have clamps slightly oversized to allow limited pipe movement.

Acceptable Products:	Bare Steel, Plastic or Insulated Pipe	Bare Copper Pipe
Unistrut	Fig. P1100 or P2500	
Cooper/B-Line	Fig. B2000 or B2400	Fig. BVT
Nibco/Tolco	Fig. A-14 or 2STR	

J. Unless otherwise shown, upper attachments for hanger rods or support struts shall be as follows:

1. Concrete Anchors: Fasten to concrete using cast-in or post-installed anchors designed per the requirements of Appendix D of ACI 318-08. Post-installed anchors shall be qualified for use in cracked concrete by ACI-355.2.
2. Masonry Anchors: Fasten to concrete masonry units with expansion anchors or self-tapping masonry screws. For expansion anchors into hollow concrete block, use sleeve-type anchors designed for the specific application. Do not fasten in masonry joints. Do not use powder actuated fasteners, wooden plugs, or plastic inserts.

- K. Copper piping located in an exposed area, shall use split ring standoff hangers for copper tubing. Support shall have copper electroplating for corrosion resistance. Use electro-galvanized or more corrosion resistant and threaded rod for floor applications. Use anchors applicable to the wall type with corrosion resistant threaded rod for wall applications.

Acceptable Products:

Erico/M-Co	Model #456
B-Line	Fig. 3198HCT
Anvil	Fig. CT138R
Nibco/Tolco	Fig. 301CT

- L. Welding:
1. Unless otherwise noted, hangers, clips, and auxiliary support steel may be welded in lieu of bolting, clamping, or riveting to the building structural frame. Take adequate precautions during all welding operations for fire prevention and for protecting walls and ceilings from being damaged by smoke.

2.3 FOUNDATIONS, BASES, AND SUPPORTS

A. Basic Requirements:

1. Furnish and install foundations, bases, and supports (not specifically indicated on the Drawings or in the Specifications of either the General Construction or Mechanical work as provided by another Contractor) for mechanical equipment.
2. All steel bases and supports shall receive a prime coat of zinc chromate or red metal primer. After completion of work, give steel supports a final coat of gray enamel.

B. Supports:

1. Provide sufficient clips, inserts, hangers, racks, rods, and auxiliary steel to securely support all suspended material, equipment and conduit without sag.
2. Hang heavy equipment from concrete floors or ceilings with Architect/Engineer-approved concrete inserts, furnished and installed by the Contractor whose work requires them, except where indicated otherwise.

C. Grout:

1. Grout shall be non-shrinking premixed (Master Builders Company "Embecco"), unless otherwise indicated on the drawings or approved by the Architect/Engineer.
2. Use Mix No. 1 for clearances of 1" or less, and Mix No. 2 for all larger clearances.
3. Grout under equipment bases, around pipes, at pipe sleeves, etc., and where shown on the drawings.

2.4 OPENINGS IN FLOORS, WALLS AND CEILINGS

- A. Exact locations of all openings for the installation of materials shall be determined by the Contractor and given to the General Contractor for installation or construction as the structure is built.
- B. Coordinate all openings with other Contractors.
- C. Hire the proper tradesman and furnish all labor, material and equipment to cut openings in or through existing structures, or openings in new structures that were not installed, or additional openings. Repair all spalling and damage to the satisfaction of the Architect/Engineer. Make saw cuts before breaking out concrete to ensure even and uniform opening edges.
- D. Said cutting shall be at the complete expense of each Contractor. Failure to coordinate openings with other Contractors shall not exempt the Contractor from providing openings at his expense.
- E. Do not cut structural members without written approval of the Architect or Structural Engineer.

2.5 ROOF PENETRATIONS

- A. Seal pipes with surface temperature below 150°F penetrating single-ply roofs with conical stepped pipe flashings and stainless steel clamps equal to Portals Plus Pipe Boots. Material shall match roofing membrane.
- B. Break insulation only at the clamp for pipes between 60°F and 150°F. Seal outdoor insulation edges watertight.

2.6 PIPE SLEEVES AND LINTELS

- A. Each Contractor shall provide pipe sleeves and lintels for all openings required for the Contractor's work in masonry walls and floors, unless specifically shown as being by others.
- B. Fabricate all sleeves from standard weight black steel pipe or as indicated on the drawings. Provide continuous sleeve. Cut or split sleeves are not acceptable.
- C. Fabricate all lintels for masonry walls from structural steel shapes or as indicated on the drawings. Have all lintels approved by the Architect or Structural Engineer.
- D. Sleeves through the floors on exposed risers shall be flush with the ceiling, with planed squared ends extending 1" above the floor in unfinished areas, and flush with the floor in finished areas, to accept spring closing floor plates.
- E. Sleeves shall not penetrate structural members or masonry walls without approval from the Structural Engineer. Sleeves shall then comply with the Architect/Engineer's design.
- F. Openings through unexcavated floors and/or foundation walls below the floor shall have a smooth finish with sufficient annular space around material passing through opening so slight settling will not place stress on the material or building structure.
- G. Install all sleeves concentric with pipes. Secure sleeves in concrete to wood forms. This Contractor is responsible for sleeves dislodged or moved when pouring concrete.

- H. Where pipes rise through concrete floors that are on earthen grade, provide 3/4" resilient expansion joint material (asphalt and cork) wrapped around the pipe, the full depth of concrete, at the point of penetration. Secure to prevent shifting during concrete placement and finishing.
- I. Size sleeves large enough to allow expansion and contraction movement. Provide continuous insulation wrapping.

2.7 ESCUTCHEON PLATES AND TRIM

- A. Fit escutcheons to all insulated or uninsulated exposed pipes passing through walls, floors, or ceilings of finished rooms.
- B. Escutcheons shall be heavy gauge, cold rolled steel, copper coated under a chromium plated finish, heavy spring clip, rigid hinge and latch.
- C. Install galvanized steel (unless otherwise indicated) trim strip to cover vacant space and raw construction edges of all rectangular openings in finished rooms. This includes pipe openings.

2.8 PIPE PENETRATIONS

- A. Seal all pipe penetrations. Seal non-rated walls and floor penetrations with grout or caulk. Backing material may be used.
- B. Seal fire rated wall and floor penetrations with fire seal system as specified.

2.9 PIPE ANCHORS

- A. Provide all items needed to allow adequate expansion and contraction of all piping. All piping shall be supported, guided, aligned, and anchored as required.
- B. Repair all piping leaks and associated damage. Pipes shall not rub on any part of the building.

2.10 FINISH

- A. Prime coat exposed steel hangers and supports. Hangers and supports in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

PART 3 - EXECUTION

3.1 PLUMBING SUPPORTS AND ANCHORS

- A. General Installation Requirements:
 - 1. Install all items per manufacturer's instructions.
 - 2. Coordinate the location and method of support of piping systems with all installations under other Divisions and Sections of the Specifications.
 - 3. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.

B. Supports Requirements:

1. Set all concrete inserts in place before pouring concrete.
2. Furnish, install and prime all auxiliary structural steel for support of piping systems that are not shown on the Drawings as being by others.
3. Install hangers and supports complete with lock nuts, clamps, rods, bolts, couplings, swivels, inserts and required accessories.
4. Hangers for horizontal piping shall have adequate means of vertical adjustment for alignment.

C. Pipe Requirements:

1. Support all piping and equipment, including valves, strainers, traps and other specialties and accessories to avoid objectionable or excessive stress, deflection, swaying, sagging or vibration in the piping or building structure during erection, cleaning, testing and normal operation of the systems.
2. Do not, however, restrain piping to cause it to snake or buckle between supports or to prevent proper movement due to expansion and contraction.
3. Support piping at equipment and valves so they can be disconnected and removed without further supporting the piping.
4. Piping shall not introduce strains or distortion to connected equipment.
5. Parallel horizontal pipes may be supported on trapeze hangers made of structural shapes and hanger rods; otherwise, pipes shall be supported with individual hangers.
6. Trapeze hangers may be used where ducts interfere with normal pipe hanging.
7. Provide additional supports where pipe changes direction, adjacent to flanged valves and strainers, at equipment connections and heavy fittings.
8. Provide at least one hanger adjacent to each joint in cast iron soil pipe, grooved end steel pipe with mechanical couplings.

D. Do not exceed 25 lbs. per hanger and a minimum spacing of 2'-0" on center when attaching to metal roof decking (limitation not required with concrete on metal deck). This 25 lbs. load and 2'-0" spacing include adjacent electrical and architectural items hanging from deck. If the hanger restrictions cannot be achieved, supplemental framing off steel framing will need to be added.

E. Do not exceed the manufacturer's recommended maximum load for any hanger or support.

F. Spacing of Hangers shall not exceed the compressive strength of the insulation inserts, and in no case shall exceed the following:

	<u>Pipe Material</u>	<u>Maximum Spacing</u>
1.	Steel (Std. Weight or Heavier – Liquid Service):	
	1-1/4" & under	7'-0"
	1-1/2"	9'-0"

Plumbing Supports And Anchors

	<u>Pipe Material</u>	<u>Maximum Spacing</u>
	2"	10'-0"
	2-1/2"	11'-0"
	3"	12'-0"
	4" & larger	12'-0"
2.	Hard Drawn Copper & Brass (Liquid Service):	
	3/4" and under	5'-0"
	1"	6'-0"
	1-1/4"	7'-0"
	1-1/2"	8'-0"
	2"	8'-0"
	2-1/2"	9'-0"
	3"	10'-0"
	4"	12'-0"
3.	Cast Iron Soil Pipe - All Sizes:	
	Over 5' pipe lengths	10'-0"
	Less than 5' pipe lengths	5'-0"
	Support all direction changes and branch connections.	
4.	Flexible Plastic Pipe, Flexible Hose, and Soft Copper Tubing:	
	a. Continuous channel with hangers maximum 8'-0" O.C.	
5.	Rigid Plastic Pipe:	
	a. Space hangers at 4'-0" maximum centers.	
6.	Installation of hangers shall conform to MSS SP-58 and the applicable Plumbing Code.	

END OF SECTION

SECTION 22 05 53

PLUMBING IDENTIFICATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Identification of products installed under Division 22.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. 3M, Bunting, Calpico, Craftmark, Emedco, Kolbi Industries, Seton, W.H. Brady, Marking Services.

2.2 MATERIALS

- A. All pipe markers (purchased or stenciled) shall conform to ANSI A13.1. Marker lengths and letter sizes shall be at least the following:

<u>O.D. of Pipe or insulation</u>	<u>Marker Length</u>	<u>Size of Letters</u>
Up to and including 1-1/4"	8"	1/2"
1-1/2" to 2"	8"	3/4"
2-1/2" to 6"	12"	1-1/4"

Plastic tags may be used for outside diameters under 3/4".

- B. Plastic Nameplates: Laminated three-layer phenolic with engraved white, 1/4" minimum letters on black background.
- C. Plastic Tags: Minimum 1-1/2" square or round laminated three-layer phenolic with engraved, 1/4" minimum white letters on colored background as selected by Owner.
- D. Plastic Pipe Markers: Semi-rigid plastic, preformed to fit around pipe or pipe covering; indicating flow direction and fluid conveyed.
- E. Underground Pipe Markers: Bright colored continuously printed plastic ribbon tape 6" wide by 3.5 mils thick, manufactured for direct burial, with aluminum foil core for location by non-ferric metal detectors and bold lettering identifying buried item.
- F. Tracer Wire:
 - 1. Single copper conductors shall be solid or stranded annealed or hard uncoated copper per UL83 and ASTM requirements. Tracer tape or copper-coated steel wire is not acceptable.
 - 2. Conductor shall be insulated with HMWPE as specified and applied in a concentric manner. The minimum at any point shall not be less than 90% of the specified average thickness in compliance with UL 83.

3. Tracer wire shall be continuously spark tested at 7500 Volts DC. Other electrical and mechanical tests shall be in accordance with UL 1581.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install all products per manufacturer's recommendations.
- B. Degrease and clean surfaces to receive adhesive for identification materials.
- C. Valves:
 1. All valves (except shutoff valves at equipment) shall have numbered tags. Utilize Owner's valve naming convention.
 2. Provide or replace numbered tags on all existing valves that are connected to new systems or that have been revised.
 3. Provide all existing valves used to extend utilities to this project with numbered tags. Review tag numbering sequence with the Owner prior to ordering tags.
 4. Secure tags with heavy duty key chain and brass "S" link or with mechanically fastened plastic straps.
 5. Attach to handwheel or around valve stem. On lever operated valves, drill the lever to attach tags.
 6. Number all tags and show the service of the pipe.
 7. Provide two sets of laminated 8-1/2" x 11" copies of a valve directory listing all valves, with respective tag numbers, uses, and locations. The directory shall be reviewed by the Owner and Architect/Engineer prior to laminating final copies. Laminated copies shall have brass eyelet in at least one corner for easy hanging.
 8. Provide an electronic (Microsoft Excel) version of the final approved schedule to the Owner.
- D. Pipe Markers:
 1. Snap-on Markers: Use Seton "Setmark" on pipes up to 5-7/8" OD. Use Seton "Setmark" with nylon or Velcro ties for pipes 6" OD and over. Similar styles by other listed manufacturers are acceptable.
 2. Apply markers and arrows in the following locations where clearly visible:
 - a. At each valve.
 - b. On both sides of walls that pipes penetrate.
 - c. At least every 10 feet along all pipes.
 - d. On each riser and each leg of each "T" joint.
 - e. At least twice in every room and each story traversed.
 3. Underground Pipe Markers: Install 8" to 10" below grade, directly above buried pipes.

E. Equipment:

1. All equipment not easily identifiable such as controls, relays, gauges, etc.; and all equipment in an area remote from its function shall have nameplates or plastic tags listing name, function, and drawing symbol. Do not label exposed equipment in public areas.
2. Mechanical equipment that is not covered by the U.S. National Appliance Energy Conservation Act (NAECA) of 1987 shall carry a permanent label installed by the manufacturer stating that the equipment complies with the requirements of ASHRAE 90.1.

F. Tracer Wire:

1. Tracer wire shall be installed on top of all non-metallic buried utilities.
2. Tracer wire shall be taped directly to plastic water or drain pipe.
3. Tracer wire shall not be fastened directly or indirectly to gas piping.
4. Tracer wire when attached shall be secured to the pipe a minimum of every 10 feet and at all changes of direction.
5. Tape shall be Polyken "930-35", Protecto-Wrap "310", or approved equal.
6. Tracer wire shall be continuous between boxes and shall be tested for continuity.
7. Splices in tracer wire shall be made with a water proof splice kit to prevent corrosion. **Wire nuts shall not be used.**
8. The tracer wire shall daylight to grade through a 2" PVC conduit, at the point of the utility entrance to building. PVC conduit shall be capped and labeled as future contact point to locate the utility.

3.2 SCHEDULE

A. Pipes to be marked:

Pipe Service	Lettering Color	Background Color
Condensate Drain	Black	Yellow
Domestic Cold Water	White	Green
Domestic Hot Water - 115°F	Black	Yellow
Sanitary Sewer	Black	Yellow
Vent	Black	Yellow
Storm Sewer	White	Green
Natural Gas	Black	Yellow
Non-Potable Water	Black	Yellow
Chemical Lines (Chlorine and Fluoride)	Black	Orange
All Underground Pipes	Varies	Varies
Tracer Wire - Water Pipe Lines	---	Blue
Tracer Wire - Natural Gas Pipe Lines	---	Yellow
Tracer Wire - All other buried types	---	Green

END OF SECTION

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SECTION 22 07 19

PLUMBING PIPING INSULATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Piping Insulation.
- B. Insulation Jackets.

1.2 QUALITY ASSURANCE

- A. Applicator: Company specializing in piping insulation application with five years minimum experience.
- B. Materials: Flame spread/smoke developed rating of 25/50 in accordance with ASTM E84, NFPA 255, or UL 723 (where required).
- C. Adhesives and Sealants: All adhesives and sealants used on the interior of the building must comply with the following requirements:
 - 1. Adhesives, sealants and sealant primers must comply with South Coast Air Quality Management District (SCAQMD) Rule #1168.
 - 2. Aerosol adhesives must comply with Green Seal Standard for Commercial Adhesives GS-36 requirements in effect on October 19, 2000.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Armacell.
- B. Certainteed Manson.
- C. Dow Chemical Company.
- D. Knauf Fiber Glass.
- E. Johns Manville/Schuller.
- F. Owens/Corning Fiberglas Corporation.

2.2 INSULATION

- A. Type A: Glass fiber; ANSI/ASTM C547; 0.24 maximum 'K' value at 75°F; non-combustible. All purpose, white kraft jacket bonded to aluminum foil and reinforced with fiberglass yarn, 25/50 flame spread/smoke developed rating when tested in accordance with ASTM E84 (UL 723).
- B. Type B: Elastomeric cellular foam; ANSI/ASTM C534; flexible plastic; 0.27 maximum 'K' value at 75°F, 25/50 flame spread/smoke developed rating when tested in accordance with ASTM E84 (UL 723). Maximum 3/4" thick per layer where multiple layers are specified.

- C. Type C: Molded rigid cellular glass; ANSI/ASTM C-552; 0.35 maximum 'K' value at 75°F; moisture resistant, non-combustible; suitable for -100°F to +900°F. For below grade installations use asphaltic mastic paper vapor barrier jacket. Use self-seal all-purpose white kraft jacket for above grade installations.
- D. Type D: Hydrous Calcium Silicate; ASTM C533; rigid molded pipe insulation; asbestos free; 0.40 'K' value at 300°F; 1200°F maximum service temperature; 16 gauge stainless steel tie wires on maximum 12" centers.

2.3 VAPOR BARRIER JACKETS

- A. Kraft reinforced foil vapor barrier with self-sealing adhesive joints. Beach puncture resistance ratio of at least 50 units. Tensile strength: 35 psi minimum. Single, self-seal acrylic adhesive on longitudinal jacket laps and butt strips.

2.4 JACKET COVERINGS

- A. Aluminum Jackets: ASTM B209; 0.016" thick; stucco embossed finish with Z edge seams and aluminum bands for outdoor use. Where colored jacket covers are called for, provide factory-applied hard film acrylic paint in color selected by Architect.
- B. Plastic Jackets and Fitting Covers: High impact, glossy white, 0.020" thick, self-extinguishing plastic. Suitable for use indoors or outdoors with ultraviolet inhibitors. Suitable for -40°F to 150°F. 25/50 maximum flame spread/smoke developed.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Install insulation after piping has been tested. Pipe shall be clean, dry and free of rust before applying insulation.

3.2 INSTALLATION

- A. General Installation Requirements:
 - 1. Install materials per manufacturer's instructions, building codes and industry standards.
 - 2. Continue insulation with vapor barrier through penetrations. This applies to all insulated piping. Maintain fire rating of all penetrations.
 - 3. On all insulated piping, provide at each support an insert of same thickness and contour as adjoining insulation, between the pipe and insulation jacket, to prevent insulation from sagging and crushing. The insert shall be suitable for planned temperatures, be suitable for use with specific pipe material, and shall be a 180° cylindrical segment the same length as metal shields. Inserts shall be a cellular glass (for all temperature ranges) or molded hydrous calcium silicate (for pipe with operating temperatures above 70°F), with a minimum compressive strength of 50 psi. Factory fabricated inserts may be used. Rectangular blocks, plugs, or wood material are not acceptable. Temporary wood blocking may be used by the Piping Contractor for proper height; however, these must be removed and replaced with proper inserts by the Insulation Contractor.
 - 4. Neatly finish insulation at supports, protrusions, and interruptions.

5. Install metal shields between all hangers or supports and the pipe insulation. Shields shall be galvanized sheet metal, half-round with flared edges. Adhere shields to insulation. On cold piping, seal the shields vapor-tight to the insulation as required to maintain the vapor barrier, or add separate vapor barrier jacket.

6. Shields shall be at least the following lengths and gauges:

	<u>Pipe Size</u>	<u>Shield Size</u>
a.	1/2" to 3-1/2"	12" long x 18 gauge
b.	4"	12" long x 16 gauge
c.	5" to 6"	18" long x 16 gauge
d.	8" to 14"	24" long x 14 gauge

7. All piping and insulation that does not meet 25/50 that is located in an air plenum shall have written approval from the Authority Having Jurisdiction and the local fire department for authorization and materials approval. If approval has been allowed, the non-rated material shall be wrapped with a product that has passed ASTM E84 and/or NFPA 255 testing with a rating of 25/50 or below.

8. On 1" and smaller piping routed through metal wall studs, provide a plastic grommet to protect the piping. The piping shall be insulated between the wall studs, and the insulation shall butt up to each stud.

B. Insulated Piping Operating Below 60°F:

1. Insulate fittings, valves, unions, flanges, strainers, flexible connections, flexible hoses, and expansion joints. Seal all penetrations of vapor barrier.
2. On piping operating below 60°F in locations that are not mechanically cooled (e.g., penthouses, mechanical rooms, tunnels, chases at exterior walls, etc.), Type B insulation shall be used.
3. All balance valves with fluid operating below 60°F shall be insulated with a removable plug wrapped with vapor barrier tape to allow reading and adjusting of the valve.

C. Insulated Piping Operating Between 60°F and 140°F:

1. Do not insulate flanges and unions, but bevel and seal ends of insulation at such locations. Insulate all fittings, valves and strainers.

D. Exposed Piping:

1. Locate and cover seams in least visible locations.
2. Where exposed insulated piping extends above the floor, provide a sheet metal guard around the insulation extending 12" above the floor. Guard shall be 0.016" cylindrical smooth or stucco aluminum and shall fit tightly to the insulation.
3. On exposed piping serving kitchen equipment or plumbing fixtures, the piping does not need to be insulated if less than four feet in developed length. If piping is longer than four feet in developed length, the piping shall be insulated and have a plastic jacket.

3.3 INSULATION

A. Type A Insulation:

1. All Service Jackets: Seal all longitudinal joints with self-seal laps using a single pressure sensitive adhesive system. Do not staple.
2. Insulation without self-seal lap may be used if installed with Benjamin Foster 85-20 or equivalent Chicago Mastic, 3M or Childers lap adhesive.
3. Apply insulation with laps on top of pipe.
4. Fittings, Valve Bodies and Flanges: For 4" and smaller pipes, insulate with 1 lb. density insulation wrapped under compression to a thickness equal to the adjacent pipe insulation. For pipes over 4", use mitered segments of pipe insulation. Finish with preformed plastic fitting covers. Secure fitting covers with pressure sensitive tape at each end. Overlap tape at least 2" on itself. For pipes operating below 60°F, seal fitting covers with vapor retarder mastic in addition to tape.

B. Type B Insulation:

1. Elastomeric Cellular Foam: Where possible, slip insulation over the open end of pipe without slitting. Seal all butt ends, longitudinal seams, and fittings with adhesive. At elbows and tees, use mitered connections. Do not compress or crush insulation at cemented joints. Joints shall be sealed completely and not pucker or wrinkle. Paint the outside of outdoor insulation with two coats of latex enamel paint recommended by the manufacturer.
2. Self-seal insulation may be used on pipes operating below 170°F.

C. Type C Insulation:

1. Seal all longitudinal joints with manufacturer approved adhesive. Secure butt joint strips in a similar manner.
2. Insulate fittings with prefabricated fittings.

D. Type D Insulation:

1. Use pre-molded half sections. Butt longitudinal and circumferential joints tightly. Wire in place with 16 gauge stainless steel wire on maximum 12" centers.
2. Apply in two layers. Stagger all joints between layers. Wire each layer individually.

3.4 JACKET COVER INSTALLATION

A. Metal Covering:

1. Provide vapor barrier as specified for insulation type. Cover with aluminum jacket covering with seams located on the bottom of horizontal piping. Include fittings, joints and valves.
2. Seal all interior and exterior butt joints with metal draw bands and sealant. Seal all exterior joints watertight.

3. Interior joints do not need to be sealed.
 4. Use metal covering on the following pipes:
 - a. All exposed vertical piping.
- B. Plastic Covering:
1. Provide vapor barrier as specified for insulation type. Cover with plastic jacket covering. Position seams to shed water.
 2. Solvent weld all joints with manufacturer recommended cement.
 3. Overlap all laps and butt joints 1-1/2" minimum. Repair any loose ends that do not seal securely. Solvent weld all fitting covers in the same manner. Final installation shall be watertight.
 4. All joints in areas noted shall meet USDA standards for Totally Sealed Systems, including overlaps of 1" on circumferential and 1.5" to 2" on longitudinal seams.

3.5 SCHEDULE

Piping System	Insulation Type/Thickness	
A. Domestic Hot Water & Circulating - Potable and Non-Potable - up to 140°F		
Up to 1-1/2" Pipe Size	A / 1"	OR E / 3/4"
Above 1-1/2" Pipe Size	A / 1-1/2"	OR E / 1"
B. Domestic Cold Water - Potable and Non-Potable	A / 1"	OR E / 3/4"
C. Storm Drainage (include drain bodies and all piping within the building, except underground)	A / 1"	OR B / 1"
D. Plumbing Vents Within 10' from Roof Penetration	A / 1/2"	OR B / 1/2"
E. Cooling Coil Condensate Drains & Dedicated Floor Drain Branch Piping, Sanitary and Indirect Waste Piping Conveying Fluids below 55°F	B / 1/2"	
F. Insulation Inserts at hangers	C or D or E - Match pipe insulation thickness	

END OF SECTION

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SECTION 22 09 00

INSTRUMENTATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Positive Displacement Meters.
- B. Pressure Gauge.
- C. Pressure Gauge Accessories.
- D. Thermometers.
- E. Test Plugs.

PART 2 - PRODUCTS

2.1 POSITIVE DISPLACEMENT METERS (LIQUID)

- A. AWWA C700 positive displacement disc type suitable for fluid with hermetically sealed register, remote reading to AWWA C706.
- B. Provide water meters with bronze case with cast iron frost-proof, breakaway bottom cap.
- C. Acceptable Manufacturers: Neptune, Badger, or Hersey.

2.2 PRESSURE GAUGES

- A. Gauges shall be 4-1/2" diameter with phenolic turret style, glycerin filled, safety case with phosphor bronze or 316 stainless steel bourdon tube, brass socket for air, steam, water or oil applications. Gauges shall be 1/2% full scale accurate per ANSI B40.1 with bushed stainless steel movement and hair spring guard. Standard ranges to be either pressure or pressure and vacuum as required of application.
- B. Acceptable Manufacturer: Ashcroft, Marshalltown, Marsh, Miljoco, Trerice, U.S. Gauge Figure 1980, Weiss, Weksler, Wika.
- C. Select gauge range for normal reading near center of gauge.

2.3 PRESSURE GAUGE ACCESSORIES

- A. All pressure gauges shall have valves and pressure snubbers.
- B. Shutoff Valve: 1/4" ball valve as specified for each piping system.
- C. Pressure snubber, brass with 1/4" connections, porous metal type.

2.4 THERMOMETERS

- A. Alcohol/Spirit Filled Type:
 - 1. 9" long phenolic case, steel stem, accuracy of 1% full scale. Adjustable elbow joint with locking device to allow rotation of thermometer to any angle.
 - 2. Select thermometer for appropriate temperature range.

3. Stem lengths as required for application with minimum insertion of 3-1/2".
 4. Thermometers for water, steam, or oil shall have brass or steel separable socket. Wells shall extend through insulation.
 5. Acceptable Manufacturer: Marsh, Miljoco, Trerice, Weiss, Weksler, Wika.
- B. Select scales to cover expected range of temperatures.

2.5 TEST PLUGS

- A. Test Plug: 1/4" or 1/2" brass fitting and cap, with Nordel core for temperatures up to 275°F, for receiving 1/8" outside diameter pressure or temperature probe. Plugs shall be rated for zero leakage from vacuum to 500 psi.
- B. Provide extended units for all plugs installed in insulated piping.
- C. Test Kit: Carrying case, internally padded and fitted containing one 3-1/2" diameter pressure gauge with 0-100 psi range, one gauge adapter with 1/8" probes, two 1-1/2" dial thermometers with 0° to 220°F and -25°F to 125°F ranges and 5" stems.
- D. Acceptable Manufacturers: Sisco, Flow Design, or Peterson Equipment.

2.6 DRAIN PLUGS

- A. Chemical Drain Line Plugs: On all floor drains immediately serving CG, FA chemicals, a drain plug shall be provided. Drain plug shall be plastic gripper plug manufactured by Cherne Industries, or equal. Drain plug shall consist of a rubber O-ring, plastic plate, and a twist-to-seal wing nut. All drain plugs shall be compatible with chemicals listed above and shall fit in floor drain indicated on the drawing.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General Installation Requirements:
 1. Install per manufacturer's instructions.
 2. Coil and conceal excess capillary on remote element instruments.
 3. Install gauges and thermometers in locations where they are easily read from normal operating level.
 4. Do not install instrumentation when areas are under construction, except for required rough-in, taps, supports and test plugs.
- B. Positive Displacement Meters:
 1. Install positive displacement meters with shutoff valves on inlet and outlet. Provide full line size valved bypass with globe valve for liquid service meters.
- C. Pressure Gauges:
 1. Connect pressure gauges to suction and discharge side of all pumps.

2. Provide snubber for each pressure gauge.
 3. Provide coil syphon for each pressure gauge connected to steam piping.
- D. Thermometers:
1. Install thermometers in piping systems in sockets in short couplings. Enlarge pipes smaller than 2-1/2" for installation of thermometer sockets.
 2. Install thermometer sockets adjacent to control system thermostat, transmitter and sensor sockets.

END OF SECTION

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SECTION 22 10 00

PLUMBING PIPING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Pipe and Pipe Fittings.
- B. Valves.
- C. Domestic Water Piping System.
- D. Sanitary Drainage and Vent Piping System.
- E. Storm Drainage Piping System.
- F. Acid Waste and Vent Piping System.

1.2 QUALITY ASSURANCE

- A. Valves: Manufacturer's name and pressure rating marked on valve body. Remanufactured valves are not acceptable.
- B. Welding Materials and Procedures: Conform to ASME Code and applicable state labor regulations.
- C. Welders Certification: In accordance with ANSI/ASME Sec 9 or ANSI/AWS D1.1.
- D. Piping, Fittings, Valves, and Flux for Potable Water Systems: All components shall be lead free per Federal Act S.3874, Reduction of Lead in Drinking Water Act.

1.3 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store valves in shipping containers with labeling in place.

1.4 COORDINATION DRAWINGS

- A. Reference Coordination Drawings article in Section 22 05 00 for required plumbing systems electronic CAD drawings to be provided to Coordinating Contractor for inclusion into composite coordination drawings.

PART 2 - PRODUCTS

2.1 COLD WATER - POTABLE AND NON-POTABLE HOT WATER - POTABLE AND NON-POTABLE TEMPERED WATER - POTABLE AND NON-POTABLE

- A. Design Pressure: 175 psi.
Maximum Design Temperature: 200°F.
- B. Piping - All Sizes:
 - 1. Tubing: Type L hard drawn seamless copper tube, ASTM B88.
 - 2. Joints: Solder with 100% lead-free solder and flux, ASTM B32.
 - 3. Fittings: Wrought copper solder joint, ANSI B16.22.

C. Piping - 3" and Under (Contractor's Option):

1. Tubing: Type K hard drawn seamless copper tube, ASTM B88.
2. Joints: Mechanical press connection.
3. Fittings: Copper, ANSI B-16.22, with embedded EPDM o-ring, NSF-61.
4. Acceptable Manufacturers: Viega ProPress, Elkhart Xpress, Nibco Press System Fittings and Valving.

D. Shutoff Valves:

1. Butterfly Valves:

a. BF-1:

- 1) 2-1/2" thru 6", 175 psi CWP, elastomers rated for 20°F to 250°F at 125 psig, fully lugged end, ductile or cast iron body (not in contact with fluid); bronze, aluminum-bronze or EPDM coated ductile iron disc; EPDM seat, stainless steel stem, extended neck, 175 psi bubble-tight, bi-directional dead-end shutoff without backing flange or nuts and with cap screws extending to centerline of valve body (for pipe extension without draining system), 10 position locking operator up to 6" size. Cv of at least 1580 in 6" size. Center Line Series 200, Keystone #222, Watts #DBF-03-121-1P, Stockham LD712-B&3-E, Nibco N200 Series, Milwaukee CL series, Hammond 5200 series.
- 2) 8" thru 12", 175# CWP, elastomers for 20°F to 225°F at 130 psi, fully lugged end, ductile or cast iron body (not in contact with fluid), bronze, EPDM coated ductile iron or aluminum-bronze disc, EPDM seat, stainless steel stem, extended neck, 175 psi bubble-tight, bi-directional dead-end shutoff without backing flange or nuts and with cap screws extending to the centerline of the valve body (to permit pipe extension without draining system), weatherproof gear operator. Center Line Series 200, Keystone #222, Watts #DBF-03-121-1G, Stockham LD722-B&3-E, Nibco N200 Series, Milwaukee CL series, Hammond 5200 series.
- 3) Wafer style valves are acceptable only if installed between two spool pieces, each of which is flanged on both ends, and if they have the features listed above. Stockham #LD522BS3E, Hammond #6111, Keystone #222, Center Line Series 200, Nibco N200 Series, Milwaukee CW series, Hammond 6200 series.
- 4) Mechanically coupled grooved end valves are acceptable if they have the features listed above. Victaulic #608, Nibco GD4765.

2. Ball Valves:

a. BA-1:

- 1) 3" and under, 150 psi saturated steam, 600 psi CWP, full port, screwed or solder ends (acceptable only if rated for soldering in line with 470°F melting point of lead-free solder), bronze body of a copper alloy containing less than 15% zinc, stainless steel ball and trim, Teflon seats and seals. Apollo #77C-140, Stockham #S-255-FB-P-UL BR1-R, Milwaukee #BA-400, Watts, Nibco #585-70-66, National Utilities Co., RUB.

NOTES:

- a) Provide extended shaft for all valves in insulated piping.
- b) Provide lock out trim for all valves opening to atmosphere installed in domestic water piping over 120°F, heating water piping over 120°F, steam, condensate, boiler feed water piping, compressed air piping and gasoline/kerosene piping, and as indicated on the drawings. Solid extended shaft is not required on valves with lock out trim.

E. Throttling/Shutoff Valves:

1. Globe Valves:

- a. GL-1: 2" and under, 150# saturated steam, 300# CWP, screwed, bronze. Crane #7TF, Stockham #B22T, Walworth #3095, Milwaukee #590, Hammond #IB413T, Watts #B-4010-T, Nibco T-235Y.
- b. GL-2: 2-1/2" thru 10", 125# steam @ 353°F, 200# CWP @ 150°F, flanged, iron body, bronze mounted. Crane #351, Hammond #IR116, Stockham #G-512, Walworth #8906F, Milwaukee #F2981, Watts #F-501, Nibco F-718B.

F. Check Valves:

1. CK-1: 2" and under, 125# steam @ 406°F, 200# CWP @ 150°F, screwed, bronze, horizontal swing. Crane #37, Hammond #IB904, Stockham #B319-Y, Walworth #3406, Milwaukee #509, Watts #G-5000, Nibco T-413B.
2. CK-14: 2-1/2" thru 12", 200# CWP, double disc wafer type, bronze or iron body, bronze trim, metal-to-metal or Viton seat, 316 SS shaft, Inconel 600 spring. Mission Duo Chek #12HPP (with Inconel springs), Mueller Steam Specialty Co. #71-AHB-K-W, Stockham #WG-961-EPDM or #WG-970-BUNA, Nibco w-920-W.

G. Strainers:

1. ST-1: Bronze body, screwed ends, screwed cover, 150 psi S @ 350°F, 200 psi CWP @ 150°F. Armstrong #F4SC, Metraflex #TS, Mueller Steam Specialty Co. #351, Sarco #BT, Watts #777.
2. ST-7: 2-1/2" thru 8", bronze body, flanged ends, flanged cover, 150# steam, 225# CWP. Mueller Steam Specialty Co. #851.

2.2 COMBINATION WATER AND FIRE PROTECTION SERVICE
FIRE PROTECTION SERVICE

- A. Design Pressure: 200 psi.
Maximum Design Temperature: 150°F.
1. Pipe: Ductile iron pressure water pipe, ANSI/AWWA C151/A21.51, 200 psi pressure class, cement-mortar lined per ANSI/AWWA C104/A21.4.
 2. Fittings: Ductile iron, ANSI/AWWA C110/A21.10, or ANSI/AWWA C153/A21.53, 200 psi pressure class, cement-mortar lined per ANSI/AWWA C104/A21.4, push-on joints.
 3. Joint: Push-on joint with rubber gasket, ANSI/AWWA C111/A21.11.
- B. Piping:
1. Pipe: Ductile iron pressure water pipe, ANSI/AWWA C151/A21.51, 200 psi pressure class, cement-mortar lined per ANSI/AWWA C104/A21.4.
 2. Fittings: Ductile iron, ANSI/AWWA C110/A21.10, or ANSI/AWWA C153/A21.53, 200 psi pressure class, cement-mortar lined per ANSI/AWWA C104/A21.4, mechanical joints.
 3. Joint: Mechanical joint with glands and gaskets and steel bolts. ANSI/AWWAC111/A21.11.

2.3 SANITARY DRAINAGE (ABOVE GROUND)
SANITARY INDIRECT DRAINAGE (ABOVE GROUND)
SANITARY VENT (ABOVE GROUND)
STORM DRAINAGE (ABOVE GROUND)
CONDENSATE DRAINAGE (ABOVE GROUND)

- A. Design Pressure: Gravity
Maximum Design Temperature: 180°F
- B. Piping - All Sizes:
1. Pipe and Fittings: Standard weight cast iron soil pipe, corrosion protective coating inside and outside, ASTM A74, NSF Certified, CISPI Trademark.
 2. Joints: Compression gasket, ASTM C564 or lead and oakum, ASTM B29.
 3. Adapters: Transitions from cast iron soil pipe to other pipe materials with manufactured adapters. Heavy duty neoprene sleeve gasket, ASTM C-564, 300 Series stainless steel shield, clamp, and screws with not less than four screw type clamps, FM 1680 or ASTM C1540.
- C. Piping - 1-1/2" through 15":
1. Pipe and Fittings: Standard weight cast iron soil pipe, corrosion protective coating inside and outside, CISPI 301 or ASTM A888, NSF certified, CISPI trademark.

2. Joints: Heavy duty, neoprene sleeve gasket, ASTM C-564, 300 Series stainless steel shield, clamp, and screws with at least four screw type clamps, FM 1680 or ASTM C1540.
 3. Adapters: Transitions from cast iron soil pipe to other pipe materials with manufactured adapters. Heavy duty neoprene sleeve gasket, ASTM C-564, 300 Series stainless steel shield, clamp, and screws with not less than four screw type clamps, FM 1680 or ASTM C1540.
- D. Piping - 1-1/4" through 16" (Maximum Design Temperature: 140°F):
1. Concealed or Underground Pipe: Schedule 40 rigid, unplasticized PVC-DWV, or ABS-DWV, normal impact Type I, with plain ends, conforming to ASTM Standards D2665 or D2661. Cellular core piping is not acceptable.
 2. Exposed Pipe: Schedule 80 rigid, unplasticized PVC-DWV, or ABS-DWV, normal impact Type I, with plain ends, conforming to ASTM Standards D2665 or D2661. Cellular core piping is not acceptable.
 3. Joints: Solvent-weld socket type with solvent recommended by pipe manufacturer.
 4. Fittings: Unplasticized PVC-DWV, or ABS-DWV, normal impact Type I, with solvent-weld socket type ends for Schedule 40 pipe.
 5. Limits: Schedule 40 PVC-DWV, or ABS-DWV pipe must not be threaded. Do not use where exposed or in return air plenums.
 6. Use: Use PVC or ABS only where allowed by local jurisdiction. Comply with all special requirements or limitations.
 7. Wrap all exposed PVC as required by local jurisdiction.
- E. Vent Flashing: Flash vents with premolded EPDM pipe flashing cones for single-ply membrane roofs.

2.4 SANITARY DRAINAGE (BELOW GROUND - INSIDE BUILDING)
 SANITARY VENT (BELOW GROUND - INSIDE BUILDING)
 STORM DRAINAGE (BELOW GROUND - INSIDE BUILDING)

- A. Design Pressure: Gravity
 Maximum Design Temperature: 180°F
- B. Piping - All Sizes:
1. Pipe and Fittings: Standard weight cast iron soil pipe, corrosion protective coating inside and outside, ASTM A74, NSF certified, CISPI trademark.
 2. Joints: Compression gasket, ASTM C564.
 3. Adapters: Transitions from cast iron soil pipe to other pipe materials with manufactured adapters. Heavy duty neoprene sleeve gasket, ASTM C-564, 300 Series stainless steel shield, clamp, and screws with not less than four screw type clamps, FM 1680 or ASTM C1540.

- C. Piping - 1-1/4" through 16" (Maximum Design Temperature: 140°F):
1. Pipe: Schedule 40 rigid, unplasticized PVC-DWV, or ABS-DWV, normal impact Type I, with plain ends, conforming to ASTM Standards D2665 or D2661. Cellular core piping is not acceptable.
 2. Joints: Solvent-weld socket type with solvent recommended by pipe manufacturer.
 3. Fittings: Unplasticized PVC-DWV, or ABS-DWV, normal impact Type I, with solvent-weld socket ends for Schedule 40 pipe.
 4. Use: Use PVC or ABS only where allowed by local jurisdiction. Comply with all special requirements or limitations.

2.5 SANITARY DRAINAGE (BELOW GROUND - OUTSIDE OF BUILDING)
STORM DRAINAGE (BELOW GROUND - OUTSIDE OF BUILDING)

- A. Design Pressure: Gravity
Maximum Design Temperature: 160°F
- B. Piping - All Sizes:
1. Pipe and Fittings: Standard weight cast iron soil pipe, corrosion protective coating inside and outside, ASTM A74, NSF Certified, CISPI Trademark.
 2. Joints: Compression gasket, ASTM C564.
 3. Adapters: Transitions from cast iron soil pipe to other pipe materials with manufactured adapters. Heavy duty neoprene sleeve gasket, ASTM C-564, 300 Series stainless steel shield, clamp, and screws with not less than four screw type clamps, FM 1680 or ASTM C1540.
- C. Piping 4" and Larger:
1. Pipe: Ductile iron pressure water pipe, ANSI/AWWA C151/A21.51, 200 psi pressure class. Cement mortar lined per ANSI/AWWA C104/A21.4.
 2. Fittings: Ductile iron, ANSI/AWWA C110/A21.10, or ANSI/AWWA C153/A21.53, 200 psi pressure class, long radius, push-on joints.
 3. Joints: Push-on joint with rubber gasket, ANSI/AWWA C111/A21.11.
- D. Piping - All Sizes (Maximum Design Temperature: 140°F):
1. Pipe and Fittings: PVC pipe, Schedule 40 and SDR 26 or less with bell and spigot ends, ASTM D1785 or ASTM D3034. Cellular core piping is not acceptable.
 2. Joints: Elastomeric gaskets, ASTM F477.
 3. Adapters: Transitions from cast iron soil pipe to other pipe materials with manufactured adapters. Heavy duty neoprene sleeve gasket, ASTM C-564, 300 Series stainless steel shield, clamp, and screws with not less than four screw type clamps, FM 1680 or ASTM C1540.

4. Use: Use PVC or ABS only where allowed by local jurisdiction. Comply with all special requirements or limitations.

2.6 ACID WASTE AND VENT

A. Design Pressure - Gravity

B. Piping – All Sizes:

1. Pipe and Fittings: Polyvinylidene fluoride (PVDF) Schedule 40 drainage pipe, ASTM E-84, UL 723.
2. Joints:
 - a. Join pipe and fittings with electrically fused joints. Make fittings between dissimilar materials with adapters furnished by the polypropylene pipe manufacturer.
 - b. Above Floor Only: Mechanical joint with gasket, stainless steel outer sleeve and corrosion resistant nuts and bolts or threaded fittings with gasket and compression nuts.
3. Fittings: Polyvinylidene fluoride (PVDF) DWV pattern with socket ends for electrically fused joints.
4. Limitations: For use in return air plenums.

2.7 ACID WASTE AND VENT (ABOVE AND BELOW GROUND - INSIDE BUILDING)

A. Design Pressure/Temperature: 90 psig at 68°F

B. Piping - Sizes 2" to 32" for 90 psig

1. Pipe and Fittings: Polypropylene SDR 17.6 (90 psig), ASTM D4101
2. Joints:
 - a. Pipe and pressure fittings 1/2" through 4" shall be socket fusion type.
 - b. Pipe, drainage pattern fittings, and pressure fittings 2" and larger shall be butt fusion welded per ASTM D2657.
3. Limitations: Not for use in return air plenums.
4. Manufacturer: Simtech or approved equal.

2.8 ACID WASTE AND VENT (BELOW GROUND - INSIDE/OUTSIDE BUILDING)

A. Design Pressure - Gravity

B. Piping - All Sizes

1. Pipe: Non-fire retardant polypropylene Schedule 40 drainage pipe.

2. Joints: Join pipe and fittings with electrically fused joints. Make fittings between dissimilar materials with adapters furnished by the polypropylene pipe manufacturer.
3. Fittings: Non-fire retardant polypropylene DWV pattern with socket ends for electrically fused joints.

2.9 UNIONS

- A. Copper pipe - wrought copper fitting - ground joint.
- B. Black Steel (Schedule 40) Pipe - malleable iron, ground joint, 150 psi, bronze to bronze seat.
- C. Galvanized Steel Pipe - galvanized malleable iron, ground joint, 150 psi, bronze to bronze seat.

2.10 AIR VENTS

- A. Provide means for venting air at all high points in the piping system and at all other points where air may be trapped.
- B. At end of main and other points where large volume of air may be trapped - Use 1/4" globe valve, angle type, 125 psi, Crane #89, attached to coupling in top of main, 1/4" discharge pipe turned down with cap.

2.11 STRAINERS

- A. Unless otherwise indicated, strainers shall be Y-pattern and have stainless steel screens with perforations as follows:

Pipe Size	1/4" - 2"	2-1/2" - 10"	12" - 18"
air	1/32"	3/64"	1/16"
water	3/64"	1/16"	1/8"
lube, hydraulic, No. 6 fuel and waste oils	3/16"	3/16"	3/16"

- B. Furnish pipe nipple with shutoff valve to blow down all strainer screens.
- C. Use bronze body strainers in copper piping and iron body strainers in ferrous piping.

2.12 BALANCING VALVE

- A. Rated for 125 psi working pressure and 250°F operating temperature, taps for determining flow with a portable meter, positive shutoff valves for each meter connection, memory feature, tight shutoff, and a permanent pressure drop between 1' and 2' water column at full flow with valve 100% open. Furnish with molded, removable insulation covers.
- B. Provide a nomograph to determine flow from meter reading (and valve position on units which sense pressure across a valve). Graph shall extend below the specified minimum flow.
- C. Furnish one meter kit.

- D. Flow rate of 0.5 GPM or larger: Valves in copper piping shall be brass or bronze. Acceptable Manufacturers: Flow Design "Accusetter", Preso "B+", Armstrong "CVB", Bell & Gossett "Circuit Setter Plus", Griswold "Quickset", Gerand "Balvalve Venturi" or Nibco Globe Style balancing valve.
- E. Flow rate less than 0.5 GPM: Valves in copper piping shall be brass or bronze. Cv value shall be less than 1.0 when valve is completely open, and minimum balanceable flow rate shall not exceed 0.1 GPM with a meter reading of at least 2.5 feet. Acceptable manufacturers: Bell & Gossett "Circuit Setter RF", Flow Design, Preso, Armstrong, Griswold, Gerand, or Nibco balancing valve.
- F. Manufacturer shall size balancing valves for the scheduled flow rate. Flow rate shall be measurable on manufacturer's standard meters.

2.13 DRAIN VALVES

- A. Drain valves shall be shutoff valves as specified for the intended service with added 3/4" male hose thread outlet and cap.

2.14 CONNECTIONS BETWEEN DISSIMILAR METALS

- A. Connections between dissimilar metals shall be insulating dielectric types that provide a water gap between the connected metals, and that either allow no metal path for electron transfer or that provide a wide water gap lined with a non-conductive material to impede electron transfer through the water path.
- B. Joints shall be rated for the temperature, pressure, and other characteristics of the service in which they are used, including testing procedure.
- C. Aluminum, iron, steel, brass, copper, bronze, and stainless steel are commonly used and require isolation from each other with the following exceptions:
 - 1. Iron, steel, and stainless steel connected to each other.
 - 2. Brass, copper, and bronze connected to each other.
 - 3. Brass or bronze valves and specialties connected to steel, iron, or stainless steel in closed systems. Where two brass or bronze items occur together, they shall be connected with brass nipples.
- D. Dielectric protection is required at connections to equipment of a material different than the piping.
- E. Screwed Joints (acceptable up to 2" size):
 - 1. Dielectric waterway rated for 300 psi CWP and 225°F.
 - 2. Acceptable Manufacturers: Elster Group ClearFlow fittings, Victaulic Series 47, Grinnell Series 407, Matco-Norca.
- F. Flanged Joints (any size):
 - 1. Use 1/8" minimum thickness, non-conductive, full-face gaskets.
 - 2. Employ one-piece molded sleeve-washer combinations to break the electrical path through the bolts.

3. Sleeve-washers are required on one side only, with sleeves minimum 1/32" thick and washers minimum 1/8" thick.
4. Install steel washers on both sides of flanges to prevent damage to the sleeve-washer.
5. Separate sleeves and washers may be used only if the sleeves are manufactured to exact lengths and installed carefully so the sleeves must extend partially past each steel washer when tightened.
6. Acceptable Manufacturers: EPCO, Central Plastics, Pipeline Seal and Insulator, F. H. Maloney, or Calpico.

2.15 LOCK OUT TRIM

- A. Provide lock out trim for all quarter turn shutoff valves opening to atmosphere and installed in domestic water piping over 120°F, in compressed air piping, and as indicated on the drawings.

2.16 VALVE OPERATORS

- A. Provide handwheels for gate valves and gear operators for butterfly valves.

2.17 VALVE CONNECTIONS

- A. Provide all connections to match pipe joints. Valves shall be same size as pipe unless noted otherwise.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Install all products per manufacturer's recommendations.
- B. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- C. Remove scale and dirt, on inside and outside, before assembly.
- D. Connect to equipment with flanges or unions.
- E. Use only piping materials rated for the maximum temperature of the application, e.g., do not use PVC for high temperature applications.
- F. Existing building sewers or building drains which are shown on the documents to be reused shall be inspected and recorded by closed circuit television for their condition. Report findings back to the Architect, Engineer, and Owner before proceeding with work so any necessary rework can take place if needed.

3.2 TESTING PIPING

A. Sanitary Drainage:
Sanitary Vent:
Storm Drainage:
Acid Waste:
Acid Vent:

1. Test all piping with water to prove tight.
2. Test piping before insulation is applied.
3. Hydrostatically test all soil, waste, and vent piping inside of building with 10 feet head of water for 15 minutes. Inspect before fixtures are connected. If leaks appear, repair them and repeat the test.
4. Hydrostatically test interior downspouts with 10 feet head of water for 15 minutes with no leaks.
5. A smoke/air test at the same pressure may be used in lieu of the hydrostatic water test. Exception: Smoke/air test shall not be performed on plastic piping.
6. Test force mains with water at 105% of the operating pump discharge pressure for 15 minutes.
7. Test pressures stated above shall be as listed or as required by the Authority Having Jurisdiction, whichever is most stringent.

B. Hot Water - Potable and Non-Potable:
Cold Water - Potable and Non-Potable:
Tempered Water - Potable and Non-Potable:
Service Water:

1. Test pipes underground or in chases and walls before piping is concealed.
2. Test all pipes before the insulation is applied. If insulation is applied before the pipe is tested and a leak develops which ruins the insulation, replace damaged insulation.
3. Test the pipe with 100 psig water pressure or equal inert gas such as nitrogen.
4. Hold test pressure for at least 2 hours.
5. Test to be witnessed by the Architect/Engineer's representative, if requested by the Architect/Engineer.

C. Fire Service:

1. Hydrostatically test the entire system for two hours at 200 psig. Maximum leakage shall be:
 - a. Interior Piping: 0 quarts per hour.
 - b. Underground Piping: 2 quarts per 100 joints per hour.

- D. All Other Piping:
1. Test piping at 150% of normal operating pressure.
 2. Piping shall hold this pressure for one hour with no drop in pressure.
 3. Test piping using water, nitrogen, or air as compatible with the final service of the pipe. Do not use combustible fluids.
 4. Drain and clean all piping after testing is complete.

3.3 CLEANING PIPING

A. Assembly:

1. Before assembling pipe systems, remove all loose dirt, scale, oil and other foreign matter on internal or external surfaces by means consistent with good piping practice subject to approval of the Architect/Engineer's representative. Blow chips and burrs from machinery or thread cutting operation out of pipe before assembly. Wipe cutting oil from internal and external surfaces.
2. During fabrication and assembly, remove slag and weld spatter from both internal and external joints by peening, chipping and wire brushing.
3. Notify the Architect/Engineer's representative before starting any post erection cleaning in sufficient time to allow witnessing the operation. Consult with and obtain approval from the Architect/Engineer's representative with regard to specific procedures and scheduling. Dispose of cleaning and flushing fluids properly.
4. Prior to blowing or flushing erected piping systems, disconnect all instrumentation and equipment, open wide all valves, and be certain all strainer screens are in place.

B. Air Blow:

1. Blow out pipe and components with clean compressed air. Instrument air, argon, nitrogen and sulfuric acid lines shall be blown out with dry, oil free air or nitrogen gas. "Oil Free" is defined as air compressed in a centrifugal, Teflon ring, carbon ring or water pumped air compressor. Where air supply is judged to be inadequate to continually attain cleaning velocity, alternate pressurization and sudden relief procedure may be used until discharge at all blow out points is clean. Use 80-90 psig pressure unless otherwise indicated.
2. Air blow applies to the following systems:
 - a. Chemical Feed

C. All Water Piping:

1. Flush all piping using faucets, flush valves, etc. until the flow is clean.
2. After flushing, thoroughly clean all inlet strainers, aerators, and other such devices.
3. If necessary, remove valves to clean out all foreign material.

D. Fire Service:

1. Flush all underground piping with minimum flow equal to the system design flow but not less than the following:
 - a. 390 gpm for 4" pipes.
 - b. 880 gpm for 6" pipes.
 - c. 1560 gpm for 8" pipes.

3.4 INSTALLATION

A. General Installation Requirements:

1. Provide dielectric connections between dissimilar metals.
2. Route piping in orderly manner and maintain gradient. Install to conserve building space.
3. Group piping whenever practical at common elevations.
4. Install piping to allow for expansion and contraction without stressing pipe, joints, or equipment.
5. Slope water piping and arrange to drain at low points.
6. Install bell and spigot piping with bells upstream.
7. Where pipe supports are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welds.
8. Seal pipes passing through exterior walls with a wall seal per Section 22 05 29. Provide Schedule 40 galvanized sleeve at least 2 pipe sizes larger than the pipe.
9. All non-potable outlets shall be clearly marked with a permanently affixed laminated sign with 3/8" high lettering saying "Non-Potable Water Not for Human Consumption." Sign shall have black lettering on a yellow background.
10. All vertical pipe drops to sinks or other equipment installed below the ceiling shall be routed within a wall cavity, unless specifically noted otherwise to be surface mounted. For renovation projects, this Contractor is responsible for opening and patching existing walls for installation of piping. Wall patching shall match existing condition.

B. Installation Requirements In Electrical Rooms:

1. Do not install piping or other equipment above electrical switchboards or panelboards. This includes a dedicated space extending 25 feet from the floor to the structural ceiling with width and depth equal to the equipment.

C. Valves/Fittings and Accessories:

1. Install shutoff valves that permit the isolation of equipment/fixtures in each room without isolating any other room or portion of the building. Individual fixture angle stops do not meet this requirement. Exception: Back-to-back rooms in no more than two adjacent rooms.

2. Provide clearance for installation of insulation and access to valves and fittings.
3. Provide access doors for concealed valves and fittings.
4. Install valve stems upright or horizontal, not inverted.
5. Provide one plug valve wrench for every ten plug valves 2" and smaller, minimum of one. Provide each plug valve 2-1/2" and larger with a wrench with set screw.
6. Install balancing valves with straight, unobstructed pipe section both upstream and downstream as required, per manufacturer's installation instructions.
7. Install corrugated, stainless steel tubing system according to manufacturer's written instructions. Include striker plates to protect tubing from puncture where tubing is restrained and cannot move.

D. Underground Piping:

1. Install buried water piping outside the building with at least 5 feet of cover.
2. Underground fire protection service piping shall have at least 6-1/2 feet of cover, or as recommended by NFPA 24, whichever is greater.
3. Install thrust blocking and restraints on all underground fire protection service piping per NFPA 24 and as shown on drawings.
4. Install underground, sleeved, corrugated, stainless steel tubing system according to manufacturer's written instructions. Extend vent from sleeve to exterior of building and terminate with screened elbow.
5. Lay all underground piping in trenches. Provide and operate pumping equipment to keep trenches free of water.
6. For all underground piping, provide a foundation (the layer below the bedding) if the trench bottom is unstable. Lay underground plastic piping on 4" to 6" of sand bedding. When the trench is in rock, lay underground metallic piping on 6" of sand bedding. Provide recessed areas for pipe bells and joints. After joints are made, any misalignment in elevation shall be corrected by tamping sand around the pipe. Backfill with sand in uniform layers not over 6" deep to the spring line of all underground pipes, and carefully compact each layer to 90 percent Standard Proctor density. Backfill with sand up to 6" above pipe for landscaped areas. Remaining backfill may be soil. Under paving and buildings, the remaining backfill shall be sand and compacted to 98 percent Standard Proctor density.
7. As an option, the Contractor may provide factory applied protective coatings consisting of a polyethylene plastic film bonded to the pipe surface by a hot applied thermo-plastic adhesive.
 - a. Acceptable Manufacturer: Republic Steel Corp. "X-Tru-Coat"
8. Exercise care in handling, storing and laying pipe to avoid damaging factory applied coatings. If any damage occurs, repair the coating to a condition equal to the original.

9. Field application of protective coatings to joints, fittings and to any damaged factory applied coatings shall be similar to factory applied coatings specified above and shall be done in strict accordance with recommendations of the supplier of pipe coatings.
10. After completion of the fabrication, laying and field coating of the joints and fittings, but prior to backfilling, inspect the entire line in the presence of the Architect/Engineer's representative with an electronic holiday detector. Any defects in the protective coatings shall be repaired in accordance with requirements for original coatings.
11. Coat flange bolts and nuts in pits and below ground at the time of installation with a corrosion protective coating.

E. Sanitary and Storm Piping:

1. Install all sanitary piping inside the building with a slope of at least the following:

<u>Pipe Size</u>	<u>Minimum Slope</u>
3" and under	- 0.25" per foot
4" and over	- 0.125" per foot

- a. All sanitary systems transporting grease laden waste shall be sloped a minimum of 0.25" per foot regardless of size.
2. Slope sanitary and storm piping outside the building to meet the invert elevations shown on the drawings and to maintain a minimum velocity of 3 feet per second.
3. Install storm piping in the building with a slope of 0.25" per foot unless noted otherwise.
4. All sanitary and storm piping shall have at least 42" of cover when leaving the building.
5. Install horizontal offset at all connections to roof drains to allow for pipe expansion.

3.5 PIPE ERECTION AND LAYING

- A. Carefully inspect all pipe, fittings, valves, equipment and accessories before installation. Any items that are unsuitable, cracked or otherwise defective shall be removed from the job immediately.
- B. All pipe, fittings, valves, equipment and accessories shall have factory applied markings, stampings, or nameplates with sufficient data to determine their conformance with specified requirements.
- C. Exercise care at every stage of storage, handling, laying and erecting to prevent entry of foreign matter into piping, fittings, valves, equipment and accessories. Do not install any item that is not clean.
- D. Until system is fully operational, all openings in piping and equipment shall be kept closed except when actual work is being performed on that item or system. Closures shall be plugs, caps, blind flanges or other items specifically designed and intended for this purpose.

- E. Run pipes straight and true, parallel to building lines with minimum use of offsets and couplings. Provide only offsets required to provide needed headroom or clearance and to provide needed flexibility in pipe lines.
- F. Make changes in direction of pipes only with fittings or pipe bends. Changes in size only with fittings. Do not use miter fittings, face or flush bushings, or street elbows. All fittings shall be of the long radius type, unless otherwise shown on the drawings or specified.
- G. Provide flanges or unions at all final connections to equipment, traps and valves.
- H. Arrange piping and connections so equipment served may be totally removed without disturbing piping beyond final connections and associated shutoff valves.
- I. Use full and double lengths of pipe wherever possible.
- J. Unless otherwise indicated, install all piping, including shutoff valves and strainers, to coils, pumps and other equipment at line size with reduction in size being made only at control valve or equipment.
- K. Cut all pipe to exact measurement and install without springing or forcing except in the case of expansion loops where cold springing is indicated on the drawings.
- L. Underground pipe shall be laid in dry trenches maintained free of accumulated water. Provide and operate sufficient pumping equipment to maintain excavations, trenches and pits free of water. Dispose of pumped water so operation areas and other facilities are not flooded. Pipe laying shall follow excavating as closely as possible.
- M. Unless otherwise indicated, branch take-offs shall be from top of mains or headers at either a 45° or 90° angle from the horizontal plane for air lines, and from top, bottom or side for liquids.

3.6 DRAINING AND VENTING

- A. Unless otherwise indicated on the drawings, all horizontal water and compressed air lines, including branches, shall pitch 1" in 40 feet to low points for complete drainage, removal of condensate and venting.
- B. Maintain accurate grade where pipes pitch or slope for venting and drainage. No pipes shall have pockets due to changes in elevation.
- C. Provide drain valves at all low points of water piping systems for complete or sectionalized draining.
- D. Provide drip legs at low points and at the base of all risers in compressed air pipes. Drip legs shall be full line size on pipes through 4" and at least 4", but not less than half line size over 4". Drip legs shall be 12" minimum length, capped with a reducer to a drain valve.
- E. Use eccentric reducing fittings on horizontal runs when changing size of pipes for proper drainage and venting. Install compressed air and gravity drain pipes with bottom of pipe and eccentric reducers in a continuous line; all other liquid lines with top of pipe and eccentric reducers in a continuous line.
- F. Provide air vents at high points and wherever else required to eliminate air in all water piping systems.

- G. Install air vents in accessible locations. If necessary to trap and vent air in a remote location, install an 1/8" pipe from the tapping location to an accessible location and terminate with a venting device.
- H. All vent and drain piping shall be of same materials and construction for the service involved.

3.7 PLUMBING VENTS

- A. Vent as shown on the drawings and in accordance with all codes having jurisdiction.
- B. Extend the high side of the soil and waste stacks at least 12" above roof.
- C. Flash pipes at roof with premolded EPDM pipe flashing cones adhered to roof membrane by General Contractor. Secure top of cone with stainless steel clamp and seal watertight.
- D. Increase vent pipes through the roof two pipe sizes with long increasers located at least 12" below the roof.
- E. In no case shall the vent through the roof be less than 4" in diameter.
- F. Vent pipes through the roof shall be located a minimum of 15 feet from any air intake or exhaust opening on the roof.

3.8 BRANCH CONNECTIONS

- A. For domestic water and vent systems only, make branch connections with standard tee or cross fittings of the type required for the service.
- B. Reducers are generally not shown. Where pipe sizes change at tee, the tee shall be the size of the largest pipe shown connecting to it.
- C. Do not use double wye or double combination wye and eighth bend DWV fittings in horizontal piping.
- D. Branch connections from the headers and mains may be mechanically formed using an extraction device. The branch piping connection shall be brazed connection for the following services only:
 - 1. Domestic water piping above grade.
- E. Further limit use of mechanically formed fittings as follows:
 - 1. Must have at least same pressure rating as the main.
 - 2. Main must be type K or L copper tubing.
 - 3. Permanent marking shall indicate insertion depth and orientation.
 - 4. Branch pipe shall conform to the inner curve of the piping main.
 - 5. Main must be 1" or larger.
 - 6. Branch must be 3/4" or larger.
- F. Branch connections from headers and mains may be cut into black steel pipe using forged weld-on fittings.

- G. Forged weld-on fittings are limited as follows:
1. Must have at least same pressure rating as the main.
 2. Main must be 2-1/2" or larger.
 3. Branch line is at least two pipe sizes under main size.

3.9 JOINING OF PIPE

A. Threaded Joints:

1. Threads shall conform to ANSI B2.1 "Pipe Threads".
2. Ream pipe ends and remove all burrs and chips formed in cutting and threading.
3. Protect plated pipe and valve bodies from wrench marks when making up joints.
4. Apply thread lubricant to male threads as follows:

Vents and Roof Conductors:	Red graphite
All Other Services:	Teflon tape

B. Flanged Joints:

1. Steel pipe flanges shall conform to ANSI B16.5 "Steel Pipe Flanges and Flanged Fittings". Cast iron pipe flanges shall conform to ANSI B16.1 "Cast Iron Flanged and Flanged Fittings". Steel flanges shall be raised face except when bolted to flat face cast iron flange.
2. Bolting for services up to 500°F shall be ASTM A307 Grade B with square head bolts and heavy hexagonal nuts conforming to ANSI B18.2.1 "Square and Hex Bolts" and B18.2.2 "Square and Hex Nuts".
3. Set flange bolts beyond finger tightness with a torque wrench for equal tension in all bolts. Tighten bolts so those 180° apart are torqued in sequence.
4. Gaskets for flat face flanges shall be full face type. Gaskets for raised faced flanges shall conform to requirements for "Group I Gaskets" in ANSI B16.5. Unless otherwise specified gaskets shall meet the following requirements:
 - a. Gasket material and thickness approved by manufacturer for intended service, chemical compatibility, pipe system test pressure, and operating temperature range.
 - b. Maximum pressure rating of at least 250 psig.
 - c. Minimum temperature rating: -10°F.
 - d. Maximum temperature rating of at least 170°F for water systems operating 140°F and less.

C. Solder Joints:

1. Make up joints with 100% lead-free solder, ASTM B32. Cut tubing so ends are perfectly square and remove all burrs inside and outside. Thoroughly clean sockets of fittings and ends of tubing to remove all oxide, dirt and grease just prior to soldering. Apply flux evenly, but sparingly, over all surfaces to be joined.

Heat joints uniformly so solder will flow to all mated surfaces. Wipe excess solder, leaving a uniform fillet around cup of fitting.

2. Flux shall be non-acid type.
3. Solder end valves may be installed directly in the piping system if the entire valve is suitable for use with 470°F melting point solder. Remove discs and seals during soldering if they are not suitable for 470°F.

D. Brazed Joints:

1. Make up joints with silver alloy brazing filler metal conforming to ASTM B260 "Brazing Filler Metal" BAg-1 or BAg-2. Cut copper tubing so ends are perfectly square and remove all burrs inside and outside. Thoroughly clean sockets of fittings and ends of tubing to remove all oxide, dirt and grease just prior to brazing. Apply non-corrosive flux of the type recommended by filler alloy manufacturer, evenly, but sparingly, over all surfaces to be joined. Heat joints uniformly using oxygen-acetylene torch with tip size recommended by fitting manufacturer. Wipe and brush joint clean after alloy has set.
2. Remove discs from solder end valves during brazing.

E. Welded Joints:

1. Welding of all pipe joints, both as to procedures and qualification of welders, shall be in accordance with Section IX, ASME "Boiler & Pressure Vessel Code" unless mandatory local codes take precedence.
2. Furnish to the Owner's Representative prior to start of work certificates qualifying each welder.
3. The Owner's Representative reserves the right to require qualifying demonstration, at the Contractor's expense, of any welders assigned to the job.
4. Ends of pipe and fittings to be joined by butt welding shall be beveled, cleaned to bare metal and internal diameters aligned before tack welding.
5. Backing rings shall be used for all butt weld joints 3" size and over, and for all sizes where operating pressure is over 200 psig and/or temperature is over 400°F. Backing rings shall be of the material being welded.

F. Mechanically Coupled Grooved Joints:

1. Mechanical coupling connections shall mechanically engage, lock and seal the grooved pipe ends in a positive couple. Each coupling shall consist of malleable iron housing clamps, steel bolts and nuts, and sealing gasket designed so internal pressure tends to increase the tightness of the seal.
2. Use grooved mechanical couplings and fasteners only in accessible locations.
3. Final tightening of bolts shall be with a torque wrench for equal tension in all bolts.

G. Mechanical Press Connection:

1. Copper press fitting shall be made in accordance with the manufacturer's installation instructions.
2. Fully insert tubing into the fitting and mark tubing.
3. Prior to making connection, the fitting alignment shall be checked against the mark made on the tube to ensure the tubing is fully engaged in the fitting.
4. Joint shall be pressed with a tool approved by the manufacturer.
5. Installers shall be trained by manufacturer personnel or representative. Provide documentation upon request.

H. Mechanical Push-To-Connect:

1. Copper push-to-connect fittings shall be made in accordance with the manufacturer's installation instructions.
2. Installers shall be trained by manufacturer personnel or representative. Provide documentation upon request.

I. Mechanical Joints:

1. Joints shall conform to ANSI A21.11 "Rubber Gasket Joints for Ductile Iron Pressure Pipe and Fittings". Gasket material shall be neoprene. The standard bolts and nuts of the pipe manufacturer shall be used and shall be coated at the factory with rust preventive lubricant after threading and tapping.
2. Final tightening of bolts shall be with a torque wrench to insure equal tension in all bolts.

J. Push-On Joints - Pressure Pipe:

1. Joints shall be single gasket type conforming to ANSI A21.11 "Rubber Gasket Joints for Ductile Iron Pressure Pipe and Fittings". The bell shall have cast or machined gasket socket recesses, a tapered annular opening and flared socket design to provide deflections up to 5°. Plain spigot ends shall be suitably beveled for easy entry into bell, centering in gasket and compression of gasket.
2. The joint shall be liquid tight under all pressures from vacuum to 350 psig.
3. Furnish sufficient lubricant for a thin coat on each spigot end. Lubricant shall be non-toxic, impart no taste or odor to conveyed liquid, and have no deleterious effect on the rubber gasket. Lubricant shall be of such consistency that it can be easily applied to the pipe in hot and cold weather and shall adhere to either wet or dry pipe.

K. Compression Gasket Joints - Sanitary Pipe and Storm Pipe:

1. Joint shall be one piece double seal compression type gasket made specifically for joining cast iron soil pipe. Gasket shall be neoprene, permitting joint to flex as much as 5 degrees without loss of seal. Gasket shall be extra heavy weight class, conforming to ASTM C-564.

- L. Solvent Weld Joints (PVC):
 - 1. Make joints with a two-step process. Use primer conforming to ASTM F656 and solvent cement conforming to ASTM D2564.
- M. Solvent Weld Joints (CPVC):
 - 1. Make joints with a one-step process. Use CPVC cement conforming to ASTM F493. A primer is not required.
 - 2. If a primer is required by the Authority Having Jurisdiction, then a primer conforming to ASTM F656 shall be used.
- N. Fusion Weld:
 - 1. Make all field cuts of pipe square and true using a pipe cutter designed for plastic pipe.
 - 2. Make sure proper heating heads are used for male and female situations.
 - 3. Bevel the leading edge of pipe section with a 45° chamfer.
 - 4. Utilize a fusion welding tool recommended and/or provided by the pipe and fitting manufacturer.
 - 5. Not recommended for temperatures below 40°F.
 - 6. Follow the manufacturer's cold weather installation procedures.
 - 7. All installers shall undergo training provided by the manufacturer or manufacturer's representative.
 - 8. Follow all manufacturer's installation instructions.
- O. Electrically Fused Joints (Acid Waste and Acid Vent):
 - 1. Fused joints shall be made in accordance with manufacturer's installation instructions.
 - 2. All installers shall undergo training provided by the manufacturer or manufacturer's representative.
 - 3. Follow the manufacturer's cold weather installation procedures.
- P. Mechanical Joint (Acid Waste and Acid Vent):
 - 1. Mechanical joints shall be made in accordance with the manufacturer's installation instructions.
 - 2. For no-hub/plain end assemblies.
 - 3. Above ground installations only.

- Q. Elastomeric Gaskets (Sanitary and Storm Pipe):
 - 1. Hub and spigot pipe joints with elastomeric gaskets shall be made in accordance with the manufacturer's installation instructions.
- R. Sleeve Gaskets (No-Hub) (Sanitary and Storm Pipe):
 - 1. Gasket shall be heavy weight class, conforming to ASTM C564.
 - 2. The gasket shall have an internal center stop.
 - 3. The gasket shall be covered by a stainless steel band secured with a minimum of four stainless steel bands per fitting/joint.
 - 4. Sleeve gaskets shall be installed in accordance with the manufacturer's installation instructions.

3.10 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

- A. Provide necessary connections at the start of individual sections of mains for adding chlorine.
- B. Before starting work, verify system is complete, flushed and clean.
- C. Ensure pH of water to be treated is between 7.4 and 7.6 by adding alkali (caustic soda or soda ash) or acid (hydrochloric).
- D. Inject disinfectant, free chlorine in liquid, powder, tablet or gas form, throughout system to obtain 50 to 80 mg/L residual.
- E. Bleed water from all outlets to ensure chlorine distribution throughout the entire domestic water system.
- F. Verify initial chlorination levels by testing at minimum 15% of outlets located throughout entire building, including the last fixture connected to each main and each branch extending over 50 feet from a main.
- G. Maintain disinfectant in system for 24 hours, after which test at minimum 15% of outlets located throughout entire building, including the last fixture connected to each main and each branch extending over 50 feet from a main. If final disinfectant residual tests less than 25 mg/L at any one of the tested outlets, flush the entire system and repeat disinfection and testing procedure.
- H. After final disinfectant residuals test at or above 25 mg/L after a minimum 24-hour duration, flush disinfectant from system at a minimum velocity of 3.0 feet/second until residual is equal to that of incoming water or 1.0 mg/L.
- I. Take water samples, no sooner than 24 hours after flushing, from 2% of outlets and from water entry. Obtain, analyze, and test samples in accordance with AWWA C651, Section 5 - Verification.

3.11 SERVICE CONNECTIONS

- A. Provide new sanitary and/or storm sewer services. Before commencing work check invert elevations needed for sewer connections, confirm inverts and verify these can be properly connected with slope for drainage and cover to avoid freezing.
- B. Provide new water service with water meter with bypass valves. Provide sleeve in wall for service main per Section 22 05 29.

END OF SECTION

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SECTION 22 10 23
NATURAL GAS PIPING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Pipe and Pipe Fittings.
- B. Valves.
- C. Natural Gas Piping System.

1.2 QUALITY ASSURANCE

- A. Valves: Manufacturer's name and pressure rating marked on valve body. Remanufactured valves are not acceptable.
- B. Welding Materials, Procedures, and Operators: Conform to ASME Section 9, ANSI/AWS D1.1, and applicable state labor regulations.
- C. Welders Certification: In accordance with ANSI/ASME Sec 9 or ANSI/AWS D1.1.

1.3 DELIVERY, STORAGE, AND HANDLING

- A. Store and protect piping to prevent entrance of foreign matter into pipe and to prevent exterior corrosion.
- B. Deliver and store valves in shipping containers with labeling in place.

1.4 COORDINATION DRAWINGS

- A. Reference Coordination Drawings article in Section 22 05 00 for the required natural gas piping system electronic CAD drawings to be provided to Coordinating Contractor for inclusion into composite coordination drawings.

PART 2 - PRODUCTS

2.1 NATURAL GAS (0 TO 125 PSI)

- A. Design Pressure: 125 psi.
Maximum Design Temperature: 350°F
- B. Piping - 2" and Under:
 - 1. Pipe: Standard weight steel, threaded and coupled, ASTM A53.
 - 2. Joints: Screwed. (NOTE: For below ground, all sizes to have welded joints.)
 - 3. Fittings: 150# steam - 300# CWP, black malleable iron, banded, ASTM A197, ANSI B16.3.
 - 4. Unions: 250# - 500# CWP, black malleable iron, ANSI B16.39, ground joint with brass seat.

- C. Piping – 2" and Under:
1. Pipe: Corrugated stainless steel tubing, ASTM A240 Series 300 stainless steel, ANSI AGA-LC1.
 2. Jacket: UV resistant, electrically conductive polyethylene, color: black, ASTM E84 25-50 flame and smoke.
 3. Fittings: Brass with mechanical ends to fit tubing. ASME B1.20.1 threaded ends for connections to threaded pipes and components.
 4. Striker Plates: Minimum 16 gauge hardened steel, corrosion resistant, primed and zinc coated. Install to protect tubing from penetrations.
 5. Limits: 5 psi or less. For use only at termination to fixed outlets or equipment, maximum length: 48". Provide malleable iron, flange mounted, straight or 90 fitting at wall termination with maximum 12" length of tubing on inlet of flange.
 6. Manufacturer: TracPipe, Gastite, Parker PGP2.
- D. Piping - 2-1/2" and Over:
1. Pipe: Standard weight black steel, beveled ends, ASTM A53.
 2. Joints: Butt welded and flanged.
 3. Fittings: Standard weight seamless steel, butt weld type, ASTM A234, Grade I, ANSI B16.9.
 4. Flanges: 150# forged steel, weld neck or slip-on, ASTM A181, Grade I, ANSI B16.5.
- E. Piping - All Sizes:
1. Pipe: Polyethylene pipe, ASTM D2513, SDR 11.5.
 2. Joints: Fusion welded.
 3. Fittings: Socket type, ASTM D2683 or ASTM D2513.
 4. Limits: Use only below ground outside of buildings.
- F. For Underground Gas Piping - Refer to paragraph "Underground Piping Protection."
- G. Shutoff Valves/Throttling Valves:
1. BA-13: 2" and under, threaded 600 psi CWP; UL listed for 250# LP, flammable liquid, heating oil, natural and manufactured gases, 150 psi steam, bronze body and chrome plated brass ball, Teflon seats and packing. Apollo #80-100, Nibco #T580-70-UL or #T585-70-UL, Watts #B-6000.
 2. PL-1: 2" and under, 125# steam @ 450°F, 175# CWP @ 180°F, cast iron body, screwed, full port. Walworth #1700, DeZurik #425, S-RS49.
 3. PL-2: 2-1/2" thru 4", 125# steam @ 450°F, 175# CWP @ 180°F, flanged, cast iron body, full port. Walworth #1700F, DeZurik #425, F-RS49.

4. PL-3: 6" and larger, 125# steam @ 450°F, 175# CWP, cast iron body, flanged, resilient faced plug, gear and handwheel operator, full port. Walworth #1707F, DeZurik #118, F-RS24.

H. Check Valves:

1. CK-1: 2" and under, 125# steam @ 406°F, 200# CWP @ 150°F, screwed, bronze, horizontal swing. Crane #37, Hammond #IB904, Stockham #B319-Y, Walworth #3406, Milwaukee #509, Watts #B-5000, Nibco Y-413B.
2. CK-13: 2-1/2" thru 12", 200# CWP, double disc wafer type, iron body, bronze or aluminum-bronze discs, 316SS shaft and spring, Viton, EPDM or BUNA-N, Cv of at least 700 in 6" size. Mueller Steam Specialty Co. #71-AHB-6-H, Stockham #WG-961 EPDM or #WG970 BUNA, NIBCO W-920-W, Crane.

I. Strainers:

1. ST-2: Cast iron body, 125 lb. flanged ends, bolted cover, 125 psi S @ 350°F, 175 psi CWP @ 150°F. Armstrong #A1FL, Metraflex #TF, Mueller Steam Specialty Co.#751, Sarco #CI-125, Watts #77F-D.
2. ST-4: Cast iron body, screwed ends, screwed cover, 250# steam @ 406°F, 300# CWP @ 150°F. Armstrong #A1SC, Metraflex #SM, Mueller Steam Specialty Co. #11, Sarco #IT.

2.2 STRAINERS

- A. Unless otherwise indicated, strainers shall be Y-pattern and have stainless steel screens with perforations as follows:

Pipe Size	1/4" - 2"	2-1/2" - 10"	12" - 18"
Gases	1/32"	3/64"	1/16"

- B. Furnish pipe nipple with shutoff valve to blow down all strainer screens.

- C. Use iron body strainers in ferrous piping.

2.3 DRAIN VALVES AND BLOWDOWN VALVES

- A. Drain valve and blowdown valve shall mean a shutoff valve as specified for the intended service with added 3/4" male hose thread outlet, cap, and retaining chain.

PART 3 - EXECUTION

3.1 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. Connect to all equipment with flanges or unions.
- D. After completion, fill, clean, and treat systems. Refer to Section 23 25 00 for treatment.

3.2 TESTING PIPING

- A. Low Pressure - Up to 1 psi:
 - 1. Test piping with 20 psi air pressure. System must hold this pressure without adding air for two hours.
- B. High Pressure - Above 1 psi:
 - 1. Test piping with compressed air at twice the operating gas pressure, but at least 20 psi. System must hold this pressure without adding air for two hours.
- C. A non-combustible odorant, such as oil of wintergreen, may be added to help locate leaks.

3.3 CLEANING PIPING

- A. Assembly:
 - 1. Prior to assembly of pipe and piping components, remove all loose dirt, scale, oil and other foreign matter on internal or external surfaces by means consistent with good piping practice subject to approval of the Architect/Engineer. Blow chips and burrs out of pipe before assembly. Wipe cutting oil from internal and external surfaces.
 - 2. During fabrication and assembly, remove slag and weld spatter from both internal and external joints by peening, chipping and wire brushing to the degree consistent with good piping practices.
 - 3. Notify the Architect/Engineer prior to starting any post erection cleaning operation in time to allow witnessing the operation. Properly dispose of cleaning and flushing fluids.
 - 4. Prior to blowing or flushing erected piping systems, disconnect all instrumentation and equipment, open wide all valves, control valves, and balance valves, and verify all strainer screens are in place.

3.4 INSTALLATION

- A. Route piping in orderly manner, straight, plumb, with consistent pitch, parallel to building structure, with minimum use of offsets and couplings. Provide only offsets required for needed headroom or clearance and needed flexibility in pipe system.
- B. Install piping to conserve building space, and not interfere with other work.
- C. Do not install piping or other equipment above electrical switchboards or panelboards. This includes a dedicated space extending 25 feet from the floor to the structural ceiling with width and depth equal to the equipment.
- D. Group piping whenever practical at common elevations.
- E. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

- F. Reducers are generally not shown. Where pipe sizes change at tee, the tee shall be the size of the largest pipe shown connecting to it. Where pipe sizes are not shown, the larger size in either direction shall continue through the fitting nearest to the indication of a smaller pipe size.
- G. Lay all underground piping in trenches. Provide and operate pumping equipment to keep trenches free of water.
- H. Provide flanges or unions at all final connections to equipment, traps and valves.
- I. Seal pipes passing through exterior walls with a wall seal per Section 23 05 29. Provide Schedule 40 galvanized sleeve at least 2 pipe sizes larger than the pipe.
- J. For all underground piping, provide a foundation (the layer below the bedding) if the trench bottom is unstable. Lay underground plastic piping on 4" to 6" of sand bedding. When the trench is in rock, lay underground metallic piping on 6" of sand bedding. Provide recessed areas for pipe bells and joints. After joints are made, any misalignment in elevation shall be corrected by tamping sand around the pipe. Backfill with sand in uniform layers not over 6" deep to the spring line of all underground pipes, and carefully compact each layer to 90 percent Standard Proctor density. Backfill with sand up to 6" above pipe for landscaped areas. Remaining backfill may be soil. Under paving and buildings, the remaining backfill shall be sand and compacted to 98 percent Standard Proctor density.
- K. All vertical pipe drops to equipment installed below the ceiling shall be routed within a wall cavity, unless specifically noted otherwise to be surface mounted. For renovation projects, this Contractor is responsible for opening and patching existing walls for installation of piping. Wall patching shall match existing condition.
- L. Install underground plastic pipe with an electrically continuous corrosion-resistant tracer wire (minimum AWG 14) or tape per section 22 05 53 to facilitate locating. One end of the tracer wire or tape shall be brought aboveground at a building wall or riser.
- M. Install corrugated, stainless steel tubing system according to manufacturer's written instructions. Include striker plates to protect tubing from puncture where tubing is restrained and cannot move.
- N. Install underground, sleeved, corrugated, stainless steel tubing system according to manufacturer's written instructions. Extend vent from sleeve to exterior of building and terminate with screened elbow.
- O. Each above ground portion of a corrugated stainless steel tubing gas piping systems shall be bonded to the electrical service grounding electrode system. The bonding jumper shall connect to a metallic pipe or fitting between the point of delivery and the first downstream corrugated stainless steel tube fitting. The bonding jumper shall not be smaller than 6 AWG copper wire or equivalent. Gas piping systems that contain one or more segments of corrugated stainless steel tubing shall be bonded in accordance with this section.
- P. Each above ground portion of a gas piping system, other than corrugated stainless steel tubing systems, that is likely to become energized shall be electrically continuous and bonded to an effective ground-fault current path. Gas piping, other than corrugated stainless steel tubing, shall be considered to be bonded when it is connected to appliances that are connected to the appliance grounding conductor of the circuit supplying that appliance.

- Q. Gas piping shall not be used as a grounding conductor or electrode.
- R. Where a lightning protection system is installed, the bonding of the gas piping shall be in accordance with NFPA 780, Standard for the Installation of Lightning Protection Systems.

3.5 PIPE ERECTION AND LAYING

- A. Carefully inspect all pipe, fittings, valves, equipment and accessories prior to installation. Immediately reject and remove from the job any items which are unsuitable, cracked or otherwise defective.
- B. All pipe, fittings, valves, equipment and accessories shall have factory-applied markings, stampings, or nameplates sufficient to determine their conformance with specified requirements.
- C. Exercise care at every stage of storage, handling, laying and erecting to prevent entry of foreign matter into piping, fittings, valves, equipment and accessories. Do not erect or install any unclean item.
- D. During construction, until system is fully operational, keep all openings in piping and equipment closed at all times except when actual work is being performed on that item. Closures shall be plugs, caps, blind flanges or other items designed for this purpose.
- E. Change direction of pipes only with fittings or pipe bends. Change size only with fittings. Do not use miter fittings, face or flush bushings, or street elbows. **All fittings shall be long radius type**, unless otherwise shown on the drawings or specified. Construct welded elbows of angles not available as standard fittings by cutting and welding standard elbows to form smooth, long radius fittings.
- F. Use full and double lengths of pipe wherever possible.
- G. Cut all pipe to exact measurement and install without springing or forcing.
- H. Do not create, even temporarily, undue loads, forces or strains on valves, equipment or building elements.
- I. Underground pipe shall be laid in dry trenches maintained free of accumulated water. Provide and operate sufficient pumping equipment to maintain excavations, trenches and pits free of water. Dispose of pumped water so operation areas and other facilities are not flooded. Pipe laying shall follow excavating as closely as possible.

3.6 DRAINING AND VENTING

- A. Unless otherwise indicated on the drawings, all horizontal pipes, including branches, shall pitch 1" in 40 feet to low points for complete drainage.
- B. Use eccentric reducing fittings on horizontal runs when changing size for proper drainage and venting. Install gas pipes with bottom of pipe and eccentric reducers in a continuous line.
- C. Provide drip legs at low points and at the base of all risers in gas pipes. Drip legs shall be full line size on pipes through 4" and at least 4", but not less than half line size over 4". Drip legs shall be 12" minimum length, capped with a reducer to a drain valve.

3.7 BRANCH CONNECTIONS

- A. Make branch connections with standard tee or cross fittings of the type required for the service unless otherwise specified herein or detailed on the drawings.
- B. At the option of the Contractor, branch connections from headers and mains may be cut into black steel pipe using forged weld-on fittings.
- C. Use of forged weld-on fittings is also limited as follows:
 - 1. Must have at least same pressure rating as the main.
 - 2. Header or main must be 2-1/2" or over.
 - 3. Branch line is at least two pipe sizes under header or main size.
- D. Reducers are generally not shown. Where pipe sizes change at tee, the tee shall be the size of the largest pipe shown connecting to it.
- E. All branch piping connections for natural gas shall take off on the top or on the side of the main.

3.8 JOINING OF PIPE

- A. Threaded Joints:
 - 1. Ream pipe ends and remove all burrs and chips.
 - 2. Protect plated pipe and valve bodies from wrench marks when making up joints.
 - 3. Apply Teflon tape to male threads.
- B. Flanged Joints:
 - 1. Steel flanges shall be raised face.
 - 2. Bolting for services up to 500°F shall be ASTM A307 Grade B with square head bolts and heavy hexagonal nuts conforming to ANSI B18.2.1 "Square and Hex Bolts" and B18.2.2 "Square and Hex Nuts".
 - 3. Torque bolts in at least three passes, tightening to 1/3, 2/3, and final torque in a cross pattern with an indicating torque wrench for equal tension in all bolts.
 - 4. Gaskets for flat face flanges shall be full face type. Gaskets for raised faced flanges shall conform to requirements for "Group I Gaskets" in ANSI B16.5. Unless otherwise specified gaskets shall meet the following requirements:
 - a. Gasket material and thickness approved by manufacturer for intended service, chemical compatibility, pipe system test pressure, and operating temperature range.
 - b. Maximum pressure rating of at least 250 psig.
 - c. Minimum temperature rating: -10°F.
 - d. Maximum temperature rating of at least 170°F for water systems operating 140°F and less.

C. Welded Joints:

1. Welding of all pipe joints, both as to procedures and qualification of welders, shall be in accordance with Section IX, ASME "Boiler & Pressure Vessel Code" unless local codes take precedence.
2. Furnish certificates qualifying each welder to the Owner's Representative prior to start of work.
3. The Owner's Representative reserves the right to require qualifying demonstration, at the Contractor's expense, of any welders assigned to the job.
4. Ends of pipe and fittings to be joined by butt-welding shall be beveled, cleaned to bare metal and internal diameters aligned before tack welding.
5. Backing rings shall be used for all butt weld joints 3" size and over, and for all sizes where operating pressure is over 200 psig and/or temperature is over 400°F. Backing rings shall be of the material being welded.

D. Fusion Weld:

1. Make all field cuts of pipe square and true using a pipe cutter designed for plastic pipe.
2. Make sure proper heating heads are used for male and female situations.
3. Bevel the leading edge of pipe section with a 45° chamfer.
4. Utilize a fusion welding tool recommended and/or provided by the pipe and fitting manufacturer.
5. Not recommended for temperatures below 40°F.
6. Follow the manufacturer's cold weather installation procedures.
7. All installers shall undergo training provided by the manufacturer or manufacturer's representative.
8. Follow all manufacturers' installation instructions.

3.9 SERVICE CONNECTIONS

- A. Provide new gas service complete with gas meter and regulators. Verify gas service pressure with the Utility Company.

END OF SECTION

SECTION 22 10 30
PLUMBING SPECIALTIES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Roof and Floor Drains.
- B. Cleanouts.
- C. Traps.
- D. Trap Seals and Primers.
- E. Backflow Preventers.
- F. Water Hammer Arresters and Air Chambers.

1.2 QUALITY ASSURANCE

- A. Manufacturer: For each product specified, provide components by same manufacturer throughout.

1.3 SUBMITTALS

- A. Submit shop drawings under provisions of Section 22 05 00.
- B. Include sizes, rough-in requirements, service sizes, and finishes.

PART 2 - PRODUCTS

2.1 CLEANOUTS

- A. Provide cleanouts as shown and specified on the drawings as well as required by code.
- B. Coordinate floor cleanout cover with surrounding floor finish. Provide either solid, recessed for tile or terrazzo.
- C. Cleanouts on exposed pipes shall be cast iron with heavy duty cast brass plug with raised head.
- D. Cleanout shall be same size as the pipe up to 6" and 6" for larger pipes.

2.2 YARD CLEANOUTS

- A. Provide yard cleanouts as shown and specified on the drawings as well as required by code.
- B. Cleanout shall be same size as pipe up to 6" and 6" for larger pipes.

2.3 TRAPS

- A. Provide all individual connections to the sanitary system with P-traps, except where such drains discharge directly into a properly trapped collection basin or sump. Unless otherwise specified or shown, traps shall be:

1. Chromium plated cast brass when used with plumbing fixtures or when installed exposed in finished spaces.
 2. Insulated at accessible lavatories.
 3. Cast iron, deep-seal pattern where concealed above ceiling, below grade or in unfinished areas.
 4. Deep-seal pattern of the same material and/or coating where drainage lines are of special materials or coatings such as polypropylene, PVDF, CPVC, etc.
- B. All traps shall have accessible, removable cleanouts, except where installed on floor drains with removable strainers.
- C. Each trap shall be completely filled with water at the end of construction but before building turnover to the Owner. All floor drains, floor sinks, trench drains, etc. shall be filled with water and a 1/2" minimum layer of mineral oil.
- 2.4 TRAP SEALS AND PRIMERS
- A. Provide trap seals as specified on the drawings.
- B. Provide trap primers as shown and specified on the drawings.
- 2.5 FLOOR DRAINS
- A. Provide floor drains as shown and specified on the drawings as well as required by code.
- 2.6 ROOF DRAINS
- A. Provide roof drains as shown and specified on the drawings as well as required by code.
- 2.7 BACKFLOW PREVENTERS
- A. Provide backflow preventers as shown and specified on the drawings as well as required by code.
- 2.8 WATER HAMMER ARRESTERS AND AIR CHAMBERS
- A. Provide water hammer arresters as shown and specified on the drawings as well as required by code.
- B. ANSI A112.26.1; sized and located in accordance with PDI WH-201, precharged for operation between -100°F and 300°F and maximum 250 psig working pressure.
- C. Air chambers shall meet the requirements of the applicable plumbing code. Minimum 12" long at fixtures and minimum 24" long on risers. Air chambers shall be the same size or larger than the piping it is connected to.

PART 3 - EXECUTION

3.1 INSTALLATION AND APPLICATION

- A. Coordinate construction to receive drains at required invert elevations.

- B. Install all items per manufacturer's instructions.
- C. Water Hammer Arresters and Air Chambers:
 - 1. Install water hammer arresters in accessible locations. Provide access doors as required. Coordinate type with Architect/Engineer/Owner.
 - 2. Water hammer arrestors shall be installed in cold and hot water lines upstream of all plumbing fixtures or equipment, with a quick acting valve or multiple quick acting valves. Quick acting valves shall be defined as solenoid actuated valves, manual flush valves, sensor activated faucets and flush valves, squeeze handle spray faucets, and other similar type valves.
 - 3. Install multiple water hammer arrestors in toilet group branch piping greater than 20 feet in developed length from the cold and hot water mains.
 - 4. Install air chambers at each fixture not protected by a water hammer arrester.
- D. Cleanouts:
 - 1. Provide cleanouts where shown on the drawings and as required by code, but in no case farther apart than 50 feet in pipe less than 6" size and 100 feet apart in 6" and larger pipes inside the building.
 - 2. Provide cleanouts at bases of all sanitary and storm risers as shown on the drawings and as required by code.
 - 3. Extend cleanouts to the floor with long sweep elbows.
 - 4. Install a full size, two-way cleanout within 5 feet of the foundation inside or outside of building.
 - 5. Extend cleanouts to finished floor or wall surface. Lubricate threaded cleanout plugs with graphite and linseed oil. Ensure clearance at cleanouts for rodding of drainage system.
 - 6. Wall cleanouts shall be installed above the flow line of the pipe they serve, but no less than 12" above the finished floor.
- E. Yard Cleanouts:
 - 1. Install cleanouts on maximum 90 foot centers (including riser) for pipes 8" and smaller.
 - 2. Extend cleanout to grade. Encase cleanout in 5" thick concrete pad extending 6" beyond cleanout, set low enough not to interfere with lawn mowers.
- F. Floor Drains:
 - 1. Use alternate sealing method when installing drains in existing floor slabs.
 - 2. Coordinate sloping requirements with the architectural plans and specifications.
- G. Roof Drains:
 - 1. Roof drains shall have bearing pans.

2. Provide auxiliary support steel under drains as required to prevent movement of the drain.
3. All roof drains shall have underdeck clamps.
4. Drains in built-up roofing systems shall have a 36" x 36", 3 lb density lead sheet flashing.

H. Backflow Preventer:

1. Provide an air gap fitting and piping to drain. On 2-1/2" and larger units, install a tail piece from air gap fitting to drain to prevent water from spraying out of drain air gap receptor. Maintain air gap distance required by Code.
2. Units shall be field tested and tagged in accordance with manufacturer's instructions and applicable codes by a certified tester before initial operation.
3. Install unit between 12" and 60" above finish floor.

END OF SECTION

SECTION 22 30 00

PLUMBING EQUIPMENT

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Water Heaters.

1.2 QUALITY ASSURANCE

- A. Products and installation of specified products shall conform to recommendations and requirements of the following organizations:
 - 1. American Gas Association (AGA).
 - 2. National Sanitation Foundation (NSF).
 - 3. American Society of Mechanical Engineers (ASME).
 - 4. National Board of Boiler and Pressure Vessel Inspectors (NBBPVI).
 - 5. National Electrical Manufacturers' Association (NEMA).
 - 6. Underwriters' Laboratories (UL).

1.3 SUBMITTALS

- A. Submit shop drawings under provisions of Section 22 05 00.
- B. Include dimension drawings of water heaters indicating components and connections to other equipment and piping.
- C. Include heat exchanger dimensions, size of tappings, and performance data.
- D. Include dimensions of tanks, tank lining methods, anchors, attachments, lifting points, tappings, and drains.
- E. For equipment connected to an electric power source, submit short circuit rating (SCCR) of integrated unit.
- F. Submit manufacturer's installation instructions including control and wiring diagrams.
- G. Submit manufacturer's certificate that pressure vessels meet or exceed specified requirements.
- H. Submit operation, maintenance, and inspection data, replacement part numbers and availability, and service depot location and telephone number.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Provide temporary inlet and outlet caps. Maintain caps in place until installation.

1.5 REGULATORY REQUIREMENTS

- A. Water heaters shall conform to AGA, ANSI/NFPA 54, ANSI/NFPA 70, ANSI/UL 1453 as applicable.

- B. Conform to ANSI/ASME Section 8 Division 1 for fabrication of steel pressure vessels.
- C. Conform to ANSI/ASME Section 10 for manufacture of fiber-reinforced plastic pressure vessels.

PART 2 - PRODUCTS

2.1 WATER HEATERS

- A. All water heaters shall be as scheduled on the drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install all items in accordance with manufacturer's instructions.

3.2 WATER HEATER INSTALLATION

- A. Install water heaters on concrete bases or elevated on steel frame. Coordinate sizes and locations of concrete bases. Refer to Section 22 05 29.
- B. Install water heaters level and plumb, according to drawings, manufacturer's instructions, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.
- C. Install combination temperature and pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend drain piping full size from relief valve and discharge by positive air gap onto closest floor drain. Discharge pipe material shall be same as domestic water piping.
- D. Install gas water heaters according to NFPA 54.

END OF SECTION

SECTION 22 40 00
PLUMBING FIXTURES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. All plumbing fixtures.

1.2 SUBMITTALS

- A. Submit product data under provisions of Section 22 05 00. Submittals shall include fixture carriers for record purposes only. Architect/Engineer does not review or approve carriers except for manufacturer.
- B. Include fixtures, sizes, rough-in dimensions, utility sizes, trim, and finishes.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Wall Hung Fixture Carriers:
 - 1. Material: All Metal, ASME/ANSI A112.6.1M.
 - 2. Acceptable Manufacturers: Zurn, Smith, Wade, Josam, Watts, Mifab.
 - 3. Water closet carrier shall be rated to support 500 lbs.
- B. All fixtures shall be as scheduled on the drawings.
- C. All china shall be from the same manufacturer where possible.
- D. All lavatory and sink trim shall be from the same manufacturer where possible.
- E. All fixtures shall be lead free. Faucets, traps, stops, and other fixture accessories shall not contain more lead than allowed per the latest State or Federal Act.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General Installation Requirements:
 - 1. Review millwork shop drawings. Confirm location and size of fixtures and openings before rough-in and installation.
 - 2. Install each fixture with trap easily removable for servicing and cleaning. Use screwed tailpiece couplings. Connect fixture waste to stack with slip fitting.
 - 3. Provide fixtures with chrome plated rigid or flexible supplies, loose key stops, reducers, and escutcheons.

4. Install components level and plumb.
 5. Caulk joint between finish floor and floor mounted fixtures and between finish walls and wall mounted fixtures with silicone caulk. Caulk the joint, between rim and fixture where a fixture builds into a counter top, with caulking compound. Refer to DIVISION 7 for "Caulking" requirements. Color to match fixture.
 6. Where there is a possibility of water following pipe brackets, etc., into a wall; caulk escutcheons, space around brackets, etc., to exclude water. Refer to DIVISION 7 for "Caulking" requirements.
 7. Refer to Plumbing Material List for fixture mounting heights.
 8. All non-potable outlets shall be clearly marked with a permanently affixed laminated sign with 3/8" high lettering saying "Non-Potable Water Not for Human Consumption." Sign shall have black lettering on a yellow background.
- B. Wall-Mounted Fixture Requirements:
1. All wall-mounted fixtures shall have compatible carriers designed for their intended service and suitable for the space available and configuration of fixtures. All carriers shall extend to the floor and be anchored to the slab.
- C. Floor-Mounted Fixture Requirements:
1. Where floor mounted fixtures are installed on a sloped floor, the open void below the fixture shall be grouted, leveled, and caulked to eliminate stress on the fixture and to prevent water migration to the floor below.
- D. Exposed or Inside Accessible Cabinets Traps, Valve and Pipe Requirements:
1. All traps exposed under fixtures or inside accessible cabinets shall be chrome plated brass.
 2. All water or waste piping for plumbing fixtures that is exposed or inside cabinets shall be chrome plated.
 3. All exposed flush valves for water closets and urinals shall have a chrome plated hanger to anchor the piping to the wall.
 4. All exposed water supply piping and fittings in a finished space to a shower valve, hose bibb, or other water outlet shall be chrome plated.
- E. ADA Lavatory Requirements:
1. All handicapped accessible lavatory traps, piping and angle stops shall be installed with an insulating kit specially manufactured for this installation. Armaflex with duct tape is not acceptable.
- F. ADA Water Closet Requirements:
1. Handicapped accessible water closet flush valve handles shall face the center of the stall.

2. Coordinate flush valves in handicap accessible locations with grab bars installed by the General Contractor. Make modifications required to flush valve after review by Architect/Engineer.

3.2 ADJUSTING AND CLEANING

- A. Adjust stops or valves for intended water flow rate to fixtures without splashing, noise, or overflow.
- B. At completion, clean plumbing fixtures, equipment, and faucet aerator screens.

3.3 FIXTURE ROUGH-IN SCHEDULE

- A. Rough-in fixture piping connections in accordance with table on plumbing drawings of minimum sizes for particular fixtures.

END OF SECTION

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SECTION 23 05 00

BASIC HVAC REQUIREMENTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Requirements applicable to all Division 23 Sections. Also refer to Division 1 - General Requirements.
- B. All materials and installation methods shall conform to the applicable standards, guidelines and codes referenced in the specification section.

1.2 SCOPE OF WORK

- A. This Specification and the associated drawings govern the furnishing, installing, testing and placing into satisfactory operation the Mechanical Systems.
- B. Each Contractor shall provide all new materials indicated on the drawings and/or in these specifications, and all items required to make his portion of the Mechanical Work a finished and working system.
- C. Scope of Work:
 - 1. Plumbing Work shall include, but is not necessarily limited to:
 - a. Furnish and install all items listed in the Plumbing Material List.
 - b. Furnish and install a new domestic water service to the building.
 - c. Furnish and install water meter and domestic water backflow preventer as required by Code.
 - d. Furnish and install a complete domestic water piping system including cold and hot water piping within the building. Reconnect to existing exterior hose bibbs. Insulate all piping as specified.
 - e. Furnish and install gas piping system including all meter requirements.
 - f. Furnish and install water heaters.
 - g. Furnish and install a new fire protection service to the building including backflow preventer as required by Code.
 - h. Furnish and install all fire hydrants and associated piping, valves, and supports including connection to the water main.
 - i. Furnish and install a complete storm water drainage system.
 - j. Furnish and install a complete sanitary sewer and vent system.
 - k. Furnish and install firestopping systems for penetrations of fire-rated construction associated with this Contractor's work.

2. Heating, Ventilating and Air Conditioning Work shall include, but is not necessarily limited to:
 - a. Furnish and install a complete chilled water system including piping, insulation, air control equipment, terminal cooling equipment, and specialties. Make final connections to coils, including those furnished by others.
 - b. Furnish and install a complete terminal heating system including unit heaters, piping, flues, and controls.
 - c. Furnish and install condensate drain piping from cooling related equipment such as air handlers and cooling coil drain pans.
 - d. Furnish and install firestopping systems for penetrations of fire-rated construction associated with this Contractor's work.

3. Air Conditioning and Ventilating Work shall include, but is not necessarily limited to:
 - a. Furnish and install package indoor air handling units complete with dampers, filters, coils, fans, and motors.
 - b. Furnish and install complete supply air ductwork systems including all fittings, insulation, and outlets.
 - c. Furnish and install complete return air ductwork systems including all fittings, insulation, and inlets.
 - d. Furnish and install complete exhaust ductwork systems including all fittings, insulation, inlets, and fans.
 - e. Furnish and install chemical room ventilation systems including louvers, dampers, ductwork, insulation, and fans.
 - f. Furnish and install gas flues, stacks, and breechings.
 - g. Furnish and install all temperature control systems.
 - h. Furnish and install all fire dampers.
 - i. Furnish and install firestopping systems for penetrations of fire-rated construction associated with this Contractor's work.

4. Temperature Control Work shall include, but is not necessarily limited to:
 - a. Temperature control system shall consist of a full Direct Digital Control (DDC) system including all accessories, sensors, and programming.
 - b. Furnish automatic control valves and dampers for installation by others.
 - c. Furnish and install firestopping systems for penetrations of fire-rated construction associated with this Contractor's work.

5. Fire Protection Work shall include, but is not necessarily limited to:
 - a. Furnish and install a complete wet pipe sprinkler system for areas noted on the drawings.
 - b. Furnish and install all items listed on the Fire Protection Material List.
 - c. Furnish all hydraulic calculations and working sprinkler drawings.
 - d. Furnish and install firestopping systems for penetrations of fire-rated construction associated with this Contractor's work.
6. Testing, Adjusting, and Balancing Work shall include, but is not necessarily limited to:
 - a. Furnish complete testing, adjusting, and balancing as specified in Section 23 05 93, including, but not limited to, air systems, hydronic systems, plumbing systems, and verification of control systems.

1.3 DIVISION OF WORK BETWEEN MECHANICAL, ELECTRICAL & CONTROL CONTRACTORS

A. Definitions:

1. "Mechanical Contractors" refers to the following:
 - a. Plumbing Contractor.
 - b. Heating Contractor.
 - c. Air Conditioning and Ventilating Contractor.
 - d. Temperature Control Contractor.
 - e. Fire Protection Contractor.
 - f. Testing, Adjusting, and Balancing Contractor.
2. Motor Control Wiring: The wiring associated with the remote operation of the magnetic coils of magnetic motor starters or relays, or the wiring that permits direct cycling of motors by means of devices in series with the motor power wiring. In the latter case the devices are usually single phase and are usually connected to the motor power wiring through a manual motor starter having "Manual-Off-Auto" provisions.
3. Control devices such as start-stop push buttons, thermostats, pressure switches, flow switches, relays, etc., generally represent the types of equipment associated with motor control wiring.
4. Motor control wiring is single phase and usually 120 volts. In some instances, the voltage will be the same as the motor power wiring. Generally, where the motor power wiring exceeds 120 volts, a control transformer is used to give a control voltage of 120 volts.
5. Temperature Control Wiring: The wiring associated with the operation of a motorized damper, solenoid valve or motorized valve, etc., either modulating or two-position, as opposed to wiring which directly powers or controls a motor used to drive equipment such as fans, pumps, etc.
 - a. This wiring will be from a 120 volt source and may continue as 120 volt, or be reduced in voltage (24 volt) in which case a control transformer shall be furnished as part of the temperature control wiring.

6. Control Motor: An electric device used to operate dampers, valves, etc. It may be two-position or modulating. Conventional characteristics of such a motor are 24 volts, 60 cycles, 1 phase, although other voltages may be encountered.

B. General:

1. The purpose of these Specifications is to outline the Electrical and Mechanical Contractor's responsibilities related to electrical work required for items such as temperature controls, mechanical equipment, fans, chillers, compressors and the like. The exact wiring requirements for much of the equipment cannot be determined until the systems have been selected and submittals reviewed. Therefore, the electrical drawings show only known wiring related to such items. All wiring not shown on the electrical drawings, but required for mechanical systems, is the responsibility of the Mechanical Contractor.
2. Where the drawings require the Electrical Contractor to wire between equipment furnished by the Mechanical Contractor, such wiring shall terminate at terminals provided in the equipment. The Mechanical Contractor shall provide complete wiring diagrams and supervision to the Electrical Contractor and designate the terminal numbers for correct wiring.
3. All electrical work shall conform to the National Electrical Code. All provisions of the Electrical Specifications concerning wiring, protection, etc., apply to wiring provided by the Mechanical Contractor unless noted otherwise.
4. All Contractors shall establish utility elevations prior to fabrication and shall coordinate their material and equipment with other trades. When a conflict arises, priority is as follows:
 - a. Light fixtures.
 - b. Sheet metal.
 - c. Sprinkler piping and other piping.
 - d. Electrical conduits and wireway.

C. Mechanical Contractor's Responsibility:

1. Assumes responsibility for internal wiring of all equipment provided by the Mechanical Contractor.
2. Assumes all responsibility for the Temperature Control wiring, when the Temperature Control Contractor is a Subcontractor to the Mechanical Contractor.
3. Temperature Control Subcontractor's Responsibility:
 - a. Wiring of all devices needed to make the Temperature Control System functional.
 - b. Verifying any control wiring on the electrical drawings as being by the Electrical Contractor. All wiring required for the Control System, but not shown on the electrical drawings, is the responsibility of the Temperature Control Subcontractor.
 - c. Coordinating equipment locations (such as relays, transformers, etc.) with the Electrical Contractor, where wiring of the equipment is by the Electrical Contractor.

4. This Contractor is responsible for coordination of utilities with all other Contractors. If any field coordination conflicts are found, the Contractor shall coordinate with other Contractors to determine a viable layout.

D. Electrical Contractor's Responsibility:

1. Provides all combination starters, manual starters and disconnect devices shown on the Electrical Drawings or indicated to be by the Electrical Contractor on the Mechanical Drawings or Specifications.
2. Installs and wires all remote control devices furnished by the Mechanical Contractor or Temperature Control Subcontractor when so noted on the Electrical Drawings.
3. Provides motor control and temperature control wiring, where so noted on the drawings.
4. Coordinate with the Mechanical Contractor for size of motors and/or other electrical devices involved with repair or replacement of existing equipment.
5. Furnishes, installs and connects all relays, etc., for automatic shutdown of certain fans upon actuation of the Fire Alarm System as indicated and specified in Division 28.
6. This Contractor is responsible for coordination of utilities with all other Contractors. If any field coordination conflicts are found, the Contractor shall coordinate with other Contractors to determine a viable layout.

1.4 COORDINATION DRAWINGS

A. Definitions:

1. Coordination Drawings: A compilation of the pertinent layout and system drawings that show the sizes and locations, including elevations, of system components and required access areas to ensure that no two objects will occupy the same space.
 - a. Mechanical trades shall include, but are not limited to, mechanical equipment, ductwork, fire protection systems, plumbing piping, medical gas systems, hydronic piping, steam and steam condensate piping, and any item that may impact coordination with other disciplines.
 - b. Electrical trades shall include, but are not limited to, electrical equipment, conduit 1.5" and larger, conduit racks, cable trays, pull boxes, transformers, raceway, busway, lighting, ceiling-mounted devices, and any item that may impact coordination with other disciplines.
 - c. Technology trades shall include, but are not limited to, technology equipment, racks, conduit 1.5" and larger, conduit racks, cable trays, ladder rack, pull boxes, raceway, ceiling-mounted devices, and any item that may impact coordination with other disciplines.
 - d. Maintenance clearances and code-required dedicated space shall be included.

- e. The coordination drawings shall include all underground, underfloor, in-floor, in chase, and vertical trade items.
 2. The contractors shall use the coordination process to identify the proper sequence of installation of all utilities above ceilings and in other congested areas, to ensure an orderly and coordinated end result, and to provide adequate access for service and maintenance.
- B. Participation:
 1. The contractors and subcontractors responsible for work defined above shall participate in the coordination drawing process.
 2. One contractor shall be designated as the Coordinating Contractor for purposes of preparing a complete set of composite electronic CAD coordination drawings that include all applicable trades, and for coordinating the activities related to this process. The Coordinating Contractor for this project shall be the Mechanical Contractor.
 - a. The Coordinating Contractor shall utilize personnel familiar with requirements of this project and skilled as draftspersons/CAD operators, competent to prepare the required coordination drawings.
 3. Electronic CAD drawings shall be submitted to the Coordinating Contractor for addition of work by other trades. KJWW will provide electronic file copies of ventilation drawings for contractor's use if the contractor signs and returns an "Electronic File Transfer" waiver provided by KJWW. KJWW will not consider blatant reproductions of original file copies an acceptable alternative for coordination drawings.
- C. Drawing Requirements:
 1. The file format and file naming convention shall be coordinated with and agreed to by all contractors participating in the coordination process and the Owner.
 - a. Scale of drawings:
 - 1) General plans: 1/4 Inch = 1'-0" (minimum).
 - 2) Mechanical, electrical, communication rooms, and including the surrounding areas within 10 feet: 1/2 Inch = 1'-0" (minimum).
 - 3) Shafts and risers: 1/2 Inch = 1'-0" (minimum).
 - 4) Sections of shafts and mechanical and electrical equipment rooms: 1/4 Inch = 1'-0" (minimum).
 - 5) Sections of congested areas: 1/2 Inch = 1'-0" (minimum).
 2. Ductwork layout drawings shall be the baseline system for other components. Ductwork layout drawings shall be modified to accommodate other components as the coordination process progresses.
 3. There may be more drawings required for risers, top and bottom levels of mechanical rooms, and shafts.

4. The minimum quantity of drawings will be established at the first coordination meeting and sent to the A/E for review. Additional drawings may be required if other areas of congestion are discovered during the coordination process.

D. General:

1. Coordination drawing files shall be made available to the A/E and Owner's Representative. The A/E will only review identified conflicts and give an opinion, but will not perform as a coordinator.
2. A plotted set of coordination drawings shall be available at the project site.
3. Coordination drawings are not shop drawings and shall not be submitted as such.
4. The contract drawings are schematic in nature and do not show every fitting and appurtenance for each utility. Each contractor is expected to have included in his/her bid sufficient fittings, material, and labor to allow for adjustments in routing of utilities made necessary by the coordination process and to provide a complete and functional system.
5. The contractors will not be allowed additional costs or time extensions due to participation in the coordination process.
6. The contractors will not be allowed additional costs or time extensions for additional fittings, reroutings or changes of duct size, that are essentially equivalent sizes to those shown on the drawings and determined necessary through the coordination process.
7. The A/E reserves the right to determine space priority of equipment in the event of spatial conflicts or interference between equipment, piping, conduit, ducts, and equipment provided by the trades.
8. Changes to the contract documents that are necessary for systems installation and coordination shall be brought to the attention of the A/E.
9. Access panels shall preferably occur only in gypsum board walls or plaster ceilings where indicated on the drawings.
 - a. Access to mechanical, electrical, technology, and other items located above the ceiling shall be through accessible lay-in ceiling tile areas.
 - b. Potential layout changes shall be made to avoid additional access panels.
 - c. Additional access panels shall not be allowed without written approval from the A/E at the coordination drawing stage.
 - d. Providing additional access panels shall be considered after other alternatives are reviewed and discarded by the A/E and the Owner's Representative.
 - e. When additional access panels are required, they shall be provided without additional cost to the Owner.

10. Complete the coordination drawing process and obtain sign off of the drawings by all contractors prior to installing any of the components.
11. Conflicts that result after the coordination drawings are signed off shall be the responsibility of the contractor or subcontractor who did not properly identify their work requirements, or installed their work without proper coordination.
12. Updated coordination drawings that reflect as-built conditions may be used as record documents.

1.5 QUALITY ASSURANCE

A. Contractor's Responsibility Prior to Submitting Pricing Data:

1. The Contractor is responsible for constructing complete and operating systems. The Contractor acknowledges and understands that the Contract Documents are a two-dimensional representation of a three-dimensional object, subject to human interpretation. This representation may include imperfect data, interpreted codes, utility guidelines, three-dimensional conflicts, and required field coordination items. Such deficiencies can be corrected when identified prior to ordering material and starting installation. The Contractor agrees to carefully study and compare the individual Contract Documents and report at once in writing to the Design Team any deficiencies the Contractor may discover. The Contractor further agrees to require each subcontractor to likewise study the documents and report at once any deficiencies discovered.
2. The Contractor shall resolve all reported deficiencies with the Architect/Engineer prior to awarding any subcontracts, ordering material, or starting any work with the Contractor's own employees. Any work performed prior to receipt of instructions from the Design Team will be done at the Contractor's risk.

B. Qualifications:

1. Only products of reputable manufacturers are acceptable.
2. All Contractors and subcontractors shall employ only workers skilled in their trades.

C. Compliance with Codes, Laws, Ordinances:

1. Conform to all requirements of the City of Madison, Wisconsin Codes, Laws, Ordinances and other regulations having jurisdiction.
2. Conform to all State Codes.
3. If there is a discrepancy between the codes and regulations and these specifications, the Architect/Engineer shall determine the method or equipment used.
4. If the Contractor notes, at the time of bidding, any parts of the drawings or specifications that do not comply with the codes or regulations, he shall inform the Architect/Engineer in writing, requesting a clarification. If there is insufficient time for this procedure, he shall submit with his proposal a separate price to make the system comply with the codes and regulations.

5. All changes to the system made after letting of the contract, to comply with codes or requirements of Inspectors, shall be made by the Contractor without cost to the Owner.
 6. If there is a discrepancy between manufacturer's recommendations and these specifications, the manufacturer's recommendations shall govern.
 7. All rotating shafts and/or equipment shall be completely guarded from all contact. Partial guards and/or guards that do not meet all applicable OSHA standards are not acceptable. Contractor is responsible for providing this guarding if it is not provided with the equipment supplied.
- D. Permits, Fees, Taxes, Inspections:
1. Procure all applicable permits and licenses.
 2. Abide by all laws, regulations, ordinances, and other rules of the State or Political Subdivision where the work is done, or as required by any duly constituted public authority.
 3. Pay all charges for permits or licenses.
 4. Pay all fees and taxes imposed by the State, Municipal and/or other regulatory bodies.
 5. Pay all charges arising out of required inspections by an authorized body.
 6. Pay all charges arising out of required contract document reviews associated with the project and as initiated by the Owner or authorized agency/consultant.
 7. Where applicable, all fixtures, equipment and materials shall be listed by Underwriters' Laboratories, Inc. and approved by FM Global.
- E. Utility Company Requirements:
1. Secure from the appropriate private or public utility company all applicable requirements.
 2. Comply with all utility company requirements.
 3. Make application for and pay for service connections, such as gas.
 4. Make application for and pay for all meters and metering systems required by the utility company.
- F. Examination of Drawings:
1. The drawings for the mechanical work are completely diagrammatic, intended to convey the scope of the work and to indicate the general arrangements and locations of equipment, outlets, etc., and the approximate sizes of equipment.
 2. Contractor shall determine the exact locations of equipment and rough-ins, and the exact routing of pipes and ducts to best fit the layout of the job.
 3. Scaling of the drawings is not sufficient or accurate for determining these locations.

4. Where job conditions require reasonable changes in indicated arrangements and locations, such changes shall be made by the Contractor at no additional cost to the Owner.
5. Because of the scale of the drawings, certain basic items, such as fittings, boxes, valves, unions, etc., may not be shown, but where required by other sections of the specifications or required for proper installation of the work, such items shall be furnished and installed.
6. If an item is either on the drawings or in the specifications, it shall be included in this contract.
7. Determination of quantities of material and equipment required shall be made by the Contractor from the documents. Where discrepancies arise between drawings, schedules and/or specifications, the greater number shall govern.
8. Where used in mechanical documents, the word "furnish" shall mean supply for use, the word "install" shall mean connect complete and ready for operation, and the word "provide" shall mean to supply for use and connect complete and ready for operation.
 - a. Any item listed as furnished shall also be installed, unless otherwise noted.
 - b. Any item listed as installed shall also be furnished, unless otherwise noted.

G. Field Measurements:

1. Verify all pertinent dimensions at the job site before ordering any materials or fabricating any supports, pipes or ducts.

H. Electronic Media/Files:

1. Construction drawings for this project have been prepared utilizing Revit.
2. Contractors and Subcontractors may request electronic media files of the contract drawings and/or copies of the specifications. Specifications will be provided in PDF format.
3. Upon request for electronic media, the Contractor shall complete and return a signed "Electronic File Transmittal" form provided by KJWW.
4. If the information requested includes floor plans prepared by others, the Contractor will be responsible for obtaining approval from the appropriate Design Professional for use of that part of the document.
5. The electronic contract documents can be used for preparation of shop drawings and as-built drawings only. The information may not be used in whole or in part for any other project.
6. The drawings prepared by KJWW for bidding purposes may not be used directly for ductwork layout drawings or coordination drawings.

7. The use of these CAD documents by the Contractor does not relieve them from their responsibility for coordination of work with other trades and verification of space available for the installation.
8. The information is provided to expedite the project and assist the Contractor with no guarantee by KJWW as to the accuracy or correctness of the information provided. KJWW accepts no responsibility or liability for the Contractor's use of these documents.

1.6 SUBMITTALS

- A. Submittals shall be required for the following items, and for additional items where required elsewhere in the specifications or on the drawings.

1. Submittals list:

<u>Referenced Specification Section</u>	<u>Submittal Item</u>
23 05 93	Testing, Adjusting, and Balancing
23 34 23	Power Ventilators
23 37 00	Grilles, Registers, and Diffusers
23 37 00	Louvers
23 81 13	Packaged Terminal Air Conditioning Units
23 82 00	Terminal Heat Transfer Equipment

- B. General Submittal Procedures: In addition to the provisions of Division 1, the following are required:

1. Transmittal: Each transmittal shall include the following:

- a. Date
- b. Project title and number
- c. Contractor's name and address
- d. Division of work (e.g., plumbing, heating, ventilating, etc.)
- e. Description of items submitted and relevant specification number
- f. Notations of deviations from the contract documents
- g. Other pertinent data

2. Submittal Cover Sheet: Each submittal shall include a cover sheet containing:

- a. Date
- b. Project title and number
- c. Architect/Engineer
- d. Contractor and subcontractors' names and addresses
- e. Supplier and manufacturer's names and addresses
- f. Division of work (e.g., plumbing, heating, ventilating, etc.)
- g. Description of item submitted (using project nomenclature) and relevant specification number
- h. Notations of deviations from the contract documents
- i. Other pertinent data
- j. Provide space for Contractor's review stamps

3. Composition:

- a. Submittals shall be submitted using specification sections and the project nomenclature for each item.

- b. Individual submittal packages shall be prepared for items in each specification section. All items within a single specification section shall be packaged together where possible. An individual submittal may contain items from multiple specifications sections if the items are intimately linked (e.g., pumps and motors).
 - c. All sets shall contain an index of the items enclosed with a general topic description on the cover.
4. Content: Submittals shall include all fabrication, erection, layout, and setting drawings; manufacturers' standard drawings; schedules; descriptive literature, catalogs and brochures; performance and test data; wiring and control diagrams; dimensions; shipping and operating weights; shipping splits; service clearances; and all other drawings and descriptive data of materials of construction as may be required to show that the materials, equipment or systems and the location thereof conform to the requirements of the contract documents.
5. Contractor's Approval Stamp:
- a. The Contractor shall thoroughly review and approve all shop drawings before submitting them to the Architect/Engineer. The Contractor shall stamp, date and sign each submittal certifying it has been reviewed.
 - b. Unstamped submittals will be rejected.
 - c. The Contractor's review shall include, but not be limited to, verification of the following:
 - 1) Only approved manufacturers are used.
 - 2) Addenda items have been incorporated.
 - 3) Catalog numbers and options match those specified.
 - 4) Performance data matches that specified.
 - 5) Electrical characteristics and loads match those specified.
 - 6) Equipment connection locations, sizes, capacities, etc. have been coordinated with other affected trades.
 - 7) Dimensions and service clearances are suitable for the intended location.
 - 8) Equipment dimensions are coordinated with support steel, housekeeping pads, openings, etc.
 - 9) Constructability issues are resolved (e.g., weights and dimensions are suitable for getting the item into the building and into place, sinks fit into countertops, etc.).
 - d. The Contractor shall review, stamp and approve all subcontractors' submittals as described above.
 - e. **The Contractor's approval stamp is required on all submittals. Approval will indicate the Contractor's review of all material and a complete understanding of exactly what is to be furnished. Contractor shall clearly mark all deviations from the contract documents on all submittals. If deviations are not marked by the Contractor, then the item shall be required to meet all drawing and specification requirements.**

6. Submittal Identification and Markings:
 - a. The Contractor shall clearly mark each item with the same nomenclature applied on the drawings or in the specifications.
 - b. The Contractor shall clearly indicate the size, finish, material, etc.
 - c. Where more than one model is shown on a manufacturer's sheet, the Contractor shall clearly indicate exactly which item and which data is intended.
 - d. All marks and identifications on the submittals shall be unambiguous.
7. Schedule submittals to expedite the project. Coordinate submission of related items.
8. Identify variations from the contract documents and product or system limitations that may be detrimental to the successful performance of the completed work.
9. Reproduction of contract documents alone is not acceptable for submittals.
10. Incomplete submittals will be rejected without review. Partial submittals will only be reviewed with prior approval from the Architect/Engineer.
11. Submittals not required by the contract documents may be returned without review.
12. The Architect/Engineer's responsibility shall be to review one set of shop drawing submittals for each product. If the first submittal is incomplete or does not comply with the drawings and/or specifications, the Contractor shall be responsible to bear the cost for the Architect/Engineer to recheck and handle the additional shop drawing submittals.
13. Submittals shall be reviewed and approved by the Architect/Engineer **before** releasing any equipment for manufacture or shipment.
14. Contractor's responsibility for errors, omissions or deviation from the contract documents in submittals is not relieved by the Architect/Engineer's approval.

C. Electronic Submittal Procedures:

1. Distribution: Email submittals as attachments to all parties designated by the Architect/Engineer, unless a web-based submittal program is used.
2. Transmittals: Each submittal shall include an individual electronic letter of transmittal.
3. Format: Electronic submittals shall be in PDF format only. Scanned copies, in PDF format, of paper originals are acceptable. Submittals that are not legible will be rejected. Do not set any permission restrictions on files; protected, locked, or secured documents will be rejected.

4. File Names: Electronic submittal file names shall include the relevant specification section number followed by a description of the item submitted, as follows. Where possible, include the transmittal as the first page of the PDF instead of using multiple electronic files.
 - a. Submittal file name: 23 XX XX.description.YYYYMMDD
 - b. Transmittal file name: 23 XX XX.description.YYYYMMDD
5. File Size: Electronic file size shall be limited to a maximum of 4MB. Larger files shall be transmitted via a pre-approved method.

1.7 SCHEDULE OF VALUES

- A. The requirements herein are in addition to the provisions of Division 1.
- B. Format:
 1. Use AIA Document Continuation Sheets G703 or another similar form approved by the Owner and Architect/Engineer.
 2. Submit in Excel format.
 3. Support values given with substantiating data.
- C. Preparation:
 1. Itemize the cost for each of the following:
 - a. Overhead and profit.
 - b. Bonds.
 - c. Insurance.
 - d. General Requirements: Itemize all requirements.
 2. Itemize work required by each specification section and list all providers. All work provided by subcontractors and major suppliers shall be listed on the Schedule of Values. List each subcontractor and supplier by company name.
 - a. Contractor's own labor forces.
 - b. All subcontractors.
 - c. All major suppliers of products or equipment.
 3. Break down all costs into:
 - a. Material: Delivered cost of product with taxes paid.
 - b. Labor: Labor cost, excluding overhead and profit.
- D. Update Schedule of Values when:
 1. Indicated by Architect/Engineer.
 2. Change of subcontractor or supplier occurs.
 3. Change of product or equipment occurs.

1.8 CHANGE ORDERS

- A. A detailed material and labor takeoff shall be prepared for each change order, along with labor rates and markup percentages. Change orders with inadequate breakdown will be rejected.
- B. Change order work shall not proceed until authorized.

1.9 PRODUCT DELIVERY, STORAGE, HANDLING & MAINTENANCE

- A. Exercise care in transporting and handling to avoid damage to materials. Store materials on the site to prevent damage. Keep materials clean, dry and free from harmful conditions. Immediately remove any materials that become wet or that are suspected of becoming contaminated with mold or other organisms.
- B. Keep all bearings properly lubricated and all belts properly tensioned and aligned.
- C. Coordinate the installation of heavy and large equipment with the General Contractor and/or Owner. If the Mechanical Contractor does not have prior documented experience in rigging and lifting similar equipment, he/she shall contract with a qualified lifting and rigging service that has similar documented experience. Follow all equipment lifting and support guidelines for handling and moving.
- D. Contractor is responsible for moving equipment into the building and/or site. Contractor shall review site prior to bid for path locations and any required building modifications to allow movement of equipment. Contractor shall coordinate his/her work with other trades.

1.10 WARRANTY

- A. Provide one-year warranty, unless otherwise noted, to the Owner for all fixtures, equipment, materials, and workmanship.
- B. The warranty period for all work in this Division of the specifications shall commence on the date of final acceptance, unless a whole or partial system or any separate piece of equipment or component is put into use for the benefit of any party other than the installing contractor with prior written authorization. In this instance, the warranty period shall commence on the date when such whole system, partial system or separate piece of equipment or component is placed in operation and accepted in writing by the Owner.
- C. Warranty requirements shall extend to correction, without cost to the Owner, of all Work found to be defective or nonconforming to the contract documents. The Contractor shall bear the cost of correcting all damage resulting from defects or nonconformance with contract documents.

1.11 INSURANCE

- A. Contractor shall maintain insurance coverage as set forth in Division 0 of these specifications.

1.12 MATERIAL SUBSTITUTION

- A. Where several manufacturers' names are given, the manufacturer for which a catalog number is given is the basis for job design and establishes the quality required.

- B. Equivalent equipment manufactured by the other named manufacturers may be used. Contractor shall ensure that all items submitted by these other manufacturers meet all requirements of the drawings and specifications, and fits in the allocated space.
- C. Any material, article or equipment of other unnamed manufacturers which will adequately perform the services and duties imposed by the design and is of a quality equal to or better than the material, article or equipment identified by the drawings and specifications may be used if approval is secured in writing from the Architect/Engineer not later than ten days prior to the bid opening.
- D. This Contractor assumes all costs incurred as a result of using the offered material, article or equipment, on his part or on the part of other Contractors whose work is affected.
- E. This Contractor may list voluntary add or deduct prices for alternate materials on the bid form. These items will not be used in determining the low bidder.
- F. All material substitutions requested later than ten (10) days prior to bid opening must be listed as voluntary changes on the bid form.

PART 2 - PRODUCTS

NOT APPLICABLE

PART 3 - EXECUTION

3.1 JOBSITE SAFETY

- A. Neither the professional activities of the Architect/Engineer, nor the presence of the Architect/Engineer or his or her employee and subconsultants at a construction site, shall relieve the Contractor and other entity of their obligations, duties and responsibilities including, but not limited to, construction means, methods, sequence, techniques or procedures necessary for performing, superintending or coordinating all portions of the work of construction in accordance with the contract documents and any health or safety precautions required by any regulatory agencies. The Architect/Engineer and his or her personnel have no authority to exercise any control over any construction contractor or other entity or their employees in connection with their work or any health or safety precautions. The Contractor is solely responsible for jobsite safety. The Architect/Engineer and the Architect/Engineer's consultants shall be indemnified and shall be made additional insureds under the Contractor's general liability insurance policy.

3.2 ARCHITECT/ENGINEER OBSERVATION OF WORK

- A. The Contractor shall provide seven (7) calendar days' notice to the Architect/Engineer prior to:
 - 1. Placing fill over underground and underslab utilities.
 - 2. Covering exterior walls, interior partitions and chases.
 - 3. Installing hard or suspended ceilings and soffits.
- B. The Architect/Engineer will have the opportunity to review the installation and provide a written report noting deficiencies requiring correction. The Contractor's schedule shall account for these reviews and show them as line items in the approved schedule.

C. Above-Ceiling Final Observation

1. All work above the ceilings must be complete prior to the Architect/Engineer's review. This includes, but is not limited to:
 - a. Pipe insulation is installed and fully sealed.
 - b. Pipe and duct wall penetrations are sealed.
 - c. Pipe identification and valve tags are installed.
 - d. Main, branch and flexible ducts are installed.
 - e. Diffusers, registers and grilles are installed and connected to ductwork.
 - f. Terminal unit piping or wiring is complete.
2. In order to prevent the Above-Ceiling Final Observation from occurring too early, the Contractor shall review the status of the work and certify, in writing, that the work is ready for the Above-Ceiling Final Observation.
3. It is understood that if the Architect/Engineer finds the ceilings have been installed prior to this review and prior to 7 days elapsing, the Architect/Engineer may not recommend further payments to the contractor until such time as full access has been provided.

3.3 PROJECT CLOSEOUT

A. The following paragraphs supplement the requirements of Division 1.

B. Final Jobsite Observation:

1. In order to prevent the Final Jobsite Observation from occurring too early, the Contractor is required to review the completion status of the project and certify that the job is ready for the final jobsite observation.
2. Attached to the end of this section is a typical list of items that represent the degree of job completeness expected prior to requesting a review.
3. Upon Contractor certification that the project is complete and ready for a final observation, the Contractor shall sign the attached certification and return it to the Architect/Engineer so that the final observation can be scheduled.
4. It is understood that if the Architect/Engineer finds the job not ready for the final observation and that additional trips and observations are required to bring the project to completion, the costs incurred by the Architect/Engineer's additional time and expenses will be deducted from the Contractor's contract retainage prior to final payment at the completion of the job.

C. Before final payment is authorized, this Contractor must submit the following:

1. Operation and maintenance manuals with copies of approved shop drawings.
2. Record documents including marked-up drawings and specifications.
3. A report documenting the instructions given to the Owner's representatives complete with the number of hours spent in the instruction. The report shall bear the signature of an authorized agent of This Contractor and shall be signed by the Owner's representatives.

4. Start-up reports on all equipment requiring a factory installation inspection or start-up.
5. Provide spare parts, maintenance, and extra materials in quantities specified in individual specification sections. Deliver to and place in location as directed; receipt by Architect/Engineer required prior to final payment approval.

3.4 OPERATION AND MAINTENANCE MANUALS

A. General:

1. Provide an electronic copy of the O&M manuals as described below for Architect/Engineer's review and approval. The electronic copy shall be corrected as required to address the Architect/Engineer's comments. Once corrected, electronic copies and paper copies shall be distributed as directed by the Architect/Engineer.
2. Approved O&M manuals shall be completed and in the Owner's possession prior to Owner's acceptance and at least 10 days prior to instruction of operating personnel.

B. Electronic Submittal Procedures:

1. Distribution: Email the O&M manual as attachments to all parties designated by the Architect/Engineer.
2. Transmittals: Each submittal shall include an individual electronic letter of transmittal.
3. Format: Electronic submittals shall be in PDF format only. Scanned copies, in PDF format, of paper originals are acceptable. Submittals that are not legible will be rejected. Do not set any permission restrictions on files; protected, locked, or secured documents will be rejected.
4. File Names: Electronic submittal file names shall include the relevant specification section number followed by a description of the item submitted, as follows. Where possible, include the transmittal as the first page of the PDF instead of using multiple electronic files.
 - a. O&M file name: O&M.div23.contractor.YYYYMMDD
 - b. Transmittal file name: O&Mtransmittal.div23.contractor.YYYYMMDD
5. File Size: Electronic file size shall be limited to a maximum of 4MB. Larger files shall be divided into files that are clearly labeled as "1 of 2", "2 of 2", etc.
6. Provide the Owner with an approved copy of the O&M manual on compact discs (CD), digital video discs (DVD), or flash drives with a permanently affixed label, printed with the title "Operation and Maintenance Instructions", title of the project and subject matter of disc/flash drive when multiple disc/flash drives are required.
7. All text shall be searchable.
8. Bookmarks shall be used, dividing information first by specification section, then systems, major equipment and finally individual items. All bookmark titles shall include the nomenclature used in the construction documents and shall be an active link to the first page of the section being referenced.

- C. Operation and Maintenance Instructions shall include:
1. Title Page: Include title page with project title, Architect, Engineer, Contractor, all subcontractors, and major equipment suppliers, with addresses, telephone numbers, website addresses, email addresses and point of contacts. Website URLs and email addresses shall be active links in the electronic submittal.
 2. Table of Contents: Include a table of contents describing specification section, systems, major equipment, and individual items.
 3. Copies of all final approved shop drawings and submittals. Include Architect's/Engineer's shop drawing review comments. Insert the individual shop drawing directly after the Operation and Maintenance information for the item(s) in the review form.
 4. Refer to Section 23 09 00 for additional requirements for Temperature Control submittals.
 5. Copy of final approved test and balance reports.
 6. Copies of all factory inspections and/or equipment startup reports.
 7. Copies of warranties.
 8. Schematic wiring diagrams of the equipment that have been updated for field conditions. Field wiring shall have label numbers to match drawings.
 9. Dimensional drawings of equipment.
 10. Capacities and utility consumption of equipment.
 11. Detailed parts lists with lists of suppliers.
 12. Operating procedures for each system.
 13. Maintenance schedule and procedures. Include a chart listing maintenance requirements and frequency.
 14. Repair procedures for major components.
 15. List of lubricants in all equipment and recommended frequency of lubrication.
 16. Instruction books, cards, and manuals furnished with the equipment.

3.5 INSTRUCTING THE OWNER'S REPRESENTATIVES

- A. Adequately instruct the Owner's designated representatives in the maintenance, care, and operation of all systems installed under this contract.
- B. Provide verbal and written instructions to the Owner's representatives by FACTORY PERSONNEL in the care, maintenance, and operation of the equipment and systems.
- C. The Owner has the option to make a video recording of all instructions. Coordinate schedule of instructions to facilitate this recording.

- D. The instructions shall include:
 - 1. Explanation of all air handling systems.
 - 2. Temperature control system operation including calibration, adjustment and proper operating conditions of all sensors.
 - 3. Maintenance of equipment.
 - 4. Start-up procedures for all major equipment.
- E. The Architect/Engineer shall be notified of the time and place instructions will be given to the Owner's representatives so he or his representative can attend if desired.
- F. Operating Instructions:
 - 1. Contractor is responsible for all instructions to the Owner's representatives for the mechanical and control systems.
 - 2. If the Contractor does not have staff that can adequately provide the required instructions he shall include in his bid an adequate amount to reimburse the Owner for the Architect/Engineer to perform these services.

3.6 SYSTEM COMMISSIONING

- A. The mechanical systems shall be complete and operating. System start-up, testing, balancing, and satisfactory system performance is the responsibility of the Contractor. This includes calibration and adjustments of all controls, noise level adjustments and final comfort adjustments as required.
- B. Operate all HVAC systems continuously for at least one week prior to occupancy to bring construction materials to suitable moisture levels. Areas with mechanical cooling shall be maintained below 60% RH.
- C. Contractor shall adjust the mechanical systems and controls at season changes during the one year warranty period, as required, to provide satisfactory operation and to prove performance of all systems in all seasons.
- D. All operating conditions and control sequences shall be tested during the start-up period. Test all interlocks, safety shutdowns, controls, and alarms.
- E. The Contractor, subcontractors, and equipment suppliers shall have skilled technicians to ensure that all systems perform properly. If the Architect/Engineer is requested to visit the job site for trouble shooting, assisting in start-up, obtaining satisfactory equipment operation, resolving installation and/or workmanship problems, equipment substitution issues or unsatisfactory system performance, including call backs during the warranty period, through no fault of the design; the Contractor shall reimburse the Owner on a time and materials basis for services rendered at the Architect/Engineer's standard hourly rates in effect when the services are requested. The Contractor shall pay the Owner for services required that are product, installation or workmanship related. Payment is due within 30 days after services are rendered.

3.7 RECORD DOCUMENTS

- A. The following paragraph supplements Division 1 requirements:

Contractor shall maintain at the job site a separate and complete set of mechanical drawings and specifications on which he shall clearly and permanently mark in complete detail all changes made to the mechanical systems.

- B. Mark drawings to indicate revisions to piping and ductwork, size and location, both exterior and interior; including locations of coils, dampers, other control devices, filters, and other units requiring periodic maintenance or repair; actual equipment locations, dimensioned from column lines; actual inverts and locations of underground piping; concealed equipment, dimensioned from column lines; mains and branches of piping systems, with valves and control devices located and numbered, concealed unions located, and with items requiring maintenance located (e.g., traps, strainers, expansion compensators, tanks, etc.); Change Orders; concealed control system devices.
- C. Refer to Section 23 09 00 for additional requirements for Temperature Control documents.

3.8 PAINTING

- A. This Contractor shall paint the following items:
 - 1. Exposed ductwork and piping.
- B. Paint all equipment that is marred or damaged prior to the Owner's acceptance. Paint and color shall match original equipment paint and shall be obtained from the equipment supplier if available.
- C. Equipment in finished areas that will be painted to match the room decor will be painted by others. Should this Contractor install equipment in a finished area after the area has been painted, he shall have the equipment and all its supports, hangers, etc., painted to match the room decor.
- D. Equipment cabinets, casings, covers, metal jackets, etc., in equipment rooms or concealed spaces, shall be furnished in standard or prime finish, free from scratches, abrasions, chips, etc.
- E. Equipment in occupied spaces, or if standard to the unit, shall have a baked primer with baked enamel finish coat free from scratches, abrasions, chips, etc. If color option is specified or is standard to the unit, this Contractor shall, before ordering, verify with the Architect/Engineer his color preference and furnish this color.
- F. Paint all equipment in unfinished areas such as boiler room, mechanical spaces, storage room, etc., furnished by this Contractor. Equipment furnished with a factory coat of paint and enamel need not be painted, provided the factory applied finish is not marred or spattered. If so, equipment shall be refinished with the same paint as was factory applied.
- G. Paint all outdoor uninsulated steel piping the color selected by Owner or Architect/Engineer.
- H. After surfaces have been thoroughly cleaned and are free of oil, dirt, and other foreign matter; paint all pipes and equipment with the following:
 - 1. Bare Metal Surfaces - Apply one coat of primer suitable for the metal being painted. Finish with two coats of Alkyd base enamel paint.

2. Insulated Surfaces - Paint insulation jackets with two coats of semi-gloss acrylic latex paint.
3. Color of paint shall be selected by Architect.

3.9 ADJUST AND CLEAN

- A. Thoroughly clean all equipment and systems prior to the Owner's final acceptance of the project. Clean all foreign paint, grease, oil, dirt, labels, stickers, and other foreign material from all equipment.
- B. Clean all drain pans and areas where moisture is present. Immediately report any mold, biological growth, or water damage.
- C. Remove all rubbish, debris, etc., accumulated during construction from the premises.

END OF SECTION

SECTION 23 05 05

HVAC DEMOLITION FOR REMODELING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Mechanical demolition.
- B. Cutting and Patching.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

- A. Materials and equipment shall be as specified in individual Sections.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. THE DRAWINGS ARE INTENDED TO INDICATE THE GENERAL SCOPE OF WORK AND DO NOT SHOW EVERY PIPE, DUCT, OR PIECE OF EQUIPMENT THAT MUST BE REMOVED. THE CONTRACTOR SHALL VISIT THE SITE AND VERIFY CONDITIONS PRIOR TO SUBMITTING A BID.
- B. Where walls, ceilings, etc., are shown as being removed on general drawings, the Contractor shall remove all mechanical equipment, devices, fixtures, piping, ducts, systems, etc., from the removed area.
- C. Where ceilings, walls, partitions, etc., are temporarily removed and replaced by others, This Contractor shall remove, store, and replace equipment, devices, fixtures, pipes, ducts, systems, etc.
- D. Verify that abandoned utilities serve only abandoned equipment or facilities. Extend services to facilities or equipment that shall remain in operation following demolition.
- E. Coordinate work with all other Contractors and the Owner. Schedule removal of equipment to avoid conflicts.
- F. This Contractor shall verify all existing equipment sizes and capacities where equipment is scheduled to be replaced or modified, prior to ordering new equipment.
- G. Bid submittal shall mean the Contractor has visited the project site and verified existing conditions and scope of work.

3.2 PREPARATION

- A. Disconnect mechanical systems in walls, floors, and ceilings scheduled for removal.

3.3 DEMOLITION AND EXTENSION OF EXISTING MECHANICAL WORK

- A. Demolish and extend existing mechanical work under provisions of Division 2 and this Section.
- B. Remove, relocate, and extend existing installations to accommodate new construction.
- C. Remove abandoned ducts and piping to source of supply and/or main lines.
- D. Remove exposed abandoned pipes and ducts, including abandoned pipes and ducts above accessible ceilings. Cut ducts flush with walls and floors, cap duct that remains, and patch surfaces. Cut pipes above ceilings, below floors and behind walls. Cap remaining lines. Repair building construction to match original. Remove all clamps, hangers, supports, etc. associated with pipe and duct removal.
- E. Disconnect and remove mechanical devices and equipment serving equipment that has been removed.
- F. Repair adjacent construction and finishes damaged during demolition and extension work.
- G. Maintain access to existing mechanical installations which remain. Modify installation or provide access panels as appropriate.
- H. Remove unused sections of supply and return air ductwork back to mains. Patch opening with sheet metal and seal airtight. Patch existing insulation to match existing. Where existing ductwork is to be capped and reused, locate the end cap within 6" of the last branch. End caps shall be 3" pressure class and seal class "A".
- I. Extend existing installations using materials and methods compatible with existing installations, or as specified.

3.4 CUTTING AND PATCHING

- A. This Contractor is responsible for all penetrations of existing construction required to complete the work of this project. Refer to Section 23 05 29 for additional requirements.
- B. Penetrations in existing construction should be reviewed carefully prior to proceeding with any work.
- C. Penetrations shall be neat and clean with smooth and/or finished edges. Core drill where possible for clean opening.
- D. Repair existing construction as required after penetration is complete to restore to original condition. Use similar materials and match adjacent construction unless otherwise noted or agreed to by the Architect/Engineer prior to start of work.
- E. Floor slab is post-tensioned. All penetrations shall be x-rayed prior to cutting and/or drilling to avoid any tension cables or utilities encased in floor construction.
- F. Floor slabs may contain conduit systems. This Contractor is responsible for taking any measures required to ensure no conduits or other services are damaged. This includes x-ray or similar non-destructive means.
- G. This Contractor is responsible for all costs incurred in repair, relocations, or replacement of any cables, conduits, or other services if damaged without proper investigation.

3.5 CLEANING AND REPAIR

- A. Clean and repair existing materials and equipment which remain or are to be reused.
- B. Clean all systems adjacent to project which are affected by the dust and debris caused by this construction.
- C. MECHANICAL ITEMS REMOVED AND NOT RELOCATED REMAIN THE PROPERTY OF THE OWNER. CONTRACTOR SHALL PLACE ITEMS RETAINED BY THE OWNER IN A LOCATION COORDINATED WITH THE OWNER. THE CONTRACTOR SHALL DISPOSE OF MATERIAL THE OWNER DOES NOT WANT TO REUSE OR RETAIN FOR MAINTENANCE PURPOSES.

3.6 SPECIAL REQUIREMENTS

- A. Install temporary filter media over outside air intakes which are within 100 feet of the limits of construction or as noted on the drawings. This Contractor shall complete any cleaning required for existing systems which are affected by construction dust and debris.
- B. Review locations of all new penetrations in existing floor slabs or walls. Determine construction type and review for possible interferences. Bring all concerns to the attention of the Architect/Engineer before proceeding.

END OF SECTION

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SECTION 23 05 13

MOTORS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Single Phase and Three Phase Electric Motors.

1.2 DELIVERY, STORAGE, AND HANDLING

- A. Protect motors stored on site from weather and moisture by maintaining factory covers and suitable weatherproof coverings. For extended outdoor storage, follow manufacturer's recommendations for equipment and motor.

1.3 OPERATION AND MAINTENANCE DATA

- A. Submit operation and maintenance data including assembly drawings, bearing data including replacement sizes, and lubrication instructions.

1.4 QUALIFICATIONS

- A. Manufacturer: Company specializing in the manufacture of commercial and industrial motors and accessories, with a minimum of three years documented manufacturing experience.

PART 2 - PRODUCTS

2.1 MOTORS - GENERAL CONSTRUCTION AND REQUIREMENTS

- A. Refer to the drawings for required electrical characteristics.
- B. Design motors for continuous operation in 40°C environment, and for temperature rise in accordance with ANSI/NEMA MG 1 limits for insulation class, service factor, and motor enclosure type.
- C. Explosion-Proof Motors: UL listed and labeled for the hazard classification shown on the drawing, with over-temperature protection.
- D. Visible Nameplate: Indicating horsepower, voltage, phase, hertz, RPM, full load amps, locked rotor amps, frame size, manufacturer's name and model number, service factor, power factor, insulation class.
- E. Electrical Connection: Boxes, threaded for conduit. For fractional horsepower motors where connection is made directly, provide conduit connection in end frame.
- F. Unless otherwise indicated, motors 3/4 HP and smaller shall be single phase, 60 hertz, open drip-proof or totally enclosed fan-cooled type.
- G. Unless otherwise indicated, motors 1 HP and larger shall be three phase, 60 hertz, squirrel cage type, NEMA Design Code B (low current in-rush, normal starting torque), open drip-proof or totally enclosed fan-cooled type.

- H. Each contractor shall set all motors furnished by him.
- I. All motors shall have a minimum service factor of 1.15.
- J. All motors shall have ball or roller bearings with a minimum L-10 fatigue life of 150,000 hours in direct-coupled applications and 50,000 hours for belted applications. Belted rating shall be based on radial loads and pulley sizes called out in NEMA MG1-14.43.
- K. Bearings shall be sealed type for 10 HP and smaller motors. Bearings shall be regreasable type for larger motors.
- L. Provide all belted motors with a means of moving and securing the motor to tighten belts. Motors over 2 HP shall have screw type tension adjustment. Motors over 40 HP shall have dual screw adjusters. Slide bases shall conform to NEMA standards.

2.2 PREMIUM EFFICIENCY MOTORS (INCLUDING MOST 3-PHASE GENERAL PURPOSE MOTORS)

- A. All motors, unless exempted by EPCAct legislation that became federal law on December 19, 2010, shall comply with the efficiencies listed in that standard, which are reprinted below. These match the 2010 NEMA premium efficiency ratings. All ratings listed are nominal full load efficiencies, verified in accordance with IEEE Standard 112, Test Method B. Average expected (not guaranteed minimum) power factors shall also be at least the following:

HP	Full-Load Efficiencies %					
	Open Drip-Proof			Totally Enclosed Fan Cooled		
	1200 rpm	1800 rpm	3600 rpm	1200 rpm	1800 rpm	3600 rpm
1.0	82.5	85.5	77.0	82.5	85.5	77.0
1.5	86.5	86.5	84.0	87.5	86.5	84.0
2.0	87.5	86.5	85.5	88.5	86.5	85.5
3.0	88.5	89.5	85.5	89.5	89.5	86.5
5.0	89.5	89.5	86.5	89.5	89.5	88.5
7.5	90.2	91.0	88.5	91.0	91.7	89.5
10.0	91.7	91.7	89.5	91.0	91.7	90.2

- B. Motor nameplate shall be noted with the above ratings.

2.3 MOTORS ON VARIABLE FREQUENCY DRIVES

- A. All motors driven by VFDs shall be premium efficiency type.
- B. Motors shall be designed for use with VFDs in variable torque applications with 1.15 service factor. Motors shall not be equipped with auxiliary blowers.
- C. Motors driven by VFDs shall have Class F or H insulation and be designated by the motor manufacturer to be suitable for inverter duty service in accordance with NEMA MG 1 Section IV, "Performance Standards Applying to All Machines," Part 31 "Definite-Purpose Inverter-Fed Polyphase Motors."

- D. All 460 volt motors 5 HP and larger controlled by VFDs shall be equipped with an alternate discharge path, such as a shaft grounding ring or grounding brush, to divert adverse shaft currents from the motor bearings on the drive end of the motor shaft. Motor shafts 2" and larger require shaft grounding on the drive end and the non-drive end. This Contractor shall ensure (via field observation and measurement) that the shaft is effectively grounded upon startup.
 - 1. Providing grounding rings internal to the motor housing is an acceptable solution, provided the motor is affixed with a label clearly indicating the presence of a grounding assembly. The grounding ring shall be listed for 40,000 hours of motor service and shall be accessible via the drive endplate.

2.4 MOTORS FOR WET OR CORROSIVE DUTY

- A. Where noted for wet and/or corrosive duty, motors shall be designed for severe duty with cast-iron frame, epoxy finish, stainless steel nameplate, polymer shaft seal, corrosion resistant fasteners and fan, moisture resistant windings, and non-wicking leads.

2.5 MOTORS FOR HAZARDOUS DUTY

- A. Where noted for hazardous duty, motors shall be designed for the class, group, and T code listed for the application. Frame sizes 143T and larger shall have normally closed winding thermostats to keep surface temperatures below the nameplate T code under all conditions.

2.6 MOTOR DRIVEN EQUIPMENT

- A. No equipment shall be selected or operate above 90% of its motor nameplate rating. Motor size may not be increased to compensate for equipment with efficiency lower than that specified.
- B. If a larger motor than specified is required on equipment, the contractor supplying the equipment is responsible for all additional costs due to larger starters, wiring, etc.

2.7 SHEAVES

- A. All sheaves shall conform to NEMA Standard MG1-14.42, which lists minimum diameters and maximum overhangs. Locate motors to minimize overhang.
- B. When replacing sheaves, use sheaves of at least the originally supplied sizes.
- C. Contractor responsible for motor shall also be responsible for replacement sheaves. Coordinate with testing and balancing of the equipment.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. All rotating shafts and/or equipment shall be completely guarded from all contact. Partial guards and/or guards that do not meet all applicable OSHA standards are not acceptable. Contractor is responsible for providing this guarding if it is not provided with the equipment supplied.

- B. For flexible coupled drive motors, mount coupling to the shafts in accordance with the coupling manufacturer's recommendations. Align shafts to manufacturer's requirements or within 0.002 inch per inch diameter of coupling hub.
- C. For belt drive motors, mount sheaves on the appropriate shafts per manufacturer's instructions. Use a straight edge to check alignment of the sheaves. Reposition sheaves as necessary so the straight edge contacts both sheave faces squarely. After sheaves are aligned, loosen the adjustable motor base so the belt(s) can be added, and tighten the base so the belt tension is in accordance with the drive manufacturer's recommendations. Frequently check belt tension and adjust if necessary during the first day of operation and again after 80 hours of operation.

END OF SECTION

SECTION 23 05 29

HVAC SUPPORTS AND ANCHORS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Hangers, Supports, and Associated Anchors.
- B. Equipment Bases and Supports.
- C. Sleeves and Seals.
- D. Flashing and Sealing of Equipment and Pipe Stacks.
- E. Cutting of Openings.
- F. Escutcheon Plates and Trim.

1.2 SUBMITTALS

- A. Submit shop drawings and product data under provisions of Section 23 05 00.

1.3 WORK FURNISHED BUT INSTALLED UNDER OTHER SECTIONS

- A. Furnish sleeves and hanger inserts to General Contractor for placement into formwork.

PART 2 - PRODUCTS

2.1 HANGER RODS

- A. Hanger rods for single rod hangers shall conform to the following:

Pipe Size	Hanger Rod Diameter	
	Column #1	Column #2
2" and smaller	3/8"	3/8"
2-1/2" through 3-5/8"	1/2"	1/2"
4" and 5"	5/8"	1/2"

Column #1: Steel pipe.

Column #2: Copper, plastic and fiberglass reinforced pipe.

- B. Rods for double rod hangers may be reduced one size. Minimum rod diameter is 3/8 inches.
- C. Hanger rods and accessories used in mechanical spaces or otherwise dry areas shall have ASTM B633 electro-plated zinc finish.
- D. All hanger rods, nuts, washers, clevises, etc., shall have ASTM A123 hot-dip galvanized finish applied after fabrication.

2.2 PIPE HANGERS AND SUPPORTS

- A. All pipe hangers, clamps, and supports shall conform to Manufacturers Standardization Society MSS-SP-58 and 127 (where applicable).
- B. Oversize all hangers, clamps, and supports on insulated piping to allow insulation and jacket to pass through unbroken. This applies to both hot and cold pipes.

- C. Ferrous hot piping 2-1/2 inches and larger shall have steel saddles tack welded to the pipe at each support at a depth not less than the specified insulation. Factory fabricated inserts may be used.

Acceptable Products:

- Anvil - Fig. 160, 161, 162, 163, 164, 165
- Cooper/B-Line - Fig. 3160, 3161, 3162, 3163, 3164, 3165
- Erico - Model 630, 631, 632, 633, 634, 635
- Nibco/Tolco - Fig. 260-1, 261-1 1/2, 262-2, 263-2 1/2, 264-3, 265-4

- D. On all insulated piping, provide a semi-cylindrical metallic shield and fire resistant vapor barrier jacket.

- E. As an alternative to separate pipe insulation insert and saddle, properly sized integral rigid insulation sections may be used for this application.

Acceptable Products:

- Cooper/B-Line - Fig. B3380 through B3384
- Pipe Shields - A1000, A2000
- Erico - Model 124, 127

- F. Hangers in direct contact with copper pipe shall be coated with plastic with appropriate temperature range. HYDRA-ZORB clamps are permitted for this application for bare pipes within their temperature limits of -65°F to +275°F.

- G. Unless otherwise indicated, hangers shall be as follows:

1. Clevis Type:

- Service: Bare Metal Pipe
Rigid Plastic Pipe
Insulated Cold Pipe
Insulated Hot Pipe - 3 inches & Smaller

Acceptable Products:	Bare Steel, Plastic or Insulated Pipe	Bare Copper Pipe
Anvil	Fig. 260	
Cooper/B-Line	Fig. 3100	Fig. B3100C
Erico	Model 400	
Nibco/Tolco	Fig. 1	Fig. 81PVC

2. Continuous Channel with Clevis Type:

- Service: Plastic Tubing
Flexible Hose
Soft Copper Tubing

Acceptable Products:

- Cooper/B-Line - Fig. B3106, with Fig. B3106V
- Erico - Model 104, with Model 104V
- Nibco/Tolco - Fig. 1V

3. Adjustable Swivel Ring Type:
 Service: Bare Metal Pipe - 4 inches and Smaller

Acceptable Products:	Bare Steel Pipe	Bare Copper Pipe
Anvil	Fig. 69	
Cooper/B-Line	Fig. B3170NF	Fig. B3170CTC
Erico	Model FCN	102A0 Series
Nibco/Tolco	Fig. 200	Fig. 203

- H. Support may be fabricated from U-Channel strut or similar shapes. Piping less than 4" in diameter shall be secured to strut with clamps of proper design and capacity as required to maintain spacing and alignment. Strut shall be independently supported from hanger drops or building structure. Size and support shall be per manufacturer's installation requirements for structural support of piping. Clamps shall not interrupt piping insulation.

1. Strut used in mechanical spaces or otherwise dry areas shall have ASTM B633 electro-plated zinc finish.
2. Strut used in damp areas listed in hanger rods shall have ASTM A123 hot-dip galvanized finish applied after fabrication.

- I. Unless otherwise indicated, pipe supports for use with struts shall be as follows:

1. Clamp Type:

Service: Bare Metal Pipe
 Rigid Plastic Pipe
 Insulated Cold Pipe

- a. Clamps in direct contact with copper pipe shall be plastic coated.
- b. Pipes subject to expansion and contraction shall have clamps slightly oversized to allow limited pipe movement.

Acceptable Products:	Bare Steel, Plastic or Insulated Pipe	Bare Copper Pipe
Unistrut	Fig. P1100 or P2500	
Cooper/B-Line	Fig. B2000 or B2400	Fig. BVT
Nibco/Tolco	Fig. A-14 or 2STR	

2. Roller Type:

Service: Insulated Hot Pipe - 4 inches and larger.

Acceptable Products:	4" through 6"	8" and Above
Unistrut	Fig. P2474	Fig. P2474-1
Cooper/B-Line	Fig. B218	Fig. B219
Nibco/Tolco	Fig. ROL-12	Fig. ROL-13

- J. Unless otherwise shown, upper attachments for hanger rods or support struts shall be as follows:

1. Beam Clamps:

Acceptable Products:	
Anvil	Fig. 228, 292
Cooper/B-Line	Fig. B3054
Erico	Model 360
Nibco/Tolco	Fig. 329

2. Concrete Anchors: Fasten to concrete using cast-in or post-installed anchors designed per the requirements of Appendix D of ACI 318-09. Post-installed anchors shall be qualified for use in cracked concrete by ACI-355.2.
 3. Masonry Anchors: Fasten to concrete masonry units with expansion anchors or self-tapping masonry screws. For expansion anchors into hollow concrete block, use sleeve-type anchors designed for the specific application. Do not fasten in masonry joints. Do not use powder actuated fasteners, wooden plugs, or plastic inserts.
- K. Wall supports shall be used where vertical height of structure exceeds minimum spacing requirements. Install wall supports at same spacing as hangers or strut supports along vertical length of pipe runs.
- L. Welding:
1. Unless otherwise noted, hangers, clips, and auxiliary support steel may be welded in lieu of bolting, clamping, or riveting to the building structural frame. Take adequate precautions during all welding operations for fire prevention and for protecting walls and ceilings from being damaged by smoke.

2.3 FOUNDATIONS, BASES, AND SUPPORTS

A. Basic Requirements:

1. Furnish and install foundations, bases, and supports (not specifically indicated on the Drawings or in the Specifications of either the General Construction or Mechanical work as provided by another Contractor) for mechanical equipment.
2. All concrete foundations, bases and supports, shall be reinforced. All steel bases and supports shall receive a prime coat of zinc chromate or red metal primer. After completion of work, give steel supports a final coat of gray enamel.

B. Concrete Bases (Housekeeping Pads):

1. Unless shown otherwise on the drawings, concrete bases shall be nominal 4 inches thick and shall extend 3 inches on all sides of the equipment (6 inches larger than factory base).
2. Where a base is less than 12 inches from a wall, extend the base to the wall to prevent a "dirt-trap".
3. Concrete materials and workmanship required for the Contractor's work shall be provided by him. Materials and workmanship shall conform to the applicable standards of the Portland Cement Association. Reinforce with 6"x6", W1.4-W1.4 welded wire fabric. Concrete shall withstand 3,000 pounds compression per square inch at 28 days.
4. Equipment requiring bases is as follows:
 - a. Air Handling Unit

C. Supports:

1. Provide sufficient clips, inserts, hangers, racks, rods, and auxiliary steel to securely support all suspended material, equipment and conduit without sag.

2. Hang heavy equipment from concrete floors or ceilings with Architect/Engineer-approved concrete inserts, furnished and installed by the Contractor whose work requires them, except where indicated otherwise.

D. Grout:

1. Grout shall be non-shrinking premixed (Master Builders Company "Embecco"), unless otherwise indicated on the drawings or approved by the Architect/Engineer.
2. Use Mix No. 1 for clearances of 1" or less, and Mix No. 2 for all larger clearances.
3. Grout under equipment bases, around pipes, at pipe sleeves, etc., and where shown on the drawings.

2.4 OPENINGS IN FLOORS, WALLS AND CEILINGS

- A. Exact locations of all openings for the installation of materials shall be determined by the Contractor and given to the General Contractor for installation or construction as the structure is built.
- B. Coordinate all openings with other Contractors.
- C. Hire the proper tradesman and furnish all labor, material and equipment to cut openings in or through existing structures, or openings in new structures that were not installed, or additional openings. Repair all spalling and damage to the satisfaction of the Architect/Engineer. Make saw cuts before breaking out concrete to ensure even and uniform opening edges.
- D. Said cutting shall be at the complete expense of each Contractor. Failure to coordinate openings with other Contractors shall not exempt the Contractor from providing openings at his expense.
- E. Do not cut structural members without written approval of the Architect or Structural Engineer.

2.5 ROOF PENETRATIONS

- A. Seal pipes with surface temperature below 150°F penetrating single-ply roofs with conical stepped pipe flashings and stainless steel clamps equal to Portals Plus Pipe Boots. Material shall match roofing membrane.
- B. Break insulation only at the clamp for pipes between 60°F and 150°F. Seal outdoor insulation edges watertight.

2.6 SLEEVES AND LINTELS

- A. Each Contractor shall provide sleeves and lintels for all duct and pipe openings required for the Contractor's work in masonry walls and floors, unless specifically shown as being by others.
- B. Fabricate all sleeves from standard weight black steel pipe or as indicated on the drawings. Provide continuous sleeve. Cut or split sleeves are not acceptable.

- C. Fabricate all lintels for masonry walls from structural steel shapes or as indicated on the drawings. Have all lintels approved by the Architect or Structural Engineer.
- D. Sleeves through the floors on exposed risers shall be flush with the ceiling, with planed squared ends extending 1" above the floor in unfinished areas, and flush with the floor in finished areas, to accept spring closing floor plates.
- E. Sleeves shall not penetrate structural members or masonry walls without approval from the Structural Engineer. Sleeves shall then comply with the Architect/Engineer's design.
- F. Openings through unexcavated floors and/or foundation walls below the floor shall have a smooth finish with sufficient annular space around material passing through opening so slight settling will not place stress on the material or building structure.
- G. Install all sleeves concentric with pipes. Secure sleeves in concrete to wood forms. This Contractor is responsible for sleeves dislodged or moved when pouring concrete.
- H. Where pipes rise through concrete floors that are on earthen grade, provide 3/4" resilient expansion joint material (asphalt and cork) wrapped around the pipe, the full depth of concrete, at the point of penetration. Secure to prevent shifting during concrete placement and finishing.
- I. Size sleeves large enough to allow expansion and contraction movement. Provide continuous insulation wrapping.

2.7 ESCUTCHEON PLATES AND TRIM

- A. Fit escutcheons to all insulated or uninsulated exposed pipes passing through walls, floors, or ceilings of finished rooms.
- B. Escutcheons shall be heavy gauge, cold rolled steel, copper coated under a chromium plated finish, heavy spring clip, rigid hinge and latch.
- C. Install galvanized steel (unless otherwise indicated) trim strip to cover vacant space and raw construction edges of all rectangular openings in finished rooms. This includes pipe openings.

2.8 PIPE PENETRATIONS

- A. Seal all pipe penetrations. Seal non-rated walls and floor penetrations with grout or caulk. Backing material may be used.
- B. Seal fire rated wall and floor penetrations with fire seal system as specified.

2.9 PIPE ANCHORS

- A. Provide all items needed to allow adequate expansion and contraction of all piping. All piping shall be supported, guided, aligned, and anchored as required.
- B. Repair all piping leaks and associated damage. Pipes shall not rub on any part of the building.

2.10 FINISH

- A. Prime coat exposed steel hangers and supports. Hangers and supports in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

PART 3 - EXECUTION

3.1 HVAC SUPPORTS AND ANCHORS

A. General Installation Requirements:

1. Install all items per manufacturer's instructions.
2. Coordinate the location and method of support of piping systems with all installations under other Divisions and Sections of the Specifications.
3. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.

B. Supports Requirements:

1. Where building structural steel is fireproofed, all hangers, clamps, auxiliary steel, etc., which attach to it shall be installed prior to application of fireproofing. Repair all fireproofing damaged during pipe installation.
2. Set all concrete inserts in place before pouring concrete.
3. Furnish, install and prime all auxiliary structural steel for support of piping systems that are not shown on the Drawings as being by others.
4. Install hangers and supports complete with lock nuts, clamps, rods, bolts, couplings, swivels, inserts and required accessories.
5. Hangers for horizontal piping shall have adequate means of vertical adjustment for alignment.

C. Pipe Requirements:

1. Support all piping and equipment, including valves, strainers, traps and other specialties and accessories to avoid objectionable or excessive stress, deflection, swaying, sagging or vibration in the piping or building structure during erection, cleaning, testing and normal operation of the systems.
2. Do not, however, restrain piping to cause it to snake or buckle between supports or to prevent proper movement due to expansion and contraction.
3. Support piping at equipment and valves so they can be disconnected and removed without further supporting the piping.
4. Piping shall not introduce strains or distortion to connected equipment.
5. Parallel horizontal pipes may be supported on trapeze hangers made of structural shapes and hanger rods; otherwise, pipes shall be supported with individual hangers.
6. Trapeze hangers may be used where ducts interfere with normal pipe hanging.
7. Provide additional supports where pipe changes direction, adjacent to flanged valves and strainers, at equipment connections and heavy fittings.

8. Provide at least one hanger adjacent to each joint in grooved end steel pipe with mechanical couplings.
- D. Provided the installation complies with all loading requirements of truss and joist manufacturers, the following practices are acceptable:
1. Loads of 100 lbs. or less may be attached anywhere along the top or bottom chords of trusses or joists with a minimum 3' spacing between loads.
 2. Loads greater than 100 lbs. must be hung concentrically and may be hung from top or bottom chord, provided one of the following conditions is met:
 - a. The hanger is attached within 6" from a web/chord joint.
 - b. Additional L2x2x1/4 web reinforcement is installed per manufacturer's requirements.
 3. It is prohibited to cantilever a load using an angle or other structural component that is attached to a truss or joist in such a fashion that a torsional force is applied to that structural member.
 4. If conditions cannot be met, coordinate installation with truss or joist manufacturer and contact Architect/Engineer.
- E. Do not exceed 25 lbs. per hanger and a minimum spacing of 2'-0" on center when attaching to metal roof decking (limitation not required with concrete on metal deck). This 25 lbs. load and 2'-0" spacing include adjacent electrical and architectural items hanging from deck. If the hanger restrictions cannot be achieved, supplemental framing off steel framing will need to be added.
- F. Do not exceed the manufacturer's recommended maximum load for any hanger or support.
- G. Spacing of Hangers shall not exceed the compressive strength of the insulation inserts, and in no case shall exceed the following:

	<u>Pipe Material</u>	<u>Maximum Spacing</u>
1.	Steel (Std. Weight or Heavier – Liquid Service):	
	1-1/4" & under	7'-0"
	1-1/2"	9'-0"
	2"	10'-0"
	2-1/2"	11'-0"
	3"	12'-0"
2.	Steel (Std. Weight or Heavier – Vapor Service):	
	1-1/4" and under	9'-0"
	1-1/2"	12'-0"
	2" & larger	12'-0"
3.	Hard Drawn Copper & Brass (Liquid Service):	
	3/4" and under	5'-0"
	1"	6'-0"
	1-1/4"	7'-0"
	1-1/2"	8'-0"

	<u>Pipe Material</u>	<u>Maximum Spacing</u>
	2"	8'-0"
	2-1/2"	9'-0"
	3"	10'-0"
4.	Hard Drawn Copper & Brass (Vapor Service):	
	3/4" & under	7'-0"
	1"	8'-0"
	1-1/4"	9'-0"
	1-1/2"	10'-0"
	2"	11'-0"
	2-1/2" & larger	12'-0"
5.	Installation of hangers shall conform to MSS SP-58.	

END OF SECTION

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SECTION 23 05 53

HVAC IDENTIFICATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Identification of products installed under Division 23.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. 3M, Bunting, Calpico, Craftmark, Emedco, Kolbi Industries, Seton, W.H. Brady, Marking Services.

2.2 MATERIALS

- A. All pipe markers (purchased or stenciled) shall conform to ANSI A13.1. Marker lengths and letter sizes shall be at least the following:

<u>O.D. of Pipe or insulation</u>	<u>Marker Length</u>	<u>Size of Letters</u>
Up to and including 1-1/4"	8"	1/2"
1-1/2" to 2"	8"	3/4"

Plastic tags may be used for outside diameters under 3/4".

- B. Plastic Nameplates: Laminated three-layer phenolic with engraved white, 1/4" minimum letters on black background.
- C. Plastic Tags: Minimum 1-1/2" square or round laminated three-layer phenolic with engraved, 1/4" minimum white letters on black background.
- D. Plastic Pipe Markers: Semi-rigid plastic, preformed to fit around pipe or pipe covering; indicating flow direction and fluid conveyed.
- E. Underground Pipe Markers: Bright colored continuously printed plastic ribbon tape 6" wide by 3.5 mils thick, manufactured for direct burial, with aluminum foil core for location by non-ferric metal detectors and bold lettering identifying buried item.
- F. Tracer Wire:
 - 1. Single copper conductors shall be solid or stranded annealed or hard uncoated copper per UL83 and ASTM requirements. Tracer tape or copper-coated steel wire is not acceptable.
 - 2. Conductor shall be insulated with HMWPE as specified and applied in a concentric manner. The minimum at any point shall not be less than 90% of the specified average thickness in compliance with UL 83.
 - 3. Tracer wire shall be continuously spark tested at 7500 Volts DC. Other electrical and mechanical tests shall be in accordance with UL 1581.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install all products per manufacturer's recommendations.
- B. Degrease and clean surfaces to receive adhesive for identification materials.
- C. Valves:
 - 1. All valves (except shutoff valves at equipment) shall have numbered tags.
 - 2. Provide or replace numbered tags on all existing valves that are connected to new systems or that have been revised.
 - 3. Provide all existing valves used to extend utilities to this project with numbered tags. Review tag numbering sequence with the Owner prior to ordering tags.
 - 4. Secure tags with heavy duty key chain and brass "S" link or with mechanically fastened plastic straps.
 - 5. Attach to handwheel or around valve stem. On lever operated valves, drill the lever to attach tags.
 - 6. Number all tags and show the service of the pipe.
 - 7. Provide two sets of laminated 8-1/2" x 11" copies of a valve directory listing all valves, with respective tag numbers, uses, and locations. The directory shall be reviewed by the Owner and Architect/Engineer prior to laminating final copies. Laminated copies shall have brass eyelet in at least one corner for easy hanging.
- D. Pipe Markers:
 - 1. Adhesive Backed Markers: Use Brady Style 1, 2, or 3 on pipes 3" diameter and larger. Use Brady Style 4, 6, or 8 on pipes under 3" diameter. Similar styles by other listed manufacturers are acceptable. Secure all markers at both ends with a wrap of pressure sensitive tape completely around the pipe.
 - 2. Snap-on Markers: Use Seton "Setmark" on pipes up to 5-7/8" OD. Use Seton "Setmark" with nylon or Velcro ties for pipes 6" OD and over. Similar styles by other listed manufacturers are acceptable.
 - 3. Apply markers and arrows in the following locations where clearly visible:
 - a. At each valve.
 - b. On both sides of walls that pipes penetrate.
 - c. At least every 10 feet along all pipes.
 - d. On each riser and each leg of each "T" joint.
 - e. At least twice in every room and each story traversed.
 - 4. Underground Pipe Markers: Install 8" to 10" below grade, directly above buried pipes.

E. Equipment:

1. All equipment not easily identifiable such as controls, relays, gauges, etc.; and all equipment in an area remote from its function such as air handling units, exhaust fans, filters, reheat coils, dampers, etc.; shall have nameplates or plastic tags listing name, function, and drawing symbol. Do not label exposed equipment in public areas.
2. Fasten nameplates or plastic tags with stainless steel self-tapping screws or permanently bonding cement.
3. Mechanical equipment that is not covered by the U.S. National Appliance Energy Conservation Act (NAECA) of 1987 shall carry a permanent label installed by the manufacturer stating that the equipment complies with the requirements of ASHRAE 90.1.

F. Tracer Wire:

1. Tracer wire shall be installed on top of all non-metallic buried utilities.
2. Tracer wire shall be taped directly to plastic water or drain pipe.
3. Tracer wire shall not be fastened directly or indirectly to gas piping.
4. Tracer wire when attached shall be secured to the pipe a minimum of every 10 feet and at all changes of direction.
5. Tape shall be Polyken "930-35", Protecto-Wrap "310", or approved equal.
6. Tracer wire shall be continuous between boxes and shall be tested for continuity.
7. Splices in tracer wire shall be made with a water proof splice kit to prevent corrosion. **Wire nuts shall not be used.**
8. The tracer wire shall daylight to grade through a 2" PVC conduit, at the point of the utility entrance to building. PVC conduit shall be capped and labeled as future contact point to locate the utility.

3.2 SCHEDULE

A. Pipes to be marked:

<u>Pipe Service</u>	<u>Lettering Color</u>	<u>Background Color</u>
Cold Water Supply	White	Green
Cold Water Return	White	Green
Condensate Drain	Black	Yellow
Tracer Wire - All other buried types	---	Green

END OF SECTION

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SECTION 23 05 93

TESTING, ADJUSTING, AND BALANCING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Testing, adjusting, and balancing of air systems.
- B. Testing, adjusting, and balancing of cooling systems.
- C. Testing, adjusting, and balancing of plumbing systems.
- D. Measurement of final operating condition of HVAC systems.

1.2 QUALITY ASSURANCE

- A. Agency shall be a company specializing in the adjusting and balancing of systems specified in this section with minimum three years' experience. Perform work under supervision of AABC Certified Test and Balance Engineer, NEBB Certified Testing, Balancing and Adjusting Supervisor, SMARTA Certified Air and Hydronic Balancer, or TABB Certified Supervisor.
- B. Work shall be performed in accordance with the requirements of the references listed at the start of this section.

1.3 REFERENCES

- A. AABC - National Standards for Total System Balance, 2002.
- B. ADC – Test Code for Grilles, Registers, and Diffusers.
- C. AMCA – Publication 203-90; Field Performance Measurement of Fan Systems.
- D. ASHRAE - 2003 HVAC Applications Handbook; Chapter 37, Testing, Adjusting and Balancing.
- E. ASHRAE/ANSI - Standard 111-1988; Practices for Measurement, Testing, Adjusting and Balancing of Building HVAC&R Systems.
- F. NEBB - Procedural Standards for Testing, Adjusting and Balancing of Environmental Systems, Sixth Edition, 1998.
- G. SMACNA - HVAC Systems; Testing, Adjusting and Balancing, Third Edition, 2002.
- H. TABB – International Standards for Environmental Systems Balance.

1.4 SUBMITTALS

- A. Submit four (4) certified copies of test reports to the Architect/Engineer for approval in soft cover, 3-hole binder manuals, with cover identification. Include index page and indexing tabs.

1.5 REPORT FORMS

- A. Submit reports on AABC, SMACNA or NEBB forms. Use custom forms approved by the Architect/Engineer when needed to supply specified information.

- B. Include in the final report a schematic drawing showing each system component, including balancing devices, for each system. Each drawing shall be included with the test reports required for that system. The schematic drawings shall identify all testing points and cross-reference these points to the report forms and procedures.
- C. Refer to PART 4 for required reports.

1.6 WARRANTY/GUARANTEE

- A. The TAB Contractor shall include an extended warranty of 90 days after owner receipt of a completed balancing report, during which time the Owner may request a recheck of terminals, or resetting of any outlet, coil, or device listed in the test report. This warranty shall provide a minimum of 8 man-hours of onsite service time. If it is determined that the new test results are not within the design criteria, the balancer shall rebalance the system according to design criteria.
- B. Warranty/Guarantee must meet one of the following programs: TABB International Quality Assurance Program, AABC National Project Performance Guarantee, NEBB's Conformance Certification.

1.7 SCHEDULING

- A. Coordinate schedule with other trades. Provide a minimum of seven days' notice to all trades and the Architect/Engineer prior to performing each test.

PART 2 - PRODUCTS

NOT APPLICABLE

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

- A. All procedures must conform to a published standard listed in the References article of this section. All equipment shall be adjusted in accordance with the manufacturer's recommendations. Any system not listed in this specification but installed under the contract documents shall be balanced using a procedure from a published standard listed in the References article.
- B. Recorded data shall represent actual measured or observed conditions.
- C. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing is complete, close probe holes and patch insulation with new materials as specified. Restore vapor barrier and finish as specified.
- D. Permanently mark setting of valves, dampers, and other adjustment devices allowing for settings to be restored. Set and lock memory stops.
- E. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, plugging test holes, and restoring thermostats to specified settings.

- F. The Balancing Contractor shall measure terminal air box air flow, and the TCC shall adjust DDC readout to match. Refer to Section 23 09 00 for additional information.

3.2 EXAMINATION

- A. Before beginning work, verify that systems are complete and operable. Ensure the following:
 - 1. General Equipment Requirements:
 - a. Equipment is safe to operate and in normal condition.
 - b. Equipment with moving parts is properly lubricated.
 - c. Temperature control systems are complete and operable.
 - d. Proper thermal overload protection is in place for electrical equipment.
 - e. Direction of rotation of all fans and pumps is correct.
 - f. Access doors are closed and end caps are in place.
 - 2. Duct System Requirements:
 - a. All filters are clean and in place. If required, install temporary media.
 - b. Duct systems are clean and free of debris.
 - c. Fire/smoke and manual volume dampers are in place, functional and open.
 - d. Air outlets are installed and connected.
 - e. Duct system leakage has been minimized.
 - 3. Pipe System Requirements:
 - a. Coil fins have been cleaned and combed.
 - b. Hydronic systems have been cleaned, filled, and vented.
 - c. Strainer screens are clean and in place.
 - d. Shutoff, throttling and balancing valves are open.
- B. Report any defects or deficiencies to Architect/Engineer.
- C. Promptly report items that are abnormal or prevent proper balancing.
- D. If, for design reasons, system cannot be properly balanced, report as soon as observed.
- E. Beginning of work means acceptance of existing conditions.

3.3 PREPARATION

- A. Provide instruments required for testing, adjusting, and balancing operations. Make instruments available to the Architect/Engineer for spot checks during testing.
- B. Instruments shall be calibrated within six months of testing performed for project, or more recently if recommended by the instrument manufacturer.

3.4 INSTALLATION TOLERANCES

- A. $\pm 10\%$ of scheduled values:
 - 1. Adjust air inlets and outlets to $\pm 10\%$ of scheduled values.
 - 2. Adjust piping systems to $\pm 5\%$ of design values.

3. Adjust supply and exhaust air-handling systems for space pressurization to $\pm 5\%$ of scheduled values, and to provide proper pressurization.
- B. Adjust supply, return, and exhaust air-handling systems to $+10\%$ / -5% of scheduled values.

3.5 ADJUSTING

- A. After adjustment, take measurements to verify balance has not been disrupted or that disruption has been rectified.
- B. Once balancing of systems is complete, at least one damper or valve must be 100% open.
- C. After testing, adjusting and balancing are complete, operate each system and randomly check measurements to verify system is operating as reported in the report. Document any discrepancies.
- D. Contractor responsible for each motor shall also be responsible for replacement sheaves. Coordinate with contractor.
- E. Contractor responsible for pump shall trim impeller to final duty point as instructed by this contractor on all pumps not driven by a VFD. Coordinate with contractor.

3.6 SYSTEM PERFORMANCE REPORT

- A. After the conclusion of balancing operations, utilize the building DDC system or install portable data loggers to simultaneously record temperatures and humidity during summer and winter conditions for a seven-day period, continuous over a weekend, and including at least one period of operation at outside conditions within 5°F wet bulb temperature of maximum summer design condition and within 10°F dry bulb temperature of minimum winter design condition.
- B. Design Conditions:
 1. Summer: 89°F DB ___ °F WB
 2. Winter: -15°F DB
- C. Architect/Engineer will direct all test locations.
- D. Report of test results shall include original recording and three reproductions.

3.7 SUBMISSION OF REPORTS

- A. Fill in test results on appropriate forms.

PART 4 - SYSTEMS TO BE TESTED, ADJUSTED AND BALANCED

4.1 GENERAL REQUIREMENTS

- A. Title Page:
 1. Project name.
 2. Project location.
 3. Project Architect.

4. Project Engineer (KJWW Engineering Consultants).
5. Project General Contractor.
6. TAB Company name, address, phone number.
7. TAB Supervisor's name and certification number.
8. TAB Supervisor's signature and date.
9. Report date.

B. Report Index

C. General Information:

1. Test conditions.
2. Nomenclature used throughout report.
3. Notable system characteristics/discrepancies from design.
4. Test standards followed.
5. Any deficiencies noted.
6. Quality assurance statement.

D. Instrument List:

1. Instrument.
2. Manufacturer, model, and serial number.
3. Range.
4. Calibration date.

4.2 AIR SYSTEMS

A. Air Moving Equipment:

1. General Requirements:
 - a. Drawing symbol.
 - b. Location.
 - c. Manufacturer, model, arrangement, class, discharge.
 - d. Fan RPM.
 - e. Multiple RPM fan curve with operating point marked. (Obtain from equipment supplier).
 - f. Final frequency of motor at maximum flow rate (on fans driven by VFD).
2. Flow Rate:
 - a. Supply flow rate (cfm): specified and actual.
 - b. Return flow rate (cfm): specified and actual.
3. Pressure Drop and Pressure:
 - a. Filter pressure drop: specified and actual.
 - b. Total static pressure: specified and actual. (Indicate if across fan or external to unit).
 - c. Inlet pressure.
 - d. Discharge pressure.

B. Fan Data:

1. Drawing symbol.
2. Location.
3. Manufacturer and model.
4. Flow rate (cfm): specified and actual.
5. Total static pressure: specified and actual. (Indicate measurement locations).
6. Inlet pressure.

7. Discharge pressure.
8. Fan RPM.

C. Electric Motors:

1. Drawing symbol of equipment served.
2. Manufacturer, Model, Frame.
3. Nameplate: HP, phase, service factor, RPM, operating amps, efficiency.
4. Measured: Amps in each phase.

4.3 COOLING SYSTEMS

A. Cooling Coils:

1. General Requirements:
 - a. Drawing symbol.
 - b. Service.
 - c. Location.
 - d. Size.
 - e. Manufacturer and model.
2. Temperature:
 - a. Entering air DB temperature: specified and actual.
 - b. Entering air WB temperature: specified and actual.
 - c. Leaving air DB temperature: specified and actual.
 - d. Leaving air WB temperature: specified and actual.
 - e. Entering water temperature: specified and actual.
 - f. Leaving water temperature: specified and actual.
3. Flow Rate:
 - a. Flow rate (cfm): specified and actual.
 - b. Water flow rate (gpm): specified and actual.
4. Pressure Drop and Pressure:
 - a. Water pressure drop: specified and actual.
 - b. Air pressure drop: specified and actual.
5. Energy:
 - a. Air Btuh (cfm x enthalpy change x 4.5).
 - b. Water Btuh (gpm x temperature drop x 500). Repeat tests if not within 10% of air Btuh.

B. Terminal Heat Transfer Units:

1. General Requirements:
 - a. Drawing symbol.
 - b. Location.
 - c. Manufacturer and model.
 - d. Include air data only for forced air units.
2. Temperature:
 - a. Entering air DB temperature: specified and actual.
 - b. Leaving air DB temperature: specified and actual.
 - c. Entering water temperature: specified and actual.
 - d. Leaving water temperature: specified and actual.
3. Flow rate:
 - a. Flow rate (cfm): specified and actual.
 - b. Water flow (gpm): specified and actual.

4. Energy:
 - a. Air Btuh ($\text{cfm} \times \text{temperature rise} \times 1.09$).
 - b. Water Btuh ($\text{gpm} \times \text{temperature drop} \times 500$). Repeat tests if not within 10% of air Btuh.

4.4 PLUMBING SYSTEMS

A. Balancing Valve:

1. Drawing symbol.
2. Service.
3. Location.
4. Size.
5. Manufacturer and model.
6. Flow rate (gpm): specified and actual.
7. Pressure drop: specified and actual.

B. Gas Fired Water Heater:

1. Drawing symbol.
2. Service.
3. Location.
4. Manufacturer and model.
5. Capacity (Btuh): specified, nameplate, and actual.
6. Entering water temperature: specified and actual.
7. Leaving water temperature: specified and actual.
8. Pressure Drop: specified and actual.
9. Control Setting: specified and actual.

END OF SECTION

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SECTION 23 07 13

DUCTWORK INSULATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Ductwork Insulation.
- B. Insulation Jackets.

1.2 QUALITY ASSURANCE

- A. Applicator: Company specializing in ductwork insulation application with five years minimum experience. When requested, installer shall submit manufacturer's certificate indicating qualifications.
- B. Materials: UL listed in Category HNKT; flame spread/smoke developed rating of 25/50 in accordance with ASTM E84, NFPA 255, or UL 723.
- C. Adhesives: UL listed, meeting NFPA 90A/90B requirements.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS - INSULATION

- | | | |
|----|--------------------------------------|------------------------|
| A. | Certainteed Manson. | Type A, B, and C |
| B. | Knauf Fiber Glass Corporation. | Type A, B, and C |
| C. | Johns Manville/Schuller. | Type A, B, C, D, and G |
| D. | Owens/Corning Fiberglas Corporation. | Type A, B, and C |
| E. | 3M/Firebarrier. | Type F Only |
| F. | Thermal Ceramics Firemaster. | Type F Only |
| G. | Unifrax Fyre Wrap | Type F Only |

2.2 MATERIALS

- A. Type A: Flexible Fiberglass - Outside Wrap; ANSI/ASTM C553; commercial grade; 0.28 maximum 'K' value at 75°F; foil scrim kraft facing, 1.0 lb./cu. ft. density.
- B. Type B: Semi-rigid Fiberglass Board Wrap - Outside Application; ANSI/ASTM C612, Class 1; 0.25 maximum 'K' value at 75°F; foil scrim kraft facing, 3 lb./cu. ft. density.

2.3 JACKETS

- A. Vapor Barrier Jackets: Kraft reinforced foil scrim vapor barrier with self-sealing adhesive joints. Beach puncture resistance ratio of at least 25 units. Tensile strength: 35 psi minimum. Single, self-seal acrylic adhesive on longitudinal jacket laps and butt strips.

2.4 JACKET COVERINGS

- A. Aluminum Jackets: ASTM B209; 0.016" thick; smooth or embossed stucco finish with Z edge seams and aluminum bands for outdoor use. Where colored jacket covers are called for, provide factory-applied hard film acrylic paint in color selected by Architect.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install materials in accordance with manufacturer's instructions, codes, and industry standards.
- B. Install materials after ductwork has been tested.
- C. Clean surfaces for adhesives.
- D. Provide insulation with vapor barrier when air conveyed may be below ambient temperature.
- E. Exterior Duct Wrap - Flexible, Type A:
 - 1. Apply with edges tightly butted.
 - 2. Cut slightly longer than perimeter of duct to insure full thickness at corners. Do not wrap excessively tight.
 - 3. Seal joints with adhesive backed tape.
 - 4. Apply so insulation conforms uniformly and firmly to duct.
 - 5. Provide high-density insulation inserts at trapeze duct hangers and straps to prevent crushing of insulation. Maintain continuous vapor barrier through the hanger.
 - 6. Tape all joints with Royal Tapes #RT 350 (216-439-7229), Venture Tape 1525CW, or Compac Type FSK. No substitutions will be accepted without written permission from the Architect/Engineer.
 - 7. Press tape tightly to the duct covering with a squeegee for a tight continuous seal. Fish mouths and loose tape edges are not acceptable.
 - 8. Staples may be used, but must be covered with tape.
 - 9. Vapor barrier must be continuous.
 - 10. Mechanically fasten on 12" centers at bottom of ducts over 24" wide and on all sides of vertical ducts.
- F. Semi Rigid Fiberglass Board Wrap - Type B (Indoor Use):
 - 1. Impale on pins welded to the duct and secured with speed clips. Clip pins off close to speed clips.
 - 2. Space pins as needed to hold insulation firmly against duct, but not less than one pin per square foot. Pins must be long enough to avoid compressing the insulation.
 - 3. Seal all joints and speed clips with glass fabric set in adhesive or a 3" wide strip of Royal Tapes #RT 350 (216-439-7229), Venture Tape 1525CW, or Compac Type FSK facing tape.

4. For small areas, secure insulation with adhesive over the entire surface of the duct. Use adhesive in addition to pins as needed to prevent sagging on horizontal surfaces.

G. Continue insulation with vapor barrier through penetrations unless code prohibits.

3.2 SCHEDULE

A. Refer to Section 23 31 00 for scheduling of insulation.

END OF SECTION

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SECTION 23 07 19

HVAC PIPING INSULATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Piping Insulation.
- B. Insulation Jackets.

1.2 QUALITY ASSURANCE

- A. Applicator: Company specializing in piping insulation application with five years minimum experience.
- B. Materials: Flame spread/smoke developed rating of 25/50 in accordance with ASTM E84, NFPA 255, or UL 723 (where required).

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Certainteed Manson.
- B. Knauf Fiber Glass.
- C. Johns Manville/Schuller.
- D. Owens/Corning Fiberglas Corporation.
- E. Schuller International, Inc.
- F. Armstrong

2.2 INSULATION

- A. Type A: Glass fiber; ANSI/ASTM C547; 0.24 maximum 'K' value at 75°F; non-combustible. All purpose, white kraft jacket bonded to aluminum foil and reinforced with fiberglass yarn, 25/50 flame spread/smoke developed rating when tested in accordance with ASTM E84 (UL 723).

2.3 VAPOR BARRIER JACKETS

- A. Kraft reinforced foil vapor barrier with self-sealing adhesive joints. Beach puncture resistance ratio of at least 50 units. Tensile strength: 35 psi minimum. Single, self-seal acrylic adhesive on longitudinal jacket laps and butt strips.

2.4 JACKET COVERINGS

- A. Plastic Jackets and Fitting Covers: High impact, glossy white, 0.020" thick, self-extinguishing plastic. Suitable for use indoors or outdoors with ultraviolet inhibitors. Suitable for -40°F to 150°F. 25/50 maximum flame spread/smoke developed.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Install insulation after piping has been tested. Pipe shall be clean, dry and free of rust before applying insulation.

3.2 INSTALLATION

A. General Installation Requirements:

1. Install materials per manufacturer's instructions, building codes and industry standards.
2. Continue insulation with vapor barrier through penetrations. This applies to all insulated piping. Maintain fire rating of all penetrations.
3. On all insulated piping, provide at each support an insert of same thickness and contour as adjoining insulation, between the pipe and insulation jacket, to prevent insulation from sagging and crushing. The insert shall be suitable for planned temperatures, be suitable for use with specific pipe material, and shall be a 180° cylindrical segment the same length as metal shields. Inserts shall be a cellular glass (for all temperature ranges) or molded hydrous calcium silicate (for pipe with operating temperatures above 70°F, with a minimum compressive strength of 50 psi. Factory fabricated inserts may be used. Rectangular blocks, plugs, or wood material are not acceptable. Temporary wood blocking may be used by the Piping Contractor for proper height; however, these must be removed and replaced with proper inserts by the Insulation Contractor.
4. Neatly finish insulation at supports, protrusions, and interruptions.
5. Install metal shields between all hangers or supports and the pipe insulation. Shields shall be galvanized sheet metal, half-round with flared edges. Adhere shields to insulation. On cold piping, seal the shields vapor-tight to the insulation as required to maintain the vapor barrier, or add separate vapor barrier jacket.
6. Shields shall be at least the following lengths and gauges:

	Pipe Size	Shield Size
a.	1/2" to 3"	12" long x 18 gauge
7. All piping and insulation that does not meet 25/50 that is located in an air plenum shall have written approval from the Authority Having Jurisdiction and the local fire department for authorization and materials approval. If approval has been allowed, the non-rated material shall be wrapped with a product that has passed ASTM E84 and/or NFPA 255 testing with a rating of 25/50 or below.

B. Insulated Piping Operating Below 60°F:

1. Insulate fittings, valves, unions, flanges, strainers, flexible connections, flexible hoses, and expansion joints. Seal all penetrations of vapor barrier.
2. All balance valves with fluid operating below 60°F shall be insulated with a removable plug wrapped with vapor barrier tape to allow reading and adjusting of the valve.

C. Exposed Piping:

1. Locate and cover seams in least visible locations.
2. Where exposed insulated piping extends above the floor, provide a sheet metal guard around the insulation extending 12" above the floor. Guard shall be 0.016" cylindrical smooth or stucco aluminum and shall fit tightly to the insulation.

3.3 INSULATION

A. Type A Insulation:

1. All Service Jackets: Seal all longitudinal joints with self-seal laps using a single pressure sensitive adhesive system. Do not staple.
2. Insulation without self-seal lap may be used if installed with Benjamin Foster 85-20 or equivalent Chicago Mastic, 3M or Childers lap adhesive.
3. Apply insulation with laps on top of pipe.
4. Fittings, Valve Bodies and Flanges: For 4" and smaller pipes, insulate with 1 lb. density insulation wrapped under compression to a thickness equal to the adjacent pipe insulation. For pipes over 4", use mitered segments of pipe insulation. Finish with preformed plastic fitting covers. Secure fitting covers with pressure sensitive tape at each end. Overlap tape at least 2" on itself. For pipes operating below 60°F, seal fitting covers with vapor retarder mastic in addition to tape.

3.4 JACKET COVER INSTALLATION

A. Plastic Covering:

1. Provide vapor barrier as specified for insulation type. Cover with plastic jacket covering. Position seams to shed water.
2. Solvent weld all joints with manufacturer recommended cement.
3. Overlap all laps and butt joints 1-1/2" minimum. Repair any loose ends that do not seal securely. Solvent weld all fitting covers in the same manner. Final installation shall be watertight.
4. Use plastic insulation covering on all exposed pipes including, but not limited to:
 - a. All exposed piping below 8'-0" above floor.
 - b. All piping in mechanical rooms and/or tunnels that is subject to damage from normal operations. (Example: Piping that must be stepped over routinely.)
5. Elastomeric piping insulation may have two coats of latex paint instead of plastic jacket.
6. Use colored plastic covering on all piping.

3.5 SCHEDULE

Piping System	Insulation Type/Thickness	
A. Chilled Water Supply & Return All Sizes (located in air conditioned spaces)	A / 1-1/2"	OR J / 1"
B. Cooling Coil Condensate Drains	B / 1/2"	

END OF SECTION

SECTION 23 09 00

CONTROLS

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PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Control Devices, Components, Wiring and Material.
- B. Instructions for Owners.

1.2 QUALITY ASSURANCE

- A. Manufacturer: Company specializing in manufacturing the products specified in this Section with minimum five years' experience.
- B. Technician: Minimum five years' experience installing commercial temperature control systems.

1.3 SUBMITTALS

A. Equipment Coordination:

1. The Controls Contractor shall obtain approved equipment submittals from other contractors to determine equipment wiring connections, to choose appropriate controllers, and to provide programming.
2. Control valve selections shall be based on flow rates shown in approved shop drawings.
3. Coordinate the control interface of all equipment with the equipment manufacturers prior to submittal submission.

B. Shop Drawings:

1. Submit shop drawings per Section 23 05 00. In addition, submit an electronic copy of the shop drawings in Adobe Acrobat (.pdf) format to the Owner for review.
2. Cross-reference **all** control components and point names in a single table located at the beginning of the submittal with the **identical** nomenclature used in this section.
3. Sequences: Submit a complete description of the operation of the control system, including sequences of operation. The description shall include and reference a schematic diagram of the controlled system. **The wording of the control sequences in the submittal shall match verbatim that included in the construction documents to ensure there are no sequence deviations from that intended by the Architect/Engineer. Clearly highlight any deviations from the specified sequences on the submittals.**
4. Damper Schedule: Schedule shall include a separate line for each damper and a column for each of the damper attributes:
 - a. Damper Identification Tag.
 - b. Location.
 - c. Damper Type.

- d. Damper Size.
- e. Duct Size.
- f. Arrangement.
- g. Blade Type.
- h. Velocity.
- i. Pressure Drop.
- j. Fail Position.
- k. Actuator Identification Tag.
- l. Actuator Type.
- m. Mounting.

5. Valve Schedule: Valve manufacturer shall size valves and create a valve schedule. Schedule shall include a separate line for each valve and a column for each of the valve attributes:

- a. Valve Identification Tag.
- b. Location.
- c. Valve Type.
- d. Valve Size.
- e. Pipe Size.
- f. Configuration.
- g. Flow Characteristics.
- h. Capacity.
- i. Valve C_v .
- j. Design Pressure Drop.
- k. Pressure Drop at Design Flow.
- l. Fail Position.
- m. Close-off Pressure.
- n. Valve and Actuator Model Number and Type.

1.4 DELIVERY, STORAGE AND HANDLING

- A. Provide factory-shipping cartons for each piece of equipment and control device. Maintain cartons through shipping, storage, and handling as required to prevent equipment damage. Store equipment and materials inside and protected from weather.
- B. Factory-Mounted Components: Where control devices specified in this section are indicated to be factory mounted on equipment, arrange for shipping control devices to unit manufacturer.

1.5 PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION

- A. Control Valves.
- B. Temperature Sensor Sockets.
- C. Gauge Taps.
- D. Automatic Dampers.

PART 2 - PRODUCTS

2.1 CONTROL DAMPERS

- A. Thermally Insulated Stainless Steel Control Damper:
 - 1. Shall be licensed to bear the AMCA Certified Rating Seal.

2. Test leakage and pressure drop per AMCA 500.
3. Frame: Hat-shaped channel, minimum 10 gauge Type 304 stainless steel (304L or 316L for welded duct). Caulk or weld seams to prevent leakage.
4. Bearings: Provide thrust bearings for vertical damper applications.
5. Blades: Minimum 12 gauge Type 304 stainless steel construction. No seals are required.
6. Linkage: Stainless steel, minimum 1/2" diameter shaft through 12", 3/4" shaft through 24", 1" shaft over 24" size. Stainless steel bearings. Shaft shall be securely keyed to blades and of sufficient length to mount direct-coupled actuator. Install damper with the shaft horizontal to the floor. Damper manufacturer shall provide drive pin extensions and outboard bearing support brackets as required.
7. Maximum Leakage: 26 cfm maximum at 1" w.c. pressure differential for a 24"x24" damper.
8. Maximum Pressure Drop: 0.15" for 6,280 cfm through a 24" damper (2,000 fpm).

2.2 DAMPER ACTUATORS

A. Damper Actuators - Electronic - Spring Return:

1. Damper actuators shall be UL listed, electronic direct coupled with spring return to normal position for modulating or two-position control as noted in the sequence of control. Actuator shall be 24 VAC with proportional control, electronic overload protection to prevent actuator damage due to over-rotation and "V" bolt clamp with matching "V" toothed cradle (single bolt or setscrew fasteners not acceptable).
2. Following power interruption, spring return mechanism shall close the damper. Mechanical spring shall be rated for a minimum of 60,000 full cycles. Provide breathable membrane in actuator housing to compensate for pressure differential and allow for 95% non-condensing relative humidity in the airstream.
3. Mount actuators with motor outside of airstream whenever possible. Unit casings shall have housing with proper weather, corrosive, or explosion-proof construction as required by application.
4. Actuators shall be rated for 60,000 full cycles at rated torque with 2-year unconditional warranty. Size actuators per damper manufacturer's recommendations.
5. Provide end switches as required for the sequence of operation.
6. Provide analog feedback signal for positive position indication. Refer to FMCS points list.

2.3 HYDRONIC CONTROL VALVES

A. General:

1. Size modulating valves to provide a pressure drop at full flow of 1 to 4 psi, except boiler three-way and cooling tower bypass valves shall not have a pressure drop over 2 psi.
2. Two-way valves shall be 100% tight-closing.
3. Modulating two-way valves shall have equal percentage flow characteristics.
4. Piping geometry correction factors for C_v ratings shall be used and stated for ball valves, butterfly valves, or non-characterized valves.

B. Modulating:

1. Globe 1/2" to 2":
 - a. Design Pressure: 250 psi
Design Temperature: 212°F
Design Flow Differential Pressure Rating: 35 psi
 - b. Bronze or brass body, trim and plug; stainless steel stem; stainless steel or bronze seat; EPDM or PTFE packing; threaded ends.
2. Ball 2" and under:
 - a. Design Pressure: 400 psi
Design Temperature: 212°F
Design Flow Differential Pressure Rating: 35 psi
 - b. Bronze or brass body, stainless steel stem, chrome plated brass or stainless steel full port ball, PTFE or RTFE seats and seals, screwed ends (solder ends are acceptable only if rated for soldering in line with 470°F melting point of 95-5 solder).

2.4 VALVE ACTUATORS

A. General:

1. Actuators shall be sized to operate the valve through its full range of motion and shall close against pump shutoff pressure without producing audible noise at any valve position.
2. Provide visual position indication.
3. Mount actuator directly on valve or provide linear motion assembly as required for valve type.

B. Valve Actuators - Electronic:

1. Actuator shall be UL listed and provided with NEMA housing for applicable environment, electronic overload protection to prevent actuator damage due to

over-rotation, and "V" bolt clamp with matching "V" toothed cradle (single bolt or setscrew fasteners not acceptable).

2. Actuators shall be rated for 60,000 full stroke cycles at rated torque. Stall motor not acceptable.
3. Tri-state/floating actuators shall have auto-zeroing function for realigning valve position.
4. Proportional actuator position shall be proportional to analog or pulse width modulating signal from electronic control system.
5. Spring return actuators shall have an internal spring return mechanism. Non-mechanical forms of fail-safe operation are not acceptable.
6. Provide analog feedback signal for positive position indication as required by control diagrams.

2.5 CONTROL INSTRUMENTATION

A. Temperature Measuring Devices:

1. Electric Thermostats:

- a. Single Temperature - Low Voltage Electric: Integral manual ON/OFF/AUTO selector switch, minimum dead band of 5°F, anticipator circuits, concealed temperature adjustment, locking cover, 24 V control transformer (if not included with unit under control), single or double pole as required.

2. Low Limit Switch:

- a. Provide one foot of sensing element for each one square foot of coil area, maximum element length 25 feet, of the vapor tension type, so that any point along the entire length of measuring element is capable of triggering the switch.
- b. Provide 3" minimum radius capillary support clips at each turn.
- c. Furnish each thermostat with one single pole, single throw normally-opened switch and one single pole, single throw normally-closed auxiliary switch.
- d. Setpoint range shall be 15°F to 55°F with a permanent stop at 35°F.
- e. Differential shall be fixed at approximately 5°F and supplied with manual reset.

B. Temperature Sensors:

1. Room Temperature Sensor:

- a. Sensor with Setpoint Adjustment: Two-piece construction, ventilated plastic enclosure, off-white color, thermistor sensing element or resistance temperature device (RTD), 45°F to 90°F operating range, ± 0.50°F accuracy, with exposed single setpoint adjustment (no numeric

temperature scale – provide with a single warmer/cooler or red/blue visual scale), no override button.

C. Miscellaneous Devices:

1. Control Relays:

- a. Form "C" contacts rated for the application with "push-to-test" contact transfer feature and an integral LED to indicate coil energization.
- b. Mount all relays and power supplies in a NEMA 12 enclosure beside the controlled device and clearly label their functions.

2.6 CONDUIT

- A. Conduit and Fittings: Refer to Electrical Section 26 05 33 for materials and sizing.

2.7 WIRE AND CABLE

- A. Wire and Cable Materials: Refer to Electrical Section 26 05 13 for wire and cable materials.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION

- A. Verify that systems are ready to receive work. Beginning of installation means installer accepts existing conditions.
- B. Install system and materials in accordance with manufacturer's instructions.
- C. Install all operators, sensors, and control devices where accessible for service, adjustment, calibration, and repair. Do not install devices where blocked by piping or ductwork. Devices with manual reset or limit adjustments shall be installed below 6'-0" if practical to allow inspection without using a ladder.
- D. Verify locations of wall-mounted devices (such as thermostats, temperature and humidity sensors, and other exposed sensors) with drawings and room details before installation. Coordinate mounting heights to be consistent with other wall-mounted devices. Maximum height above finished floor shall not exceed 48".
- E. Provide valves over 3/4" size with position indicators and pilot positioners where sequenced with other controls.
- F. Mount control panels adjacent to associated equipment on vibration-free walls or freestanding angle iron supports. One cabinet may accommodate more than one system in same equipment room.
- G. After completion of installation, test and adjust control equipment.
- H. Check calibration of instruments. Recalibrate or replace.
- I. Furnish and install conduit, wire, and cable per the National Electric Code, unless noted otherwise in this section.

- J. All hardware, software, equipment, accessories, wiring (power and sensor), piping, relays, sensors, power supplies, transformers, and instrumentation required for a complete and operational FMCS system, but not shown on the electrical drawings, are the responsibility of the TCC.
- K. Labels For Control Devices:
 - 1. Provide labels indicating service of all control devices in panels and other locations.
 - 2. Labels may be made with permanent marking pen in the control panels if clearly legible.
 - 3. Use engraved labels for items outside panel such as outside air thermostats.
 - 4. Labels are not required for room thermostats, damper actuators and other items where their function is obvious.

3.2 CONDUIT INSTALLATION

- A. Conduit Sizing and Installation: Refer to Electrical Section 26 05 33 for execution and installation.
 - 1. Thermostats/temperature sensors shall be installed in junction boxes, flush with the wall, and shall be coordinated for orientation with Architect/Engineer.

3.3 WIRE AND CABLE INSTALLATION

- A. Wire and Cable Materials Installation: Refer to Electrical Section 26 05 13 for execution and installation.
- B. Field Quality Control:
 - 1. Inspect wire and cable for physical damage and proper connection.
 - 2. Torque test conductor connections and terminations to manufacturer's recommended values.
 - 3. Perform continuity test on all conductors.
 - 4. Protection of cable from foreign materials:
 - a. It is the Contractor's responsibility to provide adequate physical protection to prevent foreign material application or contact with any cable type. Foreign material is defined as any material that would negatively impact the validity of the manufacturer's performance warranty. This includes, but is not limited, to overspray of paint (accidental or otherwise), drywall compound, or any other surface chemical, liquid or compound that could come in contact with the cable, cable jacket or cable termination components.
 - b. Overspray of paint on any cable, cable jacket or cable termination component will not be accepted. It shall be the Contractor's responsibility to replace any component containing overspray, in its entirety, at no additional cost to the project. Cleaning of the cables with harsh

chemicals is not allowed. This requirement is regardless of the PASS/FAIL test results of the cable containing overspray. Should the manufacturer and warrantor of the structured cabling system desire to physically inspect the installed condition and certify the validity of the structured cabling system (via a signed and dated statement by an authorized representative of the structured cabling manufacturer), the Owner may, at their sole discretion, agree to accept said warranty in lieu of having the affected cables replaced. In the case of plenum cabling, in addition to the statement from the manufacturer, the Contractor shall also present to the Owner a letter from the local Authority Having Jurisdiction stating that they consider the plenum rating of the cable to be intact and acceptable.

3.4 PREPARATION FOR BALANCING

- A. Verify that all dampers are in the position indicated by the controller (e.g., open, closed or modulating).
- B. Check the calibration and setpoints of all controllers.
- C. Check the locations of all thermostats and humidistats for potential erratic operation from outside influences such as sunlight, drafts, or cold walls.
- D. Check that all sequences operate as specified. Verify that no simultaneous heating and cooling occurs, unless specified. Observe that heating cannot begin at TAB reheat terminals until the unit is at the minimum cfm.
- E. Verify the operation of all interlock systems.

3.5 TEST AND BALANCE COORDINATION

- A. The Contractor shall furnish a single set of all tools necessary to interface to the control system for test and balance purposes.
- B. The tools used during the test and balance process shall be returned at the completion of the testing and balancing.

3.6 DEMONSTRATION AND ACCEPTANCE

- A. At completion of installation, provide two days minimum instruction for operators. Demonstrate operation of all controls and systems. Describe the normal operation of all equipment.

3.7 TRAINING

- A. On-Site:
 - 1. After completion of commissioning, the manufacturer shall provide 2 hours of training. The training course shall enable the Owner's representatives to perform Day-to-Day Operations as defined herein. A factory-trained instructor with experience in presenting the training material and the system programmer for this project shall perform the training.

END OF SECTION

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SECTION 23 09 13

INSTRUMENTATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Pressure Gauge.
- B. Pressure Gauge Accessories.
- C. Thermometers.
- D. Test Plugs.
- E. Static and Differential Airflow Pressure Gauges.

1.2 SUBMITTALS

- A. Submit shop drawings per Section 23 05 00. Include list that indicates use, operating range, total range and location for manufactured components.

PART 2 - PRODUCTS

2.1 PRESSURE GAUGES

- A. Gauges shall be 4-1/2" diameter with phenolic turret style, glycerin filled, safety case with phosphor bronze or 316 stainless steel bourdon tube, brass socket for air, steam, water or oil applications. Gauges shall be 1/2% full scale accurate per ANSI B40.1 with bushed stainless steel movement and hair spring guard. Standard ranges to be either pressure or pressure and vacuum as required of application.
- B. Acceptable Manufacturer: Ashcroft, Marshalltown, Marsh, Miljoco, Terice, U.S. Gauge Figure 1980, Weiss, Weksler, Wika.
- C. Select gauge range for normal reading near center of gauge.

2.2 PRESSURE GAUGE ACCESSORIES

- A. All pressure gauges shall have valves and pressure snubbers. All pressure gauges on steam shall have pigtail syphon.
- B. Shutoff Valve: 1/4" ball valve as specified for each piping system.
- C. Pressure snubber, brass with 1/4" connections, porous metal type.

2.3 THERMOMETERS

- A. Dial Type:
 - 1. 4-1/2" diameter, hermetically sealed case. Stainless steel case and stem. Accuracy of 1% full scale with external recalibrator.
 - 2. Select thermometers for appropriate temperature range. Adjustable elbow joint with locking device to allow rotation of thermometer to any angle.
 - 3. Stem lengths as required for application with minimum insertion of 2-1/2".

4. Thermometers for water, steam, or oil shall have brass or steel separable socket. Socket shall extend through insulation. Thermometers for air shall have an aluminum or brass duct flange.
 5. Acceptable Manufacturer: Ashcroft, Marsh, Marshalltown, Miljoco, Tel-Tru, Trerice, U.S. Gauge, Weiss, Weksler, Wika.
- B. Select scales to cover expected range of temperatures.

2.4 TEST PLUGS

- A. Test Plug: 1/4" or 1/2" brass fitting and cap, with Nordel core for temperatures up to 275°F, for receiving 1/8" outside diameter pressure or temperature probe. Plugs shall be rated for zero leakage from vacuum to 500 psi.
- B. Provide extended units for all plugs installed in insulated piping.
- C. Test Kit: Carrying case, internally padded and fitted containing one 3-1/2" diameter pressure gauge with 0-100 psi range, one gauge adapter with 1/8" probes, two 1-1/2" dial thermometers with 0° to 220°F and -25°F to 125°F ranges and 5" stems.
- D. Acceptable Manufacturers: Sisco, Flow Design, or Peterson Equipment.

2.5 STATIC AND DIFFERENTIAL AIRFLOW PRESSURE GAUGES

- A. Diaphragm-activated gauge with 4-3/4" dial, cast aluminum case, sealed interior, designed to resist shock and vibration, and rated for 15 psig.
- B. Accuracy shall be $\pm 3\%$ of full scale maximum throughout entire range at 70°F.
- C. Provide mounting brackets, probes, and shutoff valves required for proper installation.
- D. The range and service shall be as required for application or as noted on the drawings.
- E. Acceptable Manufacturers: Dwyer Magnehelic Series 2000, Marshalltown Instrument Series 85C.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General Installation Requirements:
 1. Install per manufacturer's instructions.
 2. Coil and conceal excess capillary on remote element instruments.
 3. Install gauges and thermometers in locations where they are easily read from normal operating level.
 4. Do not install instrumentation when areas are under construction, except for required rough-in, taps, supports and test plugs.

B. Pressure Gauges:

1. Connect pressure gauges to suction and discharge side of all pumps.
2. Provide snubber for each pressure gauge.
3. Provide coil syphon for each pressure gauge connected to steam piping.

C. Thermometers:

1. Install thermometers in piping systems in sockets in short couplings. Enlarge pipes smaller than 2-1/2" for installation of thermometer sockets.
2. Install thermometer sockets adjacent to control system thermostat, transmitter and sensor sockets.

END OF SECTION

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SECTION 23 21 00

HYDRONIC PIPING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Pipe and Pipe Fittings.
- B. Valves.
- C. Chilled Water Piping System.

1.2 QUALITY ASSURANCE

- A. Valves: Manufacturer's name and pressure rating marked on valve body. Remanufactured valves are not acceptable.
- B. Welding Materials, Procedures, and Operators: Conform to ASME Section 9, ANSI/AWS D1.1, and applicable state labor regulations.

1.3 DELIVERY, STORAGE, AND HANDLING

- A. Store and protect piping to prevent entrance of foreign matter into pipe and to prevent exterior corrosion.
- B. Deliver and store valves in shipping containers with labeling in place.

1.4 COORDINATION DRAWINGS

- A. Reference Coordination Drawings article in Section 23 05 00 for required hydronic systems electronic CAD drawings to be provided to Coordinating Contractor for inclusion into composite coordination drawings.

PART 2 - PRODUCTS

2.1 COOLING WATER

- A. Design Pressure: 200 psig.
Maximum Design Temperature: 225°F.
- B. Piping – 2" and Smaller:
 - 1. Tubing: Type L drawn temper seamless copper tube, ASTM B88.
 - 2. Joints: Solder with Type 95-5 solder. 50-50 solder is not acceptable.
 - 3. Fittings: Wrought copper solder joint, ASME B16.22.
- C. Shutoff Valves:
 - 1. Ball Valves:
 - a. BA-1: 3" and under, 600 psi WOG, full port, screwed or solder ends (acceptable only if rated for soldering in line with 470°F melting point of

lead-free solder), bronze body of a copper alloy containing less than 15% zinc, stainless steel ball and trim, Teflon seats and seals. Apollo #77C-140, Stockham #S-206 BR1-R, Milwaukee #BA-400, Watts, Nibco #585-70-66, National Utilities Co., RUB.

NOTES:

- 1) Provide extended shaft with operating handle of non-thermal conductive material and protective sleeve that allows operation of valve, adjustment of the packing, and adjustment of the memory stop without breaking the vapor seal or disturbing the insulation for all valves in insulated piping.

D. Check Valves:

- 1. CK-4: 2" and under, 200 psi WOG @ 150°F, solder, bronze, horizontal swing. Crane #1342, Hammond #IB912, Stockham #B309, Walworth #406SJ, Milwaukee #1509, Watts #B-5001, NIBCO #S-413.

E. Strainers:

- 1. ST-1: 304 stainless steel strainer, 1/8 inch perforations, dirt leg, Bronze body, screwed ends, screwed cover, 125 psi S @ 353°F, 200 psi WOG @ 150°F. Armstrong #F4SC, Metraflex #TS, Mueller Steam Specialty Co. #351, Sarco #BT, Watts #777, NIBCO T-122.

2.2 EQUIPMENT DRAINS AND OVERFLOWS

A. Copper Tubing: DWV drawn temper seamless copper drainage tube, ASTM B306.

- 1. Fittings: ASME B16.23 cast brass, or ASME B16.29 solder wrought copper.
- 2. Joints: Solder with Type 95-5 solder. 50-50 solder is not acceptable.

2.3 AIR VENTS

- A. At end of main and other points where large volume of air may be trapped - Use 1/4" globe valve, angle type, 125 psi, Crane #89, attached to coupling in top of main, 1/4" discharge pipe turned down with cap.
- B. On branch lines and small heating units - Use coin-operated air vent equal to B&G #4V, attached to 1/8" coupling in top of pipe. Install air vents on all coils and terminal heating units.

2.4 STRAINERS

A. Unless otherwise indicated, strainers shall be Y-pattern and have stainless steel screens with perforations as follows:

Pipe Size	1/4" - 2"	2-1/2" - 8"	10" and Up
Water and Glycol/Water	1/32"	1/16"	1/8"

- B. Furnish pipe nipple with ball valve, threaded hose connection, and cap to blow down all strainer screens.
- C. Use bronze body strainers in copper piping and iron body strainers in ferrous piping.

2.5 BALANCING VALVE

- A. Rated for 300 psi working pressure and 250°F operating temperature, taps for determining flow with a portable meter, positive shutoff valves for each meter connection, memory feature, tight shutoff, and a permanent pressure drop between 1' and 2' water column at full flow with valve 100% open. Furnish with molded, removable insulation covers.
- B. Provide a nomograph to determine flow from meter reading (and valve position on units which sense pressure across a valve). Graph shall extend below the specified minimum flow.
- C. Furnish one meter kit: Bell and Gossett Model RO-2 portable readout meter.
- D. Valves in copper piping shall be brass or bronze. Acceptable Manufacturers: Bell & Gossett CB, Griswold "Quickset", Gerand "BALVALVE Venturi", NIBCO 1710 (S1710L), Tour&Anderson (STAD), Nexus Valve "UltraXB Orturi", Victaulic 785.
- E. Manufacturer shall size balancing valves for the scheduled flow rate. Flow rate shall be measurable on manufacturer's standard meters.

2.6 COMBINATION PIPING PACKAGES

- A. Combination piping packages are allowed in lieu of individual components specified for hydronic coils and devices containing hydronic coils. Combination piping packages shall include shutoff valves, wye strainers, 1/4 turn strainer blow down valves with hose thread and cap, manual balancing valves with memory stop, test plugs, manual air vents, and unions. Automatic flow control devices are not allowed. Configuration of combination pieces shall match layouts on the drawings. Each component of the combination piping packages shall meet these specifications for the individual components being combined.
- B. Acceptable Manufacturers: Nexus Coil Pak, FDI Flowset, Griswold, HCI Terminator, Hays Mesurflo.

PART 3 - EXECUTION

3.1 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. Connect to all equipment with flanges or unions.
- D. After completion, fill and clean systems.

3.2 TESTING PIPING

- A. Cooling Water:
 - 1. Complete testing before insulation is applied. If insulation is applied before pipe is tested and a leak ruins the insulation, replace all damaged insulation.
 - 2. Test the pipe with 200 psig water pressure. Hold pressure for at least two hours.

3. Test to be witnessed by the Architect/Engineer or their representative, if requested by the Architect/Engineer.

3.3 CLEANING PIPING

A. Assembly:

1. Prior to assembly of pipe and piping components, remove all loose dirt, scale, oil and other foreign matter on internal or external surfaces by means consistent with good piping practice subject to approval of the Architect/Engineer. Blow chips and burrs out of pipe before assembly. Wipe cutting oil from internal and external surfaces.
2. During fabrication and assembly, remove slag and weld spatter from both internal and external joints by peening, chipping and wire brushing to the degree consistent with good piping practices.
3. Notify the Architect/Engineer prior to starting any post erection cleaning operation in time to allow witnessing the operation. Properly dispose of cleaning and flushing fluids.
4. Prior to blowing or flushing erected piping systems, disconnect all instrumentation and equipment, open wide all valves, control valves, and balance valves, and verify all strainer screens are in place.

B. Cleaning:

1. Flush pipe and components with clean water until all discharge from system is clean. Maintain minimum velocities at all points of 5 feet/second for 30 minutes. Flow shall be in same direction as when system is in normal operation. Discharge shall be from low points of pipes, ends of headers and as otherwise needed to flush entire system. After flushing, all residual water shall be drained and/or blown out.

3.4 INSTALLATION

A. General Installation Requirements:

1. Route piping in orderly manner, straight, plumb, with consistent pitch, parallel to building structure, with minimum use of offsets and couplings. Provide only offsets required for needed headroom or clearance and needed flexibility in pipe system.
2. Install piping to conserve building space, and not interfere with other work.
3. Group piping whenever practical at common elevations.
4. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
5. Reducers are generally not shown. Where pipe sizes change at tee, the tee shall be the size of the largest pipe shown connecting to it. Where pipe sizes are not shown, the larger size in either direction shall continue through the fitting nearest to the indication of a smaller pipe size.

6. Install bell and spigot pipe with bells upstream.
 7. Branch takeoffs shall be from the top, side, or bottom of piping.
- B. Installation Requirements in Electrical Rooms:
1. Do not install piping or other equipment above electrical switchboards or panelboards. This includes a dedicated space extending 25 feet from the floor to the structural ceiling with width and depth equal to the equipment plus its required clearance space.
- C. Valves/Fittings and Accessories:
1. Provide chain operators for all valves over 2" size that are over 10'-0" above finished floor. Extend to 7'-0" above finished floor.
 2. Provide valve position indicator on all valves 10'-0" or greater above finish floor and not located above ceiling.
 3. Provide clearance for installation of insulation, and access to valves and fittings.
 4. Provide access doors where valves are not exposed.
 5. Install balancing valves with the manufacturer's recommended straight upstream and downstream diameters of pipe.
 6. Prepare pipe, fittings, supports, and accessories for finish painting.
 7. Install valves with stems upright or horizontal, not inverted, except install manual quarter turn valves in radiation cabinets and all butterfly valves with stems horizontal.
 8. Provide shutoff valves and flanges or unions at all connections to equipment, traps, and items that require servicing.
 9. Provide flanges or unions at all final connections to equipment, traps and valves.
 10. Arrange piping and piping connections so equipment may be serviced or totally removed without disturbing piping beyond final connections and associated shutoff valves.

3.5 PIPE ERECTION AND LAYING

- A. Carefully inspect all pipe, fittings, valves, equipment and accessories prior to installation. Immediately reject and remove from the job any items which are unsuitable, cracked or otherwise defective.
- B. All pipe, fittings, valves, equipment and accessories shall have factory-applied markings, stampings, or nameplates sufficient to determine their conformance with specified requirements.
- C. Exercise care at every stage of storage, handling, laying and erecting to prevent entry of foreign matter into piping, fittings, valves, equipment and accessories. Do not erect or install any unclean item.

- D. During construction, until system is fully operational, keep all openings in piping and equipment closed at all times except when actual work is being performed on that item. Closures shall be plugs, caps, blind flanges or other items designed for this purpose.
- E. Change direction of pipes only with fittings or pipe bends. Change size only with fittings. Do not use miter fittings, face or flush bushings, or street elbows. **All fittings shall be long radius type**, unless otherwise shown on the drawings or specified. Construct welded elbows of angles not available as standard fittings by cutting and welding standard elbows to form smooth, long radius fittings.
- F. Use full and double lengths of pipe wherever possible.
- G. Unless otherwise indicated, install all inlet and outlet piping, including shutoff valves and strainers, to coils, pumps and other equipment at line size with reduction in size being made only at control valve or pump.
- H. Cut all pipe to exact measurement and install without springing or forcing except in the case of expansion loops where cold springing is indicated on the drawings.
- I. Do not create, even temporarily, undue loads, forces or strains on valves, equipment or building elements.

3.6 DRAINING AND VENTING

- A. Unless otherwise indicated on the drawings, all horizontal pipes, including branches, shall pitch 1" in 40 feet to low points for complete drainage, removal of condensate, and venting.
- B. Provide drain valves at all low points of water piping systems or where indicated on drawings for complete or sectionalized draining. Drain valves are defined above.
- C. Use eccentric reducing fittings on horizontal runs when changing size for proper drainage and venting. Install all liquid lines with top of pipe and eccentric reducers in a continuous line.
- D. Provide air vents at all high points and wherever else required for elimination of air in all water piping systems. Do not use automatic air vents in glycol systems unless they are piped to the fill tank.
- E. Air vents shall be in accessible locations. If needed to trap and vent air in a remote location, a 1/8" pipe shall connect the tapping location to a venting device in an accessible location.
- F. All vent and drain piping shall be of same materials and construction as the service involved.

3.7 BRANCH CONNECTIONS

- A. Make branch connections with standard tee or cross fittings of the type required for the service unless otherwise specified herein or detailed on the drawings.
- B. At the option of the Contractor, branch connections from headers and mains may be cut into black steel pipe using forged weld-on fittings.

- C. Use of forged weld-on fittings is also limited as follows:
 - 1. Must have at least same pressure rating as the main.
 - 2. Header or main must be 2-1/2" or over.
 - 3. Branch line is at least two pipe sizes under header or main size.

3.8 JOINING OF PIPE

A. Threaded Joints:

- 1. Ream pipe ends and remove all burrs and chips.
- 2. Protect plated pipe and valve bodies from wrench marks when making up joints.
- 3. Apply Teflon tape to male threads.

B. Flanged Joints:

- 1. Bronze flanges shall conform to B16.24 and ductile iron flanges to B16.42. Steel flanges shall be raised face except when bolted to flat face cast iron flange.
- 2. Bolting shall be ASTM A307 Grade B with bolts and heavy hexagonal nuts conforming to ASME B18.2.1 and B18.2.2.
- 3. Torque bolts in at least three passes, tightening to 1/3, 2/3, and final torque in a cross pattern with an indicating torque wrench for equal tension in all bolts.
- 4. Gaskets for flat face flanges shall be full-face type. Gaskets for raised faced flanges shall conform to requirements for "Group I gaskets" in ASME B16.5. All gaskets shall conform to ASME B16.21. Unless otherwise specified, gaskets shall meet the following requirements:
 - a. Gasket material and thickness approved by manufacturer for intended service, chemical compatibility, pipe system test pressure, and operating temperature range.
 - b. Maximum pressure rating of at least 250 psig.
 - c. Minimum temperature rating: -10°F.
 - d. Maximum temperature rating of at least 170°F for water and glycol solution systems operating 140°F and less.
 - e. Maximum temperature rating of at least 250°F for water and glycol solution systems operating above 140°F and up to 180°F.

C. Solder Joints:

- 1. Make up joints with 95% tin and 5% antimony (95-5) solder conforming to ASTM B32 Grade 95TA. Cut copper tubing ends perfectly square and remove all burrs inside and outside. Thoroughly clean sockets of fittings and ends of tubing to remove all oxide, dirt and grease just prior to soldering. Apply flux evenly, but sparingly, to all surfaces to be joined. Heat joints uniformly to proper soldering temperature so solder flows to all mated surfaces. Wipe excess solder, leaving a uniform fillet around cup of fitting.

2. Flux shall be non-acid type conforming to ASTM B813.
3. Solder end valves may be installed directly in the piping system if the entire valve is suitable for use with 470°F melting point solder. Remove composition discs and all seals during soldering if not suitable for 470°F.

END OF SECTION

SECTION 23 31 00

DUCTWORK

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Galvanized Ductwork
- B. PVC Ductwork
- C. Ductwork Sealants
- D. Rectangular Ductwork - Single Wall
- E. Leakage Testing
- F. Ductwork Penetrations

1.2 DEFINITIONS

- A. Duct Sizes shown on drawings are inside clear dimensions. Maintain clear dimensions inside any lining.
- B. Transitions are generally not shown in single-line ductwork. Where sizes change at a divided flow fitting, the larger size shall continue through the fitting.

PART 2 - PRODUCTS

2.1 GALVANIZED DUCTWORK

- A. General Requirements:
 - 1. Duct and reinforcement materials shall conform to ASTM A653 and A924.
 - 2. Interior Ductwork and reinforcements: G60 galvanized (0.60 ounces per square foot total zinc coating for two sides per ASTM A90) unless noted otherwise.
 - 3. Ductwork reinforcement shall be of galvanized steel.
 - 4. Ductwork supports shall be of galvanized or painted steel. Slip cable hangers are acceptable. Acceptable manufacturers are Gripple, Ductmate, Duro Dyne, or Architect/Engineer approved.
 - 5. All fasteners shall be galvanized or cadmium plated.

2.2 PVC DUCTS

- A. General Requirements:
 - 1. PVC piping shall conform to ASTM D1784, Class 1254-B.
 - 2. PVC piping and fittings shall be PVC 1120, Schedule 80, high impact pipe conforming to ASTM D1785 with bells conforming to ASTM D2672. Solvent weld fittings shall conform to ASTM D2467, and for threaded, ASTM D2464. PVC round duct and fittings greater than or equal to 22 inches in diameter shall be of PVC conforming to ASTM D184, Class 16444-D.

3. Entire duct shall be of PVC construction. PVC-coated materials are not acceptable.
4. All PVC shall have a flame-spread rating of 25 or less in accordance with ULC S102.2.

2.3 PVC DUCTWORK

A. General Requirements:

1. G-60 galvanized steel sheet with prime coat and a 4 mil polyvinyl chloride film on both sides. Where any duct surface is scratched, marred, or otherwise damaged, coat with PVC paint as recommended by the manufacturer to provide a complete PVC coating for the entire duct surface. Aerosol-based PVC spray paint is not acceptable.
2. Ductwork reinforcement shall be of galvanized steel. All ductwork reinforcement shall be external.
3. Ductwork supports shall be of galvanized or painted steel. Supports shall not require penetrations of the PVC coating. Slip cable hangers are acceptable. Acceptable manufacturers are Gripple, Ductmate, Duro Dyne, or Architect/Engineer approved.
4. All fasteners shall be of 316 stainless steel.

2.4 DUCTWORK SEALANTS

- A. One part joint sealers shall be water-based mastic systems that meet the following requirements: maximum 48-hour cure time, service temperature of -20°F to +175°F, resistant to mold, mildew and water, flame spread rating below 25 and smoke-developed rating below 50 when tested in accordance with ASTM E84, suitable for all SMACNA seal classes and pressure classes. Mastic used to seal flexible ductwork shall be marked UL 181B-M.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Locate ducts with space around equipment for normal operation and maintenance.
- B. Do not install ducts or other equipment above electrical switchboards or panelboards. This includes a dedicated space extending 25 feet from the floor to the structural ceiling with width and depth equal to the electrical equipment.
- C. During construction provide temporary closures of metal or taped polyethylene on open ducts to prevent dust from entering ductwork. Supply ductwork shall be free of construction debris, and shall comply with level "B" of the SMACNA Duct Cleanliness for New Construction Guidelines.
- D. Repair all duct insulation and liner tears.
- E. Support all duct systems in accordance with the SMACNA HVAC Duct Construction Standards.

3.2 DUCTWORK APPLICATION SCHEDULE

USAGE	MATERIAL	PRESSURE CLASS	SEAL CLASS †	INSULATION (Refer to Section 23 07 13 for insulation types)
Supply Duct	Galvanized Sheet Metal - Rectangular	+3"	A	1-1/2" thick Type A
General Exhaust Duct	Galvanized Sheet Metal	-1"	A	1" thick Type C
Chemical Room Exhaust Duct	PVC	-1"	A	
† Seal Class is per SMACNA HVAC Air Duct Leakage Test Manual				

3.3 DUCTWORK SEALING

A. General Requirements:

1. Openings, such as rotating shafts, shall be sealed with bushings or similar.
2. Pressure sensitive tape shall not be used as the primary sealant unless it has been certified to comply with UL-181A or UL-181B by an independent testing laboratory and the tape is used in accordance with that certification.
3. All connections shall be sealed including, but not limited to, taps, other branch connections, access doors, access panels, and duct connections to equipment. Sealing that would void product listings is not required. Spiral lock seams need not be sealed.
4. Mastic-based duct sealants shall be applied to joints and seams in minimum 3 inch wide by 20 mil thick bands using brush, putty knife, trowel, or spray, unless manufacturer's data sheet specifies other application methods or requirements.

- #### B. For Seal Class A ducts, all transverse joints, longitudinal seams, and duct wall penetrations shall be sealed. Joints are inclusive of, but not limited to, girth joints, branch and sub-branch intersections, duct collar tap-ins, fitting subsections, louver and air terminal connections to ducts, access door and access panel frames and jambs, duct, plenum, and casing abutments to building structures.

3.4 TESTING

A. Duct - 2" WG or Less (positive or negative):

1. Systems shall not leak more than shown in Table 4-1 of SMACNA HVAC Air Duct Leakage Test Manual for Seal Class A.
2. Leak testing of these systems is not normally required for interior ductwork. However, leak tests will be required if, in the opinion of the Architect/Engineer, the leakage appears excessive. All exterior ductwork shall be tested. If duct has outside wrap, testing shall be done before it is applied.
3. Leak test shall be at the Contractor's expense and shall require capping and sealing all openings.
4. Seal ducts to bring the air leakage into compliance.

5. Contractor shall notify the Architect/Engineer five business days prior to pressurizing ductwork for testing.

3.5 DUCTWORK PENETRATIONS

- A. All duct penetrations of firewalls shall have fire or fire/smoke dampers where required by code.
- B. Dampers shall be compatible with fire rating of wall assembly. Verify actual rating of any wall being penetrated with Architect/Engineer.
- C. Seal all duct penetrations of walls that are not fire rated by caulking or packing with fiberglass. Install galvanized steel (unless otherwise indicated) trim strip to cover vacant space and raw construction edges of all rectangular openings in finished rooms.

END OF SECTION



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ELECTRONIC FILE TRANSMITTAL - CONTRACTOR	
KJWW #: 15.0280.00	DATE:
PROJECT NAME: Madison Well Unit 12	SOFTWARE/RELEASE:
LOCATION: Madison, Wisconsin	FILE NAME:
ARCHITECT/ ENGINEER: Kris Cotharn	TRANSFER METHOD:
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Company: _____	Phone: _____
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SECTION 23 33 00

DUCTWORK ACCESSORIES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Fabric Connectors.
- B. Duct Test Holes.

PART 2 - PRODUCTS

2.1 FABRIC CONNECTORS

- A. Fabric connectors shall be installed between all fans or fan units and metal ducts or casings to prevent transfer of fan or motor vibration.
- B. The fabric connectors shall be completely flexible material which shall be in folds and not drawn tight.
- C. Fabric connectors shall be of glass fabric double coated with neoprene, with UL approval. Weight = 30 oz. per square yard minimum. Fabric shall not be affected by mildew and shall be absolutely waterproof, airtight and resistant to acids, alkalies, grease and gasoline, and shall be noncombustible.
- D. Fabric connections shall not exceed 6" in length on ductwork that has a positive pressure. On ductwork that has a negative pressure, the length shall not exceed 2" in length.
- E. All corners shall be folded, sealed with mastic and stapled on 1" centers.
- F. Fabric connectors shall not be painted.
- G. Unless otherwise shown on the drawings, the fabric connection at the inlet to centrifugal fans shall be at least one duct diameter from the fan to prevent inlet turbulence.
- H. Acceptable Materials: Durodyne MFN-4-100, Vent Fabrics, Inc. "Ventglas", or Proflex PFC3NGA.
- I. Fabric connectors exposed to sunlight and weather shall be as described above, except the coating shall be hypalon in lieu of neoprene.
- J. Acceptable Materials: Durodyne "Duralon MFD-4-100", Vent Fabrics, Inc. "Ventlon", or Proflex PFC3HGA.

2.2 DUCT TEST HOLES

- A. Cut or drill temporary test holes in ducts as required. Cap with neat patches, neoprene plugs, threaded plugs, or threaded or twist-on metal caps.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General Installation Requirements:

1. Install accessories in accordance with manufacturer's instructions.
2. Where duct access doors are located above inaccessible ceilings, provide ceiling access doors. Coordinate location with the Architect/Engineer.
3. Coordinate and install access doors provided by others.
4. Provide access doors for all equipment requiring maintenance or adjustment above an inaccessible ceiling. Minimum size shall be 24" x 24".
5. Provide duct test holes where indicated and as required for testing and balancing purposes.

END OF SECTION

SECTION 23 34 23
POWER VENTILATORS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. In-Line Cabinet Fan.
- B. Industrial Paddle-Type Ceiling Fan.
- C. Centrifugal Blowers.

1.2 QUALITY ASSURANCE

- A. Performance Ratings: Conform to AMCA 210 and bear AMCA Certified Rating Seal.
- B. Sound Ratings: AMCA 301, tested to AMCA 300.
- C. Fabrication: Conform to AMCA 99.

1.3 SUBMITTALS

- A. Submit shop drawings per Section 23 05 00. Include product data on wall and roof exhausters, and ceiling and cabinet fans.
- B. Provide multi-rpm fan curves with specified operating point clearly plotted.
- C. Submit manufacturer's installation instructions.

1.4 EXTRA STOCK

- A. Provide one (1) extra belt set for each fan unit.

PART 2 - PRODUCTS

2.1 IN-LINE CABINET FAN

- A. Fiberglass lined, sheet metal housing, arranged for in-line installation.
- B. Rubber torsion motor mounts.
- C. Plug type disconnect.
- D. Built-in backdraft damper.
- E. Centrifugal fan.
- F. Provide variable speed controller if shown on the drawings.
- G. Acceptable Manufacturers: ACME, Broan, Carnes, Cook, JencoFan, Penn, Greenheck.

2.2 INDUSTRIAL PADDLE-TYPE CEILING FAN

- A. Provide steel yoke assembly and aluminum housing and blades with corrosion-resistant epoxy enamel finish.
- B. Provide permanent split capacitor-type motor with permanently sealed and greased bearings and precision-balanced rotor blades.
- C. Provide thermal overload protection in motor. Provide conduit chase within down rod connector in electrical connection.
- D. Provide multispeed and reversing switch fan controller.
- E. Acceptable manufacturers are TPI Industrial, or equal.

2.3 CENTRIFUGAL BLOWERS

- A. Single piece, seamless, UV resistant polypropylene blower housing. Split-molded housings are not acceptable. All supporting hardware shall be stainless steel.
- B. Blower wheel shall be constructed of polypropylene and be forward-curved type. Blower wheel shall be electronically and dynamically balanced. Blower wheel shall be provided with a motor shaft brushing and hubcap made of polypropylene.
- C. The blower motor shall be UL listed for continuous duty. Motor shall be totally-enclosed, fan cooled (TEFC) and provided with a motor junction box. Provide polypropylene motor stand. Starters and disconnects shall be provided as a part of division 26.
- D. Provide 2-year warranty for equipment, product, and parts. Provide 1-year warranty for motor.
- E. Acceptable Manufacturers: Plastec Ventilation or equal.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Secure roof exhausters with cadmium plated lag screws to roof curb.
- C. If manufacturer has no recommendations, secure roof exhaust fans to curbs with 1/4" lag bolts on 8" maximum centers.
- D. MC shall install and wire factory provided damper to open when the fan runs if the manufacturer does not provide an option to pre-wire the damper.

END OF SECTION

SECTION 23 37 00

AIR INLETS AND OUTLETS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Grilles and Registers.
- B. Roof Hoods.
- C. Roof Curbs.

1.2 QUALITY ASSURANCE

- A. Test and rate performance of air inlets and outlets per ASHRAE 70.
- B. Test and rate performance of louvers per AMCA 500L-99.
- C. All air handling and distribution equipment mounted outdoors shall be designed to prevent rain intrusion into the airstream when tested at design airflow and with no airflow, using the rain test apparatus described in Section 58 of UL 1995.

1.3 SUBMITTALS

- A. Submit product data under provisions of Section 23 05 00.
- B. Submit schedule of inlets and outlets indicating type, size, location, application, and noise level.
- C. Review requirements of inlets and outlets as to size, finish, and type of mounting prior to submitting product data and schedules of inlets and outlets.
- D. Submit manufacturer's installation instructions.

1.4 REGULATORY REQUIREMENTS

- A. Conform to ANSI/NFPA 90A.
- B. Conform to ASHRAE 90.1.

PART 2 - PRODUCTS

2.1 GRILLES AND REGISTERS

- A. Reference to a grille means an air supply, exhaust or transfer device without a damper.
- B. Reference to a register means an air supply, exhaust or transfer device with a damper.
- C. The type of unit, margin, material, finish, etc., shall be as shown on the drawing schedule and suitable for the intended use.
- D. The capacity and size of the unit shall be as shown on the drawings.

- E. All units shall handle the indicated cfm as shown on the drawings while not exceeding an NC level of 35, referenced to 10^{-12} watts with a 10 dB room effect.
- F. Refer to the drawings for construction material, color and finish, margin style, deflection, and sizes of grilles and registers.
- G. Provide with 3/4" blade spacing. Blades shall have steel friction pivots to allow for blade adjustment, plastic pivots are not acceptable.
- H. Corners of steel grilles and registers shall be welded and ground smooth before painting. Aluminum grilles and registers shall have staked corners.
- I. Provide opposed blade volume dampers operable from the face of the register.
- J. Screw holes for surface fasteners shall be countersunk for a neat appearance. Provide concealed fasteners for installation in lay-in ceilings and as specified on the drawings.
- K. Acceptable Manufacturers: Tuttle & Bailey, Titus, Price, Nailor, Carnes, Metalaire, Krueger.

2.2 ROOF HOODS

- A. Hoods shall be constructed of all-welded aluminum.
- B. Curb cap shall be of 14 gauge formed aluminum with mitered corners continuously heliarc-welded. Hood shall be of the same material and cross-broken for added strength. Underside of hood shall be coated with insulating mastics.
- C. Hoods shall be furnished with stainless steel bird screen.
- D. Hood and throat shall be reinforced with extruded aluminum angle and have a minimum snow load rating of 30 lbs. per square foot.
- E. Size, cfm, finish and pressure drop for hoods shall be as scheduled on the drawings.
- F. Inlet area shall be minimum 150% of throat area for intake hoods. Outlet area shall be minimum 125% of throat area for exhaust hoods and relief vents.
- G. Hoods shall be furnished with 12" high curb (above top of roof) and be of the size and type as shown on the drawings.
- H. Hood shall be furnished with motorized damper unless otherwise noted on the drawings.
- I. Acceptable Manufacturers: Ammerman, Carnes, Cook, Greenheck, ILG, Jenco Fan, Penn, Twin City Fan & Blower.

2.3 ROOF CURBS

- A. Furnish and install, where shown on the drawings, prefabricated roof curbs for all rooftop hood openings.
- B. Curbs shall be sized to match curb cap of the hood. The top of all curbs shall be 12" above the top of the roof.

- C. Curbs shall be unitized construction, 18 gauge galvanized steel, with continuous arc welded corner seams, insulated with 1-1/2" thick, 3 lb. density rigid fiberglass board and damper support angle.
- D. Curb without cant – suitable for use with membrane type roof.
- E. Acceptable Manufacturers: Same manufacturer as the equipment it serves or Pate, RPS, or Thy.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General Installation Requirements:
 - 1. Install items in accordance with manufacturers' instructions.
 - 2. Check location of inlets and outlets and make necessary adjustments in position to conform to architectural features, symmetry, and lighting arrangement.
 - 3. Install diffusers to ductwork with air tight connections.
 - 4. Flexible ducts shall NOT be joined to flat-oval connections. Provide sheet metal oval-to-round transitions where required.
- B. Roof Hood:
 - 1. If manufacturer has no recommendations, secure roof hoods and louvered penthouses to curbs with 1/4" lag bolts on 8" maximum centers.
 - 2. Provide 20 gauge sheet metal duct blank-off behind louvers at unused portions of louver openings in exterior walls. Back with 2" rigid 3# density fiberglass board insulation with foil scrim facing the room. Seal watertight.

END OF SECTION

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SECTION 23 81 13

PACKAGED TERMINAL AIR CONDITIONING UNITS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Packaged Fan Coil Units.
- B. Controls.

1.2 SUBMITTALS

- A. Submit shop drawings and product data under provisions of Section 23 05 00.
- B. Indicate water, drain, and electrical rough-in connections on shop drawings or product data.
- C. Submit manufacturer's installation instructions.

1.3 DELIVERY, STORAGE, AND HANDLING

- A. Protect finished cabinets from physical damage by leaving factory packing cases in place before installation and providing temporary covers after installation.

1.4 OPERATION AND MAINTENANCE DATA

- A. Submit operation and maintenance data.
- B. Include manufacturer's descriptive literature, operating instructions, installation instructions, and maintenance and repair data.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Ventus
- B. JCI Solutions XT.
- C. McQuay CAH.

2.2 MANUFACTURED UNITS

- A. Drawings and specifications are based on the scheduled manufacturer and model number. CONTRACTOR shall be responsible for the cost of any changes because of substitutions or alternates of other manufacturers or model numbers including, but not limited to, structural, mechanical, and electrical work. CONTRACTOR shall pay all costs for revisions of drawings by ENGINEER. Any changes shall be coordinated and provided at no additional cost to OWNER.
- B. Fan coil unit: Shall be factory-assembled unit consisting of the following sections:
 - 1. Supply fan section.
 - 2. Cold water coil.

3. Filter section.
 4. Discharge plenum.
- C. Unit Casing:
1. Construct walls, roof and floor from 1-1/2-inch thick double wall panel assemblies. Panels shall be injected with polyurethane foam insulation and shall have a minimum thermal conductivity (R-value) of 12.5.
 2. The outer shell shall be constructed of solid G90 galvanized steel with baked enamel finish. The inner liner shall be constructed of solid G90 galvanized steel.
 3. Panels shall be gasketed with permanently applied bulb-type gaskets and able to be removed without affecting the integrity of casing structure.
 4. Leakage rate shall not exceed 1% of the total system air quantity when subjected to \pm 5 inches static pressure.
 5. Install sealing collars to the interior and exterior of each penetration to prevent air leakage where coil piping, air vents, drain piping, and electrical conduits penetrate air handling unit casing. Silicone sealants and duct sealants are not acceptable to seal pipe penetrations of the air handling unit casing.
- D. Access Sections and Doors:
1. Provide hinged access sections for maintenance access.
 2. Access sections shall be of the same construction as the unit casing.
 3. Access doors shall be double wall, of same construction and thickness as casing, hinged, continuously gasketed with bulb type gaskets, reinforced nylon handles with cam-type latches, and inspection windows. Door swing shall be outward with positive pressure sections having double latch to relieve pressure.
- E. Cold Water Coil Sections:
1. Use galvanized steel casing, end supports, top channel, and bottom channel to produce a rigid frame with allowance for expansion and contraction of the finned tube section.
 2. Construct coils of 0.025 inch tube wall seamless copper tubes of 5/8-inch maximum outside diameter with maximum of eight aluminum fins suitable for working pressures to 200 psig. Coil fins may be the continuous serpentine or plate fin type.
 3. Coil headers shall be constructed of seamless copper. Copper headers shall be brazed to tubes.
 4. Coils shall be drainable type with drain and vent plugs for each header.
 5. Coils shall be accessible for removal from either side of unit casing without disturbing adjacent sections.

6. Entire coil frame, headers and U-bend shall be enclosed within unit casing. Extend coil piping connections, air vent and drain connections to exterior of casing.
7. Support coils along entire length within casing and pitch coil for proper drainage.
8. Blank off space between coil frames and unit casing.
9. Fabricate cooling coil drain pans from microbial-resistant galvanized steel. Install a drain pan under cooling coil. Extend drain pans the entire width of each coil, including the header, and from the upstream face of coil to 6 inches downstream from the downstream face. Pitch drain pans in two directions toward the outlet. The bottom drain pan shall be piped to the exterior of the unit base using a minimum of 1.25 inch type 304 stainless steel or copper piping.

F. Supply Fan Sections:

1. Supply fan shall be double width, double inlet centrifugal fan.
2. Fan and motor combination shall be capable of delivering 110% of air quantity scheduled at scheduled static pressure. The motor furnished with the fan shall not operate into the motor service factor when operating under these conditions.
3. Fans to be fastened to hollow or solid steel shafts and designed for continuous operation at maximum rated static pressure.
4. Fan bearing shall be self-aligning, pillow block, regreasable ball type selected for a minimum average L-50 life of 200,000 hours.
5. Furnish extended grease lines from bearings to allow servicing without entering the unit. Grease lines can be terminated within the unit as long as they are able to be easily serviced by opening the access door.
6. Fan, drive and motor assembly shall be mounted inside fan casing section and integrally isolated with unit.
7. Motors shall be premium efficient, open dripproof design rated for use with VFD with size and electrical characteristics as shown on the drawings.

G. Filter Sections:

1. Filter section shall accept 2-inch MERV-7 pleated filter.
2. Provide two full sets of filters.

H. Electrical Control:

1. The unit shall be completely factory wired to an external electrical enclosure. Unit shall include 24-volt control circuit transformer and terminal strip for connection of field wiring. Wiring and devices shall meet requirements of Division 26.
2. Manufacturer shall provide unit controller with relays to perform sequence of operation per the documents.
3. Refer to specification section 23 09 00 for additional control information.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturers' instructions.
- B. Install unit on nominal 4" housekeeping pad.
- C. Coordinate installation of unit with architectural and electrical work.
- D. Pipe and trap condensate to nearest floor drain.
- E. Furnish and install vibration isolators sized by the manufacturer.
- F. Provide flexible duct connections on outlet of unit.
- G. Provide lubrication line extenders as required to allow regreasing of bearings without removal of equipment components.

END OF SECTION

SECTION 23 82 00

TERMINAL HEAT TRANSFER UNITS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Electric Unit Heaters.
- B. Gas Fired Unit Heaters.

1.2 QUALITY ASSURANCE

- A. All filters shall be UL listed Class 1 or Class 2.
- B. All electrical equipment shall have a UL label.
- C. All gas fired units shall be AGA approved or UL listed.
- D. All gas trains shall comply with utility company and code requirements.
- E. All louvers and dampers shall have AMCA certified ratings.
- F. Factory wired equipment shall conform to ANSI/NFPA 70.

1.3 SUBMITTALS

- A. Submit shop drawings per Section 23 05 00.
- B. Submit catalog data including arrangements, cross sections of cabinets, grilles, bracing, typical elevations.
- C. Submit schedules of equipment and enclosures indicating length, number of pieces of element and enclosure, corner pieces, end caps, cap strips, access doors, and comparison of specified to actual heat output.
- D. Indicate mechanical and electrical service locations and requirements. Show deviations from scheduled products.
- E. Submit manufacturers' installation instructions.

1.4 DELIVERY, STORAGE AND HANDLING

- A. Protect units from physical damage by storing in protected areas and leaving factory covers in place.

1.5 REGULATORY REQUIREMENTS

- A. Conform to ASHRAE 90.1.

1.6 OPERATION AND MAINTENANCE DATA

- A. Submit manufacturer's operation and maintenance data. Include operating, installation, maintenance and repair data, and parts listings.

PART 2 - PRODUCTS

2.1 ELECTRIC UNIT HEATERS

- A. Discharge as scheduled on the drawings.
- B. Units shall have corrosion-resistant grille and stainless steel wall-mounting bracket.
- C. Metal sheathed fin tube electric heating elements.
- D. Casing: Heavy gauge stainless steel with baked enamel finish.
- E. Automatic reset thermal overload wired for instantaneous pilot operation of contactor holding coil.
- F. Motors shall be totally enclosed continuous duty with built-in thermal overload protection.
- G. Provide unit mounted and wired disconnect suitable for corrosive environments.
- H. Provide resiliently mounted fan guard/motor support.
- I. Fans: Direct drive totally enclosed motor. Wired to NEMA 4X enclosure.
- J. Controls: Provide low voltage remote thermostat wired by TCC with relay for connection to control outside air damper. Refer to sequence of operation on drawings for control requirements.
- K. Acceptable Manufacturers: Chromalox, Q-Mark or equal.

2.2 GAS FIRED UNIT HEATERS

- A. Units shall be sealed vertical combustion, discharge type.
- B. Include the following controls: Electric room thermostat, solenoid gas valve, safety pilot valve, main gas pressure regulator, pilot gas pressure regulator, main manual shutoff, high limit switch, fan control thermostat.
- C. Stainless steel combustion chamber and aluminized steel burners.
- D. Provide required venting and intake flue per manufacturers recommendations.
- E. Controls: Provide low voltage remote thermostat wired by TCC. Refer to sequence of operation on drawings for control requirements.
- F. Acceptable Manufacturers: Trane, Modine, Hastings, Rupp, Sterling, Reznor.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General Installation Requirements:
 - 1. Install all products per manufacturers' instructions.
 - 2. Coordinate recess sizes for recessed equipment.

3. Protect units with protective covers during construction.
4. Comb all coils to repair bent fins.

B. Unit Heater:

1. Hang unit heaters from building structure, not from piping. Mount as high as possible within manufacturer's recommended mounting height requirements. If unit heaters cannot be installed within manufacturer's recommended range, notify Architect/Engineer prior to mounting.

3.2 CLEANING

- A. After construction is complete, including painting, clean exposed surfaces of units.
- B. Touch-up marred or scratched surfaces of factory-finished cabinets, with materials furnished by manufacturer.

END OF SECTION

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SECTION 26 05 00

COMMON WORK RESULTS FOR ELECTRICAL

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Basic Electrical Requirements specifically applicable to Division 1.
- B. If there are any conflicts or misunderstanding, the Electrical Contractor shall bring it to the attention of the Engineer before beginning any such work. In addition, it is the Electrical Contractors responsibility to coordinate with the System Integrator the installation and wiring of all components and equipment required for the project.

The Electrical Contractor shall inspect and determine if any of the System Integrators equipment is damaged before installation. If any equipment supplied by the System Integrator is damaged, it is the Electrical Contractor's responsibility to notify the Engineer immediately before installation. If the Electrical Contractor damages any equipment, it is his/her responsibility to repair or replace at the Engineer's discretion at no additional cost to the Contract.

Before any equipment that has been supplied by the System Integrator is energized, the Electrical Contractor shall notify the System Integrator at least 48 hours in advance so they can be on site to verify the installation and wiring is correct, and that system testing and start-up can begin. Any wiring malfunctions or results from the wiring damages any equipment it is the Electrical Contractor's responsibility to repair or replace at the Engineer's discretion.

- C. Scope of Electrical Work – City of Madison – Well Unit No.12 Project:
 - 1. This project includes, but not limited to:
 - a. Furnishing or furnishing and installing:
 - 1) Conduit Systems.
 - 2) Motor Control Centers with SCADA Control Panel CP-12.
 - 3) Circuit Breakers.
 - 4) Panel Boards.
 - 5) Disconnect Switches.
 - 6) Surge Suppression Systems.
 - 7) Transformers.
 - 8) Heating and Ventilation System Power and Control Wiring.
 - 9) Building Receptacles.
 - 10) Interior and Exterior Building Lighting.
 - 11) Lighting and Exhaust Fan Control Panels.
 - 12) Transducers.
 - 13) Pressure Transducers.
 - 14) Floats.
 - 15) Intrusion Switches.
 - 16) 600 volt Conductors.
 - 17) Analog and Ethernet Cables.
 - 18) Control wiring Installation.
 - 19) Instrumentation & Control Panels and wiring.
 - 20) Underground Wiring.
 - 21) Hand holes.
 - 22) Exterior Mounted Pull Boxes.
 - 23) Coordinate with and assist Owner's Card Access and Video Surveillance System Contractors. See specification section 26 09 01.

1.02 SCADA

- A. The System Integrator shall provide all new equipment including the SCADA Control Panel CP-12 as noted on the plans and specified within. The System Integrator shall furnish a new radio, antenna surge arrestor and antenna and antenna cable. The radio and surge arrestor shall be installed into the SCADA Control Panel and the antenna and cable shall be installed and connected to the radio by the Electrical Contractor.
- B. The System Integrator and Electrical Contractor shall coordinate all equipment and work necessary to complete the project.
- C. The System Integrator shall be responsible for all remote radio/PLC/HMI programming required for the project. Any radio path studies or other work necessary to communicate with the existing City wide SCADA system will be the responsibility of the System Integrator.

1.03 CONDUIT LAYOUT

- A. Install all conduits under floor slabs and in the walls in the new sections and surface mount on the existing walls where specified on the plans. Coordinate all conduit penetrations with the Engineer before proceeding with work.
- B. Some of the general routing of conduit is shown on the plans. The Electrical Contractor is responsible for locating and installing all conduits required for the project. Field verify that all equipment safeties, emergency stop switches and equipment interlocks are properly working.

1.04 REFERENCE

- A. ANSI/NFPA 70 - National Electrical Code.
- B. State of Wisconsin Electrical Code.
- C. Local Codes.

1.05 EQUIPMENT ADJUSTMENTS

- A. Submit under provisions of Division 1.
- B. Submit shop drawings and product data grouped to include complete submittals of related systems, products, and accessories in single submittals.
- C. Mark dimensions and values in units to match those specified.

1.06 PROJECT/SITE CONDITIONS

- A. Install Work in locations shown on Drawings, unless prevented by Project conditions.
- B. Prepare drawings showing proposed rearrangement of Work to meet Project conditions, including changes to Work specified in other Sections. Obtain permission of Owner or Engineer before proceeding.
- C. Where spare conductors are shown in each conduit, they shall be terminated at both ends on spare terminal blocks. They shall be identified as spare conductors unless otherwise required. If shop drawings require additional control conductors installed in the raceways, they shall be furnished and installed at no additional cost to the contract.
- D. During shop drawing review it is determined that equipment relocation or change in equipment is required, the disconnect switches, junction boxes, other electrical enclosures and conduit and wiring shall be relocated up to 30 feet from their original location whether closer or farther distance from the

intended location shown on the plans at no additional cost to the contract. This shall consider voltage drop and if the conductors are required to increase in size, this shall also occur at no additional cost to the contract.

- E. If additional junction boxes, pull boxes, hand holes, or conduit fittings are required to complete the installation, whether to meet NEC requirements or due to project conditions, these shall be furnished and installed at no additional cost to the contract.
- F. The general conduit routing of some conduits are shown on the plans, if conduit require requires a different routing this shall occur at no additional cost to the contract. Where conduits become longer the conductors shall be upsized to accommodate the minimum voltage drop as directed by the Engineer at no additional cost to the contract.
- G. If conduits entering the building require a different routing other than shown on the plans they shall enter the building to meet project conditions and these changes shall occur at no additional cost to the contract.
- H. As noted on the plans, the Electrical Contractor shall verify the location of all equipment before installing conduit, lighting, enclosures and other devices and materials with the other trades so there are no conflicts. Failure to do so will require the Electrical Contractor to relocate any equipment that is in conflict at no additional cost to the contract whether it is caused by him/her or the other trades. Where caused by the other trades immediately notify the Engineer to resolve these issues before proceeding with the installation.
- I. Where there is a conflict on the drawings indicating different conduit or conductor sizes, use the larger conduit and conductors or verify with the Engineer. This requirement shall be at no additional cost to the contract.
- J. Where light fixtures may conflict with ductwork or other items, relocate the light fixture(s) and include all necessary additional support hardware, conduit and wiring and other materials to meet project expectations. Coordinate these relocations with the Engineer at no additional cost to the contract.
- K. The Electrical Contractor shall review these requirements set forth in these specifications and understand there impact on the project.
- L. Prepare drawings showing proposed rearrangement of Work to meet Project conditions, including changes to Work specified in other Sections. Obtain permission of Owner before proceeding.

1.07 SEQUENCING AND SCHEDULING

- A. Construction Work in sequence under provisions of Division 1.

1.08 TEMPERATURE CONTROL EQUIPMENT AND WIRING

- A. The Electrical Contractor is responsible for supplying conduit, power and control wiring to the ventilation equipment and heating equipment shown on the plans. The System Integrator shall furnish the Lighting and Exhaust Fan Control Panels and the Electrical Contractor shall install power and control wiring from the electrical equipment as shown on the plans. See the Mechanical and plumbing plans for additional requirements.

1.09 CONDUIT ROUTING

- A. The Electrical Contractor shall submit conduit routing plans before installation. This information shall be supplied with the shop drawings.
- B. If the Electrical Contractor's routing does not meet the Engineers requirements, the Electrical Contractor shall relocate the conduits at no additional cost to the contract as directed by the Engineer.

1.10 TELEPHONE SERVICE

- A. The Electrical Contractor is responsible for coordinating the work required by the Telephone Company to bring telephone service into the Well Building for connection to the FACP control panel. The Electrical Contractor shall coordinate with the Owner the telephone service as required. The Telephone Company shall be responsible for equipment to provide this service.

1.11 DELIVERY, STORAGE AND HANDLING

- A. Deliver products to the project properly identified with names, model numbers, types, grades, compliance labels, and other information needed for identification.

PART 2 PRODUCTS

- A. Not Used

PART 3 EXECUTION

3.01 ROUGH-IN

- A. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.
- B. Refer to equipment specifications in Divisions 2 through 26 for rough-in requirements.

3.02 ELECTRICAL INSTALLATIONS

- A. General: Sequence, coordinate, and integrate the various elements of electrical systems, materials, and equipment. Comply with the following requirements:
 1. Coordinate electrical systems, equipment, and materials installation with other building components.
 2. Verify all dimensions by field measurements.
 3. Arrange for chases, slots, and openings in other building components during progress of construction, to allow for electrical installations.
 4. Coordinate the installation of required supporting devices and sleeves to be set in poured-in-place concrete and other structural components, as they are constructed.
 5. Sequence, coordinate, and integrate installations of electrical materials and equipment for efficient flow of the Work. Give particular attention to large equipment requiring positioning prior to closing in the building.
 6. Where mounting heights are not detailed or dimensioned, install systems, materials, and equipment to provide the maximum headroom possible.
 7. Coordinate connection of electrical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies. Provide required connection for each service.
 8. Install systems, materials, and equipment to conform with approved submittal data, including coordination drawings, to greatest extent possible. Conform to arrangements indicated by the Contract Documents, recognizing that portions of the Work are shown only in diagrammatic form. Where coordination requirements conflict with individual system requirements, refer conflict to the Engineer.
 9. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components, where installed exposed in finished spaces.
 10. Install electrical equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations.
 11. Install access panel or doors where units are concealed behind finished surfaces.

12. Install systems, materials, and equipment giving right-of-way priority to systems required to be installed at a specified slope.
13. After installation, verify that all motors are “phased” for proper rotation.
14. Coordinate electrical service work with local electrical utility company.

3.03 CUTTING AND PATCHING

- A. General: Perform cutting and patching in accordance with Division 1 Section. In addition to the requirements specified in Division 1, the following requirements apply:
 1. Perform cutting, fitting, and patching of electrical equipment and materials required to:
 - a. Uncover Work to provide for installation of ill-timed Work.
 - b. Remove and replace defective Work.
 - c. Remove and replace Work not conforming to requirements of the Contract Documents.
 - d. Remove samples of installed Work as specified for testing.
 - e. Install equipment and materials in existing structures.
 - f. Upon written instructions from the Engineer, uncover and restore Work to provide for Engineer observation of concealed Work.
 2. Cut, remove, and legally dispose of selected electrical equipment, components, and materials as indicated, including but not limited to removal of electrical items indicated to be removed and items made obsolete by the new Work.
 3. Protect the structure, furnishings, finishes, and adjacent materials not indicated or scheduled to be removed.
 4. Provide and maintain temporary partitions or dust barriers adequate to prevent the spread of dust and dirt to adjacent areas.
 5. Protection of Installed Work: During cutting and patching operations, protect adjacent installations.
 6. Patch existing finished surfaces and building components using new materials matching existing materials and experienced Installers. Installers’ qualifications refer to the materials and methods required for the surface and building components being patched.

END OF SECTION

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SECTION 26 05 01

SUBMITTAL REVIEW

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Shop Drawing review and O&M Manual review based on the Contract Documents.
- B. The list created below may not include all equipment due to Electrical Contractor substitutions when acceptable by the Engineer. With this occurrence, the Electrical Contractor shall submit additional information as directed by the Engineer at no additional cost to the contract.
- C. Project References:
 - 1. Section 01 33 00.
 - 2. Section 01 78 23.
- D. The Electrical Contractor shall submit Shop Drawings on the following Electrical Equipment:
 - 1. 600 Volt Conductors.
 - 2. Control Cables or Conductors.
 - 3. Ethernet Cable.
 - 4. Grounding Conductors and clamps.
 - 5. Ground Rods or Ground Plates. (See Plans).
 - 6. Schedule 80 PVC Conduits.
 - 7. Conduit Elbows.
 - 8. Rigid Steel Conduit.
 - 9. PVC Coated Rigid Steel Conduit.
 - 10. PVC Coated Conduit Fittings and Supports.
 - 11. Conduit Supports and Hangers.
 - 12. Interior Junction and Pull Boxes.
 - 13. Exterior Junction and Pull Boxes.
 - 14. Termination Enclosures, if required.
 - 15. Electrical Cabinets and Terminal Blocks.
 - 16. Conduit Fittings and Conduit Bodies.
 - 17. Conduit Supports.
 - 18. Interior Lighting Fixtures as Listed on the Plans.
 - 19. Exterior Lighting Fixtures as Listed on the Plans.
 - 20. Emergency Lighting Fixtures as Listed on the Plans.
 - 21. Fixture Lamps.
 - 22. Receptacles including corrosion-resistant Type and GFCI types.
 - 23. Interior and Exterior Back Boxes.
 - 24. Light Switches.
 - 25. Cover Plates and In-Use Covers.
 - 26. Panelboards.
 - 27. Circuit Breakers.
 - 28. Fuses.
 - 29. Surge Arrestors Unit(s).
 - 30. Disconnect Switches.
 - 31. Manual Starters.
 - 32. Control Transformers.
 - 33. Lighting and Power transformers.
 - 34. Magnetic Contactors and Starters.
 - 35. Relays and Contactors
 - 36. Pull Boxes and Junction Boxes, Classified and Unclassified.
 - 37. Individual Combination Motor Starters and Enclosures.
 - 38. Service Entrance Equipment.

- E. The System Integrator shall submit Shop Drawings for the following Major Instrumentation and Control Equipment:
1. SCADA Control Panel CP-12. Refer to the Process Electrical Specifications for Additional Information.
 2. Lighting & Exhaust Fan Control Panels and Pushbutton Switches and Enclosures.
 3. Pump Control Panels.
 4. Termination Enclosures.
 5. Lighting and Exhaust Fan Control Panels.
 6. Electrical and Instrumentation Devices.
 7. Motor Control Centers and Related Equipment.
 8. Instrumentation Equipment as specified.
 9. Other equipment shown on the plans and in the specifications.

1.02 SHOP DRAWING SUBMITTALS

- A. Submit Shop Drawings in accordance with procedures of Section 01 33 00. Before any components are fabricated and/or integrated into assemblies, or shipped to the site, the Electrical Contractor and System Integrator shall furnish to the Engineer and receive his review of Shop Drawings with all details, catalog cuts, inter-connecting wiring diagrams, and such other descriptive matter and documentation as described herein to fully describe the equipment and to demonstrate its conformity to these Specifications.
- B. The Shop Drawings for all Electrical Equipment shall be submitted to the Engineer under single cover. The Shop Drawings for the Instrumentation & Controls submittal may be under a separate cover.
- C. The Electrical Contractor and the System Integrator shall each provide six (6) sets of Shop Drawings in 3 ring binders (hard copy only, emailed versions are not acceptable).
- D. The Electrical equipment Shop Drawing submittal and Instrumentation & Controls Shop Drawings shall follow the specified format listed in C below. Incomplete submittals or submittals not as described in the specifications shall be returned "NOT REVIEW-RESUBMIT".

Shop Drawing Submittal for Electrical Equipment:

Each submittal shall be indexed to organize the required Electrical Equipment submittal information. The Shop Drawings shall include written description of operation (if required), equipment lists, equipment cut sheets with identification of each item submitted.

All electrical equipment documentation shall be typed and the drawings shall be produced in AutoCAD format for all control drawings and all equipment, conduit layouts and piping layouts.

Each group of equipment shall be placed in each individual section and all equipment submitted shall be clearly identified. The Electrical Contractor shall follow the general format outlined in the Instrument & Control submittal requirements.

The Shop Drawing submittal shall be all inclusive for all Electrical Equipment furnished for the project and shall contain all details, cut sheets, equipment layouts where required and the equipment shall be clearly identified for its intended purpose. The Shop Drawing submittal shall indicate the complete component listing with product literature including manufacturer's model or catalog numbers. The Electrical Contractor shall tag or otherwise identify exactly the model or catalog number of the part being furnished and where the part is to be installed in the system or building. If this information is not provided the Shop Drawings will be returned to the Electrical Contractor "**NOT REVIEWED-RESUBMIT**".

E. Shop Drawing Submittal for Instrumentation & Controls:

Provide a 3-ring binder for all Instrumentation & Controls equipment specified within and as shown on the plans. Each submittal shall be indexed to organize the required Instrumentation & Controls submittal information.

All equipment descriptive documentation shall be typed and the drawings shall be produced in AutoCAD format.

The Instrumentation & Controls submittal shall be sectioned for each project location and grouped by each item, motor or other equipment as listed in these specifications and as shown on the plans.

1. Each section shall contain the equipment, any associated control drawings and equipment required for each specified control panel located at project site, PLC program and any other information pertaining to each project location.
2. The format and content of each section is described in detail in this section.
3. System Manual organization:
 - a. Backbone and cover project identification.
 - b. Numbered indexes as follows:
 - 1) Introduction; general project and contractor references.
 - 2) Contents.
 - 3) Component listing. The System Integrator's exact "Bill of Materials" as referenced to the "Bill of Materials" referenced in the plans. Note that the "Bill of Materials" referenced on the plans may not include all items required for the project.
 - 4) Components (A through end).
 - a) With alpha numbered tab for each component, each section to include a Vendor produced data sheet and manufacturers product literature annotated for this application.
 - b) One section for each component code and one each for spares, test equipment, expendables.
 - 5) Instrument loop functional diagrams, with written loop descriptions.
 - 6) Drawing list and mechanical diagrams.
 - 7) Shop Drawings - drawing list, symbol sheets, electrical diagrams, block diagrams, interconnecting wiring, panel power and equipment wiring.
 - 8) Programmable Logic Controller program documentation in ladder logic format and each HMI display layouts and screens for the proposed HMI screens located at the SCADA Control Panel and remote Master and related equipment and other equipment shown on the plans. Assign point numbers to all inputs and outputs and indicate in the PLC program.
 - 9) Description of operation documentation and layouts. Panel and equipment sequence of operation. See item 5 above.
 - 10) PLC program documentation - written sequence of operation and computer generated ladder diagrams for each location.
 - 11) Shop Drawings - drawing list, symbol sheets, and installation details.
 - 12) Identification listings.
 - a) Panel nameplate legends.
 - b) Terminal block numbers.
 - c) Field device tag legends.
 - 13) Test procedures.
 - 14) Calibration and test records.
 - 15) Training materials.
 - 16) O&M manual outline.

F. Documentation Requirements:

1. "Bill of Material" with complete description of items supplied in sufficient detail to order spare parts; quantity used; manufacturers catalog, style, or part number; and tag or other cross reference to permit easy correlation with material appearance in specification and drawings. Catalog information shall be submitted for all equipment, regardless of whether or not it is of the same manufacturer as that listed in the specifications and in the plans. The list shall be in Excel spreadsheet format or Engineer approved equal.
2. Drawings: Provide the following:
 - a. Loop diagrams, which shall consist of an individual wiring diagram for each analog loop showing all terminal numbers, the location of the DC power supply(s), the location of any interface relays and common dropping resistors, etc. The loop diagrams shall meet the minimum requirements of ISA S5.4 plus the following requirements: Each loop diagram shall be divided into three areas for identification of element locations: front panel layouts, back

panel layouts, and field, respectively. Loop diagrams shall be on individual 11-inch by 17-inch Drawings. On each diagram present a tabular summary of:

- 1) The output capability of the transmitting instruments.
 - 2) The input impedance of each receiving instrument.
 - 3) An estimate of the loop wiring impedance based on the wire sizes and lengths shown.
 - 4) The total loop impedance.
 - 5) Reserve output capacity.
- b. Each operator interface (HMI) application programming shall fully describe the operation and functions of each key and display. This includes all legends, tags, ranges, alarms etc.
 - c. A written description and sequence shall also be provided. Submit HMI graphics in "Hand" sketched or computer generated format for preliminary review and then again for final review.
 - d. Interconnecting wiring diagrams, showing all component and panel terminal board identification numbers and external wire numbers. This diagram shall include all intermediate terminations between field elements and panels (e.g., terminal junction boxes, motor controls, etc.). Diagrams, device designations, and symbols shall be in accordance with NEMA ICS 1-101. The drawings shall contain the drawing number and terminal numbers of the interfaced equipment.
 - e. Panel mechanical drawings shall show top, front, side and back sections with dimensions. The instrument arrangement drawing shall be scaled. Internal and sub-panel equipment layout shall be provided. Include material lists, legends and scales. All drawings shall be scaled. A separate cutout detail drawing shall be provided. The HMI screens shall be provided in hard copy of graphics. The Engineer shall determine at the time of the Shop Drawing submittal if the HMI screens shall be modified. These modifications shall be provided by the System Integrator at no additional cost to the Owner.
 - f. Instrument installation detail drawings shall be provided for field process installed devices. Custom drawings shall be provided for each installation. Copies of the manufacturer's product literature shall not be acceptable. These shall be submitted for approval.
 - g. Functional loop diagrams shall be shown in the ISA standards.
 - h. The System Integrator shall submit Shop Drawings to the Engineer in accordance with the requirements of the General Conditions and Section 01 33 00.

All submittals shall be complete, neat, orderly and indexed. Partial submittals will not be accepted and will be returned- Not Reviewed-Resubmit. All components shall be referenced by the instrument name-tag designations shown. If an item(s) is not submitted, the Engineer will notify the Electrical Contractor or the System integrator and six (6) new complete submittals shall be provided. This will be considered as one of the two submittals allowed. If the second submittal is missing information and the information is not submitted in the second submittal, requiring a third submittal, the additional cost will be required by the Engineer. If the second submittal is "Approved as Noted" or Approved", a third submittal will not be required.

The Shop Drawing submittal shall be all inclusive for all Instrumentation & Control Equipment furnished for the project and shall contain all details, cut sheets, equipment layouts, wiring diagrams, and the equipment shall be clearly identified for its intended purpose. If this information is not provided the Shop Drawings will be returned to the Electrical Contractor and System Integrator "**NOT REVIEWED-RESUBMIT**".

The maximum number of Shop Drawing or O&M Manual reviews by the Engineer for each submittal group (Electrical equipment and Instrumentation and Control" shall be two (2). If more than two (2) reviews are required due to incomplete or inaccurate Shop Drawing or O&M Manual submittals, the Electrical Contractor or the System Integrator shall pay the Engineer \$1,000.00 per each additional review of each submittal. The payment shall be made to the Engineer (Powrtek Engineering, Inc) when each submittal is submitted. The Shop Drawings or O&M Manuals will not be reviewed and will be returned to the Electrical Contractor or the System Integrator. The third and subsequent Shop Drawings or O&M Manual submittals will not be further reviewed without first receiving payment in advance by the Engineer.

1.03 OPERATION AND MAINTENANCE (O&M)MANUALS

- A. Submit operation and maintenance manuals under provisions of Section 01 78 23.

- B. The O&M manuals shall be furnished at least 15 calendar days before the scheduled delivery of equipment. The manuals shall include a table of contents.
- C. The O&M manuals shall exactly follow the format of the submittal manual and include the Shop Drawings and other documentation as specified.
- D. The O&M manuals shall in addition contain an indexed section to house the calibration and loop testing documentation that shall be provided for the project.
- E. The Electrical Contractor or the System Integrator shall provide six (6) sets of "record" O&M manuals to the Engineer after the installation. The Engineer shall provide those O&M manuals to the Owner after Engineer review. If the O&M manuals are in-complete the Engineer will return the O&M Manuals to the Electrical Contractor or System Integrator for re-submittal. If this process requires more than two submittals, then the Electrical Contractor or System Integrator shall provide the same review fees as required for the Shop Drawing review(s).
- F. The factory testing results shall become part of the O & M manuals. The tests shall include the following information:
 - 1. Factory, Functional Acceptance Tests and Field Operational Acceptance Tests: Before shipment all control panels (enclosures) shall be tested for proper operation at the System Integrators panel shop before shipping to the jobsite. Results of the tests shall be recorded and submitted with the O & M Manuals.
 - 2. Field Operational Acceptance Tests: These tests are to demonstrate that the system of Process Instrumentation and Control is ready for final operation. The I&C System shall be checked for proper installation, adjusted, and calibrated on a loop-by-loop basis to verify that it is ready to function as specified. All system elements shall be checked to verify that they have been installed properly and that all terminations have been made correctly. All discrete elements and systems shall have their set points adjusted and shall be checked for proper operation (e.g., interlock functions, contact closure on rising/ falling P.V., etc.). All continuous elements and systems shall have three-point calibrations performed. All controller tuning constants shall be adjusted to preliminary settings. The operational acceptance tests shall be completed before starting the functional acceptance tests. The actual testing program shall be conducted in accordance with prior approved procedures and shall be documented as required hereinafter.
 - 3. Functional Acceptance Tests: These tests are to demonstrate that the system of Instrumentation and Controls is operating and complying with the specified performance requirements. A witnessed, functional acceptance test shall be performed on the complete system of Instrumentation and Controls. Each function shall be demonstrated to the satisfaction of the Engineer on a paragraph by paragraph and loop by loop basis. Each test shall be witnessed and signed off by the Electrical Contractor and System Integrator upon satisfactory completion. The actual testing program shall be conducted in accordance with prior approved procedures and shall be documented as required hereinafter.
 - 4. The MCC System Integrator and/or the Electrical Contractor shall notify the Engineer at least 2 weeks prior to the date of the functional acceptance test.
- G. Test Procedure Development and Test Documentation: The System Integrator/Electrical Contractor shall perform testing procedures as approved by the Engineer. The Electrical Contractor shall include in the submittal, the test procedures proposed.
- H. The Engineer may participate in many of the tests. The Engineer reserves the right to test or retest any and all specified functions whether or not explicitly stated in the prior-approved Test Procedures.
- I. The Engineer's decisions shall be final regarding the acceptability and completeness of all testing.
- J. A List of recommended spare parts shall be included in the O & M Manual.

PART 2 EXECUTION

2.01 ELECTRICAL CONTRACTOR & SYSTEM INTEGRATOR RESPONSIBILITIES

- A. Where the Electrical Contractor and/or the System Integrator's equipment interface with other equipment furnished by other Contractor's, it is the Electrical Contractor's responsibility to verify that all the submitted equipment is compatible.
- B. The Electrical Contractor and the System Integrator shall read and understand the information contained in this specification section. Any misunderstanding by the Electrical Contractor or the System Integrator is not acceptable as these requirements are bound within the Project Contract Documents.
- C. The Electrical Contractor and the System Integrator shall provide the specified information that is required by these Electrical Specifications and shall submit this information to the Engineer by mail in a timely manner.

END OF SECTION

SECTION 26 05 03

SHORT CIRCUIT/COORDINATION STUDY AND ARC FLASH HAZARD ANALYSIS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Scope:
 - 1. The System Integrator shall furnish short-circuit and protective device coordination studies as prepared by the electrical equipment manufacturer or an approved engineering firm.
 - 2. The System Integrator shall furnish an Arc Flash Hazard Analysis Study per the requirements set forth in NFPA 70E-Standard for Electrical Safety in the Workplace. The arc flash hazard analysis shall be performed according to the IEEE 1584 equations that are presented in NFPA70E, Annex D.
 - 3. The scope of the studies shall include all electrical distribution equipment furnished by the System Integrator and for other equipment furnished under this contract.
 - a. The scope of the studies shall include all new distribution equipment supplied by the equipment Manufacturer under this contract as well as all directly affected existing distribution equipment at the project facility(s).
 - b. The scope of the studies shall include all new distribution equipment supplied by the equipment Manufacturer under this contract as well as all existing distribution equipment at the customer facility. Ensure electrical equipment supplied by other Contractors is operational, within industry and manufacturer's tolerances and installed in accordance with Specifications.

1.02 RELATED SECTIONS

- A. Section 26 05 00 - Common Work Results For Electrical
- B. Section 26 05 04 - Cleaning, Inspection and Testing Electrical Equipment
- C. Section 26 24 19 - Motor Control Centers

1.03 REFERENCES

- A. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
 - 1. IEEE 141 - Recommended Practice for Electric Power Distribution and Coordination of Industrial and Commercial Power Systems.
 - 2. IEEE 242 - Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems.
 - 3. IEEE 399 - Recommended Practice for Industrial and Commercial Power System Analysis.
 - 4. IEEE 241 - Recommended Practice for Electric Power Systems in Commercial Buildings.
 - 5. IEEE 1015 - Recommended Practice for Applying Low-Voltage Circuit Breakers Used in Industrial and Commercial Power Systems.
 - 6. IEEE 1584 - Guide for Performing Arc-Flash Hazard Calculations.
- B. American National Standards Institute (ANSI)
 - 1. ANSI C57.12.00 - Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers.
 - 2. ANSI C37.13 - Standard for Low Voltage AC Power Circuit Breakers Used in Enclosures.
 - 3. ANSI C37.010 - Standard Application Guide for AC High Voltage Circuit Breakers Rated on a Symmetrical Current Basis.
 - 4. ANSI C 37.41 - Standard Design Tests for High Voltage Fuses, Distribution Enclosed Single-Pole Air Switches, Fuse Disconnecting Switches and Accessories.

- C. The National Fire Protection Association (NFPA):
 - 1. NFPA 70 - National Electrical Code, latest edition
 - 2. NFPA 70E - Standard for Electrical Safety in the Workplace Recommendations for acceptance or rejection shall be given upon consultation of Engineer.

- D. Inspections and tests shall utilize the following:
 - 1. Project specifications.
 - 2. Project drawings.
 - 3. Manufacturer's instruction manuals applicable to each particular apparatus.

- E. Requirements of Regulatory Agencies:
 - 1. National Fire Protection Associates (NFPA):
 - a. National Electrical Code (NEC) (NFPA No. 70) and State of Wisconsin amendments thereto.
 - 2. Underwriters Laboratories, Inc. (UL).
 - 3. Local Codes.

- F. National Fire Protection Associates (NFPA):
 - 1. National Electrical Code (NEC), (NFPA No. 70E).
 - 2. The System Integrator shall provide the following Arc Flash labels per NEC 110-16 and ANSI Z535.4-1998 on the electrical equipment based on the Short Circuit/ Coordination Study and Arc Flash Hazard Analysis as itemized below:
 - a. Label No.1: WARNING on first line. "Arc Flash and Shock Hazards" on second line. "Appropriate PPE Required" on third line. "Failure to Comply Can Result in Death or Injury" on fourth line and "Refer to NFPA 70E" on fifth line.
 - b. Label No.2: WARNING on first line. "Arc Flash and Shock Hazards" on second line. "Appropriate PPE Required" on third line. "Failure to Comply Can Result in Death or Injury" on fourth line "Available Three Phase bolted Fault Current" on fifth line with the appropriate fault current for the project site. The "Flash Hazard Boundary" on the sixth line, "Cal/CM 2 Flash Hazard at 18 Inches", "Hazard Risk Category" on the seventh line, Voltage "Shock Hazard" on the eighth line, "Limited Approach" on the ninth line, "Restricted Approach" on the tenth line and "Prohibited Approach" on the eleventh line.

1.04 SUBMITTALS FOR REVIEW AND APPROVAL

- A. The short-circuit and protective device coordination studies shall be submitted to the design engineer prior to receiving final approval of the distribution equipment shop drawings and/or prior to release of equipment drawings for manufacturing. If formal completion of the studies may cause delay in equipment manufacturing, approval from the engineer may be obtained for preliminary submittal of sufficient study data to ensure that the selection of device and characteristics will be satisfactory.

- B. Submit copy to Engineer.

1.05 SUBMITTALS FOR CONSTRUCTION:

- A. The results of the short circuit protective device coordination and arc flash hazard analysis studies shall be summarized in a final report that shall be submitted with the shop drawings.
 - 1. Six (6) hard bound copies of the complete final report shall be submitted.
 - 2. The printed arc flash labels shall be installed onto the major electrical equipment after installation is completed.

- B. The report shall include the following sections:
 - 1. Executive Summary.
 - 2. Descriptions, purpose, basis and scope of the study.
 - 3. Determine the amount of bus locations.
 - 4. Tabulations of circuit breaker, fuse and other protective device ratings versus calculated short circuit duties.
 - 5. Protective device time versus current coordination curves, tabulations of relay and circuit breaker trip unit settings, fuse selection.

6. Fault current calculations including a definition of terms and guide for interpretation of the computer printout.
7. Details of the incident energy and flash protection boundary calculations.
8. Recommendations for system improvements, if needed.
9. Electrical One-Line Diagram.

C. Resulting Arc flash labels shall be provided in hard copy only.

1.06 QUALIFICATIONS

- A. The short-circuit, protective device coordination and arc flash hazard analysis studies shall be conducted under the supervision and approval of a Registered Professional Electrical Engineer skilled in performing and interpreting the power system studies.
- B. The Registered Professional Electrical Engineer shall be a full-time employee of the equipment manufacturer or an approved engineering firm.
- C. The Registered Professional Electrical Engineer shall have a minimum of five (5) years of experience in performing power system studies.
- D. The equipment manufacturer or approved engineering firm shall demonstrate experience with Arc Flash Hazard Analysis by submitting names of at least ten actual arc flash hazard analysis it has performed in the past year.

1.07 COMPUTER ANALYSIS SOFTWARE

- A. The studies shall be performed using the latest revision of the SKM Systems Analysis Power Tools for Windows (PTW) software program or similar software package.

PART 2 PRODUCTS

2.01 STUDIES

- A. The System Integrator shall furnish short-circuit and protective device coordination studies as prepared by equipment manufacturer or an approved engineering firm. The Electrical Contractor shall be responsible for supplying data on equipment and motors being furnished by the other Contractors on the project.
- B. The System Integrator shall furnish an arc flash hazard analysis study per NFPA 70E - standard for electrical safety in the workplace, reference Article 130.3 and Annex D.

2.02 DATA COLLECTION

- A. The System Integrator shall furnish all data as required by the power system studies. The engineer performing the short circuit, protective device coordination and arc flash hazard analysis studies shall furnish the Electrical Contractor with a listing of required data immediately after award of the contract. The System Integrator shall expedite collection of the data to assure completion of the studies as required for final approval of the distribution equipment shop drawings and/or prior to the release of the equipment for manufacturing.
- B. Source combination may include present and future motors and generators.
- C. Load data utilized may include existing and proposed loads obtained as shown on the plans.
- D. If applicable, include fault contribution of existing motors in the study. The contractor shall obtain required existing equipment data, if necessary, to satisfy the study requirements.

2.03 SHORT-CIRCUIT AND PROTECTIVE DEVICE EVALUATION STUDY

- A. Use actual conductor impedances if known. If unknown, use typical conductor impedances based on IEEE Standard 141-1993.
- B. Transformer design impedances shall be used when test impedances are not available.
- C. Provide the following:
 - 1. Calculation methods and assumptions.
 - 2. Selected base per unit quantities.
 - 3. One-Line Diagram of the system being evaluated.
 - 4. Source impedance data, including electric utility system and motor fault contribution characteristics.
 - 5. Tabulations of calculated quantities. Note the actual available fault current from the Utility Company is shown on the electrical plans.
 - 6. Results, conclusions, and recommendations.
- D. Calculate short-circuit momentary and interrupting duties for a three-phase bolted fault at the following:
 - 1. Electric utility's supply termination point.
 - 2. Incoming switchgear or Motor Control Centers.
 - 3. Unit substation primary and secondary terminals.
 - 4. Low voltage switchgear.
 - 5. Motor control centers.
 - 6. Standby generator and automatic transfer switch.
 - 7. Branch circuit panelboards.
 - 8. Other significant locations and equipment located throughout the system.
- E. For grounded systems, provide a bolted line-to-ground fault current study for areas as defined for the three-phase bolted fault short-circuit study.
- F. Protective device evaluation:
 - 1. Evaluate equipment and protective devices and compare to short circuit ratings.
 - 2. Adequacy of switchgear, motor control centers, and panelboard bus bars to withstand short-circuit stresses.
 - 3. Notify Engineer in writing, of existing circuit protective devices improperly rated for the calculated available fault current, if applicable.

2.04 PROTECTIVE DEVICE COORDINATION STUDY

- A. Proposed protective device coordination time-current curves (TCC) shall be displayed on log-log scale graphs.
- B. Include on each TCC graph, a complete title and one-line diagram with legend identifying the specific portion of the system covered.
- C. Terminate device characteristic curves at a point reflecting maximum symmetrical or asymmetrical fault current to which the device is exposed.
- D. Identify the device associated with each curve by manufacturer type, function, and, if applicable, tap, time delay, and instantaneous settings recommended.
- E. Plot the following characteristics on the TCC graphs, where applicable:
 - 1. Electric utility's overcurrent protective device, if applicable.
 - 2. Medium voltage equipment overcurrent relays, if applicable.
 - 3. Medium and low voltage fuses including manufacturer's minimum melt, total clearing, tolerance, and damage bands, if applicable.
 - 4. Low voltage equipment circuit breaker trip devices, including manufacturer's tolerance bands.
 - 5. Transformer full-load current, magnetizing inrush current and ANSI through-fault protection curves.

6. Conductor damage curves.
 7. Ground fault protective devices, as applicable.
 8. Pertinent motor starting characteristics and motor damage points, if applicable.
 9. Pertinent generator short circuit decrement curve and generator damage point if applicable.
 10. The largest feeder(s) circuit breakers in each motor control center and applicable panelboard.
- F. Provide adequate time margins between device characteristics such that selective operation is provided, while providing proper protection.

2.05 ARC FLASH HAZARD ANALYSIS

- A. The arc flash hazard analysis shall be performed according to the IEEE 1584 equations that are presented in NFPA 70E, Annex D.
- B. The flash protection boundary and the incident energy shall be calculated at all significant locations in the electrical distribution system (switchboards, switchgear, motor-control centers, panelboards, busway and splitters) where work could be performed on energized parts.
- C. The arc-flash hazard analysis shall include all significant locations in 277/480 volt and 120/208 and 120/240 volt systems fed from transformers equal to or greater than 5 kva where work could be performed on energized parts.
- D. Safe working distances shall be based upon the calculated arc flash boundary considering an incident energy of 1.2 CAL/CM².
- E. When appropriate, the short circuit calculations and the clearing times of the phase overcurrent devices shall be retrieved from the short circuit and coordination study model. Ground overcurrent relays should not be taken into consideration when determining the clearing time when performing incident energy calculations.
- F. The short-circuit calculations and the corresponding incident energy calculations for multiple system scenarios must be compared and the greatest incident energy must be uniquely reported for each equipment location. Calculations must be performed to represent the maximum and minimum contributions of fault current magnitude for all normal and emergency operating conditions. The minimum calculation will assume that the utility contribution is at a minimum and will assume a minimum motor contribution (all motors off). Conversely, the maximum calculation will assume a maximum contribution from the utility and will assume the maximum amount of motors to be operating. Calculations shall take into consideration the parallel operation of synchronous generators with the electric utility, where applicable.
- G. The incident energy calculations must consider the accumulation of energy over time when performing arc flash calculations on buses with multiple sources. Iterative calculations must take into account the changing current contributions, as the sources are interrupted or decremented with time. Fault contribution from motors and generators should be decremented as follows:
 1. Fault contribution from induction motors should not be considered beyond 3-5 cycles.
 2. Fault contribution from induction motors should not be considered beyond 3-5 cycles.
 3. Fault contribution from synchronous motors and generators should be decayed to match the actual decrement of each as closely as possible (e.g. Contributions from permanent magnet generators will typically decay from 10 per unit to 3 per unit after 10 cycles).
- H. For the equipment locations with a separately enclosed main device (where there is adequate separation between the line side terminals of the main protective device and the work location), calculations for incident energy and flash protection boundary shall include both the line and load side of the main breaker.
- I. When performing incident energy calculations on the line side of a main breaker (as required per above), the line side and load side contributions must be included in the fault calculation.

- J. Mis-coordination should be checked amongst all devices within the branch containing the immediate protective device upstream of the calculation location and the calculation should utilize the fastest device to compute the incident energy for the corresponding location.
- K. Arc flash calculations shall be based on actual overcurrent protective device clearing time. Maximum clearing time will be capped at 2 seconds based on IEEE 1584-2002 section b.1.2.

Where it is not physically possible to move outside of the flash protection boundary in less than 2 seconds during an arc flash event, a maximum clearing time based on the specific location shall be utilized.

2.06 REPORT SECTIONS

- A. Input data shall include, but not be limited to the following:
 - 1. Feeder input data including feeder type (cable or bus), size, length, number per phase, conduit type (magnetic or non-magnetic) and conductor material (copper or aluminum).
 - 2. Transformer input data, including winding connections, secondary neutral-ground connection, primary and secondary voltage ratings, kva rating, impedance, % taps and phase shift.
 - 3. Reactor data, including voltage ratings, and impedance.
 - 4. Generation contribution data, (synchronous generators and utility), including short-circuit reactance ($X''d$), rated MVA, rated voltage, three-phase and single line-ground contribution (for utility sources) and X/R ratio.
 - 5. Motor contribution data (induction motors and synchronous motors), including short-circuit reactance, rated horsepower or kva, rated voltage, and X/R ratio.
- B. Short-circuit output data shall include, but not be limited to the following reports:
 - 1. Low voltage fault report shall include a section for three-phase and unbalanced fault calculations and shall show the following information for each applicable location:
 - a. Voltage.
 - b. Calculated fault current magnitude and angle.
 - c. Fault point x/r ratio.
 - d. Equivalent impedance.
 - 2. Momentary duty report shall include a section for three-phase and unbalanced fault calculations and shall show the following information for each applicable location:
 - a. Voltage.
 - b. Calculated fault current magnitude and angle.
 - c. Fault point x/r ratio.
 - d. Equivalent impedance.
 - 1) Based on fault point x/r ratio.
 - 2) Based on calculated symmetrical value multiplied by 1.6.
 - 3) Based on calculated symmetrical value multiplied by 2.7.
 - e. Equivalent impedance.
 - 3. Interrupting duty report shall include a section for three-phase and unbalanced fault calculations and shall show the following information for each applicable location:
 - a. Voltage.
 - b. Calculated symmetrical fault current magnitude and angle.
 - c. Fault point x/r ratio.
 - d. No ac decrement (NACD) ratio.
 - e. Equivalent impedance.
 - f. Multiplying factors for 2, 3, 5 and 8 cycle circuit breakers rated on a symmetrical basis.
 - g. Multiplying factors for 2, 3, 5 and 8 cycle circuit breakers rated on a total basis.
- C. Recommended protective device settings:
 - 1. Phase and ground relays:
 - a. Current transformer ratio.
 - b. Current setting.
 - c. Time setting.
 - d. Instantaneous setting.
 - e. Recommendations on improved relaying systems, if applicable.

2. Circuit breakers:
 - a. Adjustable pickups and time delays (long time, short time, ground).
 - b. Adjustable time-current characteristic.
 - c. Adjustable instantaneous pickup.
 - d. Recommendations on improved trip systems, if applicable.
- D. Incident energy and flash protection boundary calculations.
 1. Arcing fault magnitude.
 2. Protective device clearing time.
 3. Duration of arc.
 4. Arc flash boundary.
 5. Working distance.
 6. Incident energy.
 7. Hazard risk category.
 8. Recommendations for arc flash energy reduction.

PART 3 EXECUTION

3.01 FIELD ADJUSTMENT

- A. Adjust relay and protective device settings according to the recommended settings table provided by the coordination study. Field adjustments to be completed by the engineering service division of the equipment manufacturer under the startup and acceptance testing contract portion.
- B. Make minor modifications to equipment as required to accomplish conformance with short circuit and protective device coordination studies.
- C. Notify owner in writing of any required major equipment modifications.

3.02 ARC FLASH WARNING LABELS

- A. The System Integrator or the Electrical Contractor of the arc flash hazard analysis shall provide a 3.5 in. X 5 in. Thermal transfer type label of high adhesion polyester for each work location analyzed.
- B. All labels will be based on recommended overcurrent device settings and will be provided after the results of the analysis have been presented to the owner and after any system changes, upgrades or modifications have been incorporated in the system.
- C. The label shall include the following information, at a minimum:
 1. Location designation.
 2. Nominal voltage.
 3. Flash protection boundary.
 4. Hazard risk category.
 5. Incident energy.
 6. Working distance.
 7. Engineering report number, revision number and issue date.
- D. Labels shall be machine printed, with no field markings.
- E. Arc flash labels shall be provided in the following manner and all labels shall be based on recommended overcurrent device settings.
 1. For each 600, 480 and applicable 208 volt panelboard, one arc flash label shall be provided.
 2. For each motor control center, one arc flash label shall be provided.
 3. For each low voltage switchboard, one arc flash label shall be provided.
 4. For all switchgear, one flash label shall be provided.
 5. For medium voltage switches one arc flash label shall be provided.

- F. Labels shall be field installed by the engineering service division of the equipment manufacturer under the startup and acceptance testing contract portion.

3.03 ARC FLASH TRAINING

- A. The Electrical Contractor or the System Integrator that provides the arc flash hazard analysis shall train the Owner's qualified electrical personnel of the potential arc flash hazards associated with working on energized equipment (minimum of 4 hours). The training shall be certified for continuing education units (CEUS) by the international association for continuing education training (IACET) or equivalent.

END OF SECTION

SECTION 26 05 04

CLEANING, INSPECTION AND TESTING ELECTRICAL EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Description of Work:
1. Prior to energizing equipment, perform inspections and tests as herein specified and follow the System integrators directions.
 2. Ensure electrical equipment supplied by other Contractors is operational, within industry and manufacturer's tolerances and installed in accordance with Specifications.
 3. Before any equipment has been installed the Electrical Contractor shall megger (test) each individual branch, feeder and motor circuit installed under this contract to verify the insulation values are within specifications and that grounding continuity exists from the origin of the circuit to the load. See the INSULATION AND EQUIPMENT SCHEDULE 1A at the back of this specification section. After each circuit is tested the Electrical Contractor shall fill in the required data into the table. The Electrical Contractor shall make as many copies of the table as needed to complete the testing. The Contractor shall designate which site has been tested on the schedule. This information shall be turned over to the Engineer. If the tests do not meet the minimum values that are shown in the INSULATION RESISTANCE TESTS FOR ELECTRICAL EQUIPMENT & SYSTEMS chart, replace circuit conductors and repair or replace motors, receptacles or other devices.

1.02 QUALITY ASSURANCE

- A. Recommendations for acceptance or rejection shall be given upon consultation of Engineer.
- B. Inspections and tests shall utilize the following:
1. Project specifications.
 2. Project drawings.
 3. Manufacturer's instruction manuals applicable to each particular apparatus.
- C. Requirements of Regulatory Agencies:
1. National Fire Protection Associates (NFPA):
 - a. National Electrical Code (NEC) (NFPA No. 70) and State of Wisconsin amendments thereto Water tower, currently under construction.
 2. Underwriters Laboratories, Inc. (UL).
 3. Local Codes.
- D. National Fire Protection Associates (NFPA):
1. National Electrical Code (NEC), (NFPA No. 70E) The Electrical Contractor shall provide the required protective clothing and other protection required if working on live equipment.
 2. The Electrical Contractor shall provide the following Arc Flash labels per NEC 110-16 and ANSI Z535.4-1998 on the electrical equipment:
 - a. Label No.1: WARNING on first line. "Arc Flash and Shock Hazards" on second line. "Appropriate PPE Required" on third line. "Failure to Comply Can Result in Death or Injury" on forth line and "Refer to NFPA 70E" on fifth line.
 - b. Label No.2: WARNING on first line. "Arc Flash and Shock Hazards" on second line. "Appropriate PPE Required" on third line. "Failure to Comply Can Result in Death or Injury" on forth line "Available Three Phase bolted Fault Current" on fifth line with the appropriate fault current for the project site. The "Flash Hazard Boundary" on the sixth line, "Cal/CM 2 Flash Hazard at 18 Inches", "Hazard Risk Category" on the seventh line, Voltage "Shock Hazard" on the eighth line, "Limited Approach" on the ninth line, "Restricted Approach" on the tenth line and "Prohibited Approach" on the eleventh line.

- E. Reference Standards:
 - 1. Institute of Electrical and Electronic Engineers (IEEE):
 - a. IEEE Standard No. 81-83 - Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System.
 - b. IEEE Standard No. 400.

- F. The Electrical Contractor shall review the contract drawings and other specification sections and provide additional spare equipment as noted. In the case of duplication of spare equipment, the Electrical Contractor shall provide the spare in accordance with the specification that requires the greater number.

1.03 SUBMITTALS

- A. Test Reports and Demonstration Log:
 - 1. Permanently record checks and tests and demonstrations.
 - 2. Submit copy of complete testing or demonstration report no later than 30 days after testing or demonstration is complete.

- B. Submit copy to Engineer.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.01 DEMONSTRATIONS

- A. Demonstrate the proper operation of all electrical systems and equipment in the presence of the Owner and/or Owners designated representatives. The demonstrations shall include, but not be limited to, the following equipment and systems:
 - 1. Circuit breakers.
 - 2. Disconnect switches.
 - 3. Ground fault receptacles.
 - 4. Motor starters and contactors.
 - 5. Motor Controls.
 - 6. Motor Control Centers.
 - 7. Instrumentation and Control Panels and Systems.
 - 8. Panel Boards.
 - 9. Transformers.
 - 10. Conduit Systems.
 - 11. Lighting.
 - 12. Motors.
 - 13. Heating & ventilation equipment.
 - 14. Surge Suppression Systems.
 - 15. SCADA System.
 - 16. Pumps & VFD's.
 - 17. Instruments.
 - 18. HVAC and Lighting Control Panels.
 - 19. Security System.
 - 20. Other devices and equipment as directed by the Engineer.

- B. Demonstration Log:
 - 1. Keep log of individual demonstrations.
 - 2. Data:
 - a. Date and time of demonstration.

- b. Owner's representative.
- c. Equipment or system demonstrated.
- d. Result of demonstration.
 - 1) Success of fail.
 - 2) If failure, description of failure.
 - 3) Corrective action.
 - 4) Re-demonstration result.

3.02 TESTS

- A. Test work and equipment installed to ensure proper and safe operation in accordance with intent of drawings and specifications.
 - 1. Check interlocking and automatic control sequences and test operation of safety and protective devices.
 - 2. Correct defects.
 - 3. Cooperate with supplier's and manufacturer's representatives in order
- B. Test, adjust, and record operating voltages at each system level before energizing services, feeders or branch circuits. Re-adjust after energizing as necessary.
 - 1. Transformer taps must be adjusted to obtain as near as possible nominal system voltage. Prior to energization of transformers, check phase-to-phase and phase-to-ground insulation resistance levels. Check transformers for continuity of circuits and short circuits.
 - 2. Where transformer is under utility jurisdiction, obtain services of utility to correct voltage.
 - 3. Replace devices and equipment damaged due to failure to comply with this requirement.
 - 4. Motors:
 - a. Complete nameplate data.
 - b. Overload relay element.
 - c. Voltage and current phase readings.
 - d. Direction of rotation.
 - e. Circuit breaker/MCP instantaneous trip settings.
 - 5. Ampere readings on any cable operating in parallel to insure an even division of current.
- C. Balance load among feeder conductors at each panelboard, switchboard or substation and reconnect loads as may be necessary to obtain reasonable load balance on each phase. Electrical load unbalance shall not exceed 7-1/2%.
- D. Control Circuits, Branch Circuits, Feeders, Motor Circuits, and Transformers:
 - 1. Megger check of phase-to-phase and phase-to-ground insulation levels for all feeders. Do not megger on Hipot Test solid state equipment.
 - 2. Continuity.
 - 3. Short circuit.
 - 4. Operational check.
- E. Wiring Devices:
 - 1. Test all new receptacles with Hubbell 5200, Woodhead 1750 or equal tester for current polarity, proper ground connection, and wiring faults.

3.03 ADJUSTMENT AND CLEANING

- A. Disconnects and Motor Starters:
 - 1. Adjust covers and operating mechanisms for free mechanical movement.
 - 2. Tighten wire and cable connections to proper torque.
 - 3. Verify overcurrent protection thermal unit size with motor nameplate to provide proper operation and compliance with NEC.
 - 4. Clean interior of enclosures.
 - 5. Touch up scratched or marred surfaces to match original finish.
 - 6. Protect all VFD's and similar electrical/electronic equipment from dust and debris. Make sure all equipment is wrapped in plastic and protected during construction.

- B. Circuit Breakers:
 1. Adjustable settings shall be set to provide selective coordination, proper operation, ground fault and compliance with NEC.
 2. Provide record of all circuit breaker information and settings including circuit breaker instruction manuals and time-current characteristic curves.

3.04 GROUNDING SYSTEMS

- A. Visual and Mechanical Inspection:
 1. Inspect ground system for compliance with drawings and specifications.
- B. Electrical Tests:
 1. Fall of potential test per IEEE No. 81, Section 9.04 on main grounding electrode or system.
 2. Two-point method test per IEEE No. 81, Section 9.03, to determine ground resistance between main grounding system and major electrical equipment frame, system neutral, and derived neutral points.
 3. Alternate to two-point method.
 - a. Ground continuity test between main ground system and equipment frame, system neutral, and/or derived neutral point.
 - b. Test shall be made by passing minimum of 10 amp dc current between ground reference system and ground point to be tested.
 - c. Voltage drop shall be measured and resistance calculated by voltage drop method.
 4. Electrical grounding test shall be performed by an independent testing firm approved by the Owner or Engineer. Copies of test reports shall be submitted to the Engineer and Owner.
 5. Test Values.
 - a. Main ground electrode system resistance to ground shall be no greater than 5 ohms for commercial or industrial systems and 1 ohm or less for generating or transmission station grounds, unless otherwise specified by Engineer.

3.05 GROUND FAULT SYSTEMS

- A. Electrical Tests:
 1. Measure system neutral insulation resistance to ensure no shunt ground paths exist, neutral-ground disconnect link removed, neutral insulation resistance measured, and link replaced.
 2. Determine relay pickup current by primary injection at sensor and circuit interrupting device operated.
 3. Test relay timing by injecting 150% and 300% of pickup current into sensor. Electrically monitor total trip time.
 4. Test system operations at 55% rated voltage.
 5. Test primary service cable per IEEE 400.

INSULATION RESISTANCE TESTS FOR NEW ELECTRICAL EQUIPMENT & SYSTEMS ONLY

MAXIMUM RATING OF EQUIPMENT IN VOLTS	MINIMUM TEST VOLTAGE, DC IN VOLTS	RECOMMENDED MINIMUM INSULATION RESISTANCE*
250	500	Infinity
600	1,000	Infinity
5,000	2,500	Infinity
8,000	2,500	Infinity
15,000	2,500	Infinity
25,000	5,000	Infinity
35,000	15,000	Infinity
46,000	15,000	Infinity
69,000	15,000	infinity

Note 1: The minimum resistance level shall be 500 meg-ohms for existing motors. If resistance is less than specified, remove motor and repair or replace. If the meg-ohm readings are less than specified remove conductors and replace with new conductors as required by Specification Section 26 05 19.

END OF SECTION

INSULATION AND EQUIPMENT TEST SCHEDULE 1A: CITY OF MADISON – WELL UNIT NO.12

EQUIPMENT OR CIRCUIT NAME:	TEST BY:	TEST RESULT: PASS OR FAIL	DATE TESTED:	OWNER OR ENGINEER PRESENT:	COMMENTS:

**THE ABOVE INFORMATION SHALL BE TURNED OVER TO THE OWNER OR ENGINEER
AFTER CONSTRUCTION IS COMPLETED.**

SECTION 26 05 05

ELECTRICAL EQUIPMENT STARTUP

PART 1 GENERAL

1.01 ELECTRICAL EQUIPMENT STARTUP

- A. The Electrical Contractor shall test (MEGGER) each feeder, branch circuit, motor circuit and associated equipment per Specification Section 26 05 04 "CLEANING, INSPECTION AND TESTING ELECTRICAL EQUIPMENT" before beginning system(s) startup.
- B. Each motor shall be rotated by hand before energizing any existing equipment. Provide all system check-outs as required in Specification Division 1 and Division 22 and 23. Coordinate pump/motor startup testing with Mechanical Contractor present. Do not run pump/motor(s) dry unless otherwise directed by the Engineer.
- C. Visually inspect each motor, motor starter, control transformer, indicating lights, switches and auxiliary control equipment for damage, broken or missing parts. Field verify that each motor is protected with proper size overload and replace same if required. Where indicating lights are defective, replace same.

1.02 MEETINGS

- A. Conduct a planning meeting two weeks prior to equipment startup. Coordinate all meetings with Engineer.

1.03 PRESTARTUP CHECKOUT

- A. Field verify that all equipment safeties, emergency stop switches and equipment interlocks are properly working.
- B. Check for proper motor rotation and correct if required.

1.04 CLEANING

- A. Clean any debris that is inside each motor starter bucket, panelboard, switchboard, automatic transfer switch, disconnect switch and other electrical enclosures.

1.05 EQUIPMENT ADJUSTMENTS

- A. Check floats, limit switches, valve position switches for proper operation. Make all necessary adjustments as required for proper operation or as recommended by the manufacturer.
- B. Test and calibrate all control circuits, both analog and digital types.
- C. Verify that all new equipment is compatible. Notify the Engineer immediately if the new equipment is not compatible with equipment provided by the other trades.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

SECTION 26 05 06

BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Requirements specified in Section 26 05 00 apply to this Section.

1.02 SUMMARY

- A. This Section includes limited scope general construction materials and methods for application with electrical installations as follows:
 - 1. Excavation for underground utilities and services, including underground raceways and equipment.
 - 2. Miscellaneous metals for support of electrical materials and equipment.
 - 3. Wood Framing including nailers, blocking, fasteners, and anchorage for support of electrical materials and equipment.
 - 4. Joint sealers for sealing around electrical materials and equipment; and for sealing penetrations in fire and smoke barriers, floors, and foundation walls.

1.03 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.
- B. Shop drawings detailing fabrication and installation for metal fabrications, and wood supports and anchorage for electrical materials and equipment.
- C. Welder certificates, signed by Contractor, certifying that welders comply with requirements specified under Division 1.
- D. Schedules indicating proposed methods and sequence of operations for installation prior to commencement of Work. Include coordination for connection of electrical service.
 - 1. Coordinate sequencing with construction phasing and Owner occupancy specified in Division 1.

1.04 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced Installer for the installation and application joint sealers, access panels, and doors.
- B. Qualify welding processes and welding operators in accordance with AWS D1.1 "Structural Welding Code- Steel."
 - 1. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone re-certification.
- C. Fire-Resistance Ratings: Where a fire-resistance classification is indicated, provide access door assembly with panel door, frame, hinge, and latch from manufacturer listed in the UL "Building Materials Directory" for rating shown.
 - 1. Provide UL Label on each fire-rated access door.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Deliver joint sealer materials in original unopened containers or bundles with labels informing about manufacturer, product name and designation, color, expiration period for use, pot life, curing time, and mixing instructions for multi-component materials.
- B. Store and handle joint sealer materials in compliance with the manufacturers' recommendations to prevent their deterioration and damage.

1.06 PROJECT CONDITIONS

- A. Conditions Affecting Excavations: The following project conditions apply:
 - 1. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by excavation operations.
 - 2. Use of explosives is not permitted.
- B. Environmental Conditions: Apply joint sealers under temperature and humidity conditions within the limits permitted by the joint sealer manufacturer. Do not apply joint sealers to wet substrates.

PART 2 PRODUCTS

2.01 MISCELLANEOUS METALS

- A. Steel plates, shapes, bars, and bar grating: ASTM A 36.
- B. Cold-Formed Steel Tubing: ASTM A 500.
- C. Hot-Rolled Steel Tubing: ASTM A 501.
- D. Steel Pipe: ASTM A 53, Schedule 40, welded.
- E. Non-shrink, Nonmetallic Grout: Premixed, factory-packaged, non-staining, non-corrosive, nongaseous grout, recommended for interior and exterior applications.
- F. Fasteners: Zinc-coated, type, grade, and class as required.

2.02 MISCELLANEOUS LUMBER

- A. Framing Materials: Standard Grade, light-framing-size lumber of any species. Number 3 Common or Standard Grade boards complying with WCLIB or AWPA rules, or Number 3 boards complying with SPIB rules. Lumber shall be preservative treated in accordance with AWPB LP-2, and kiln dried to a moisture content of not more than 19 percent.
- B. Construction Panels: Plywood panels; APA C-D PLUGGED INT, with exterior glue; thickness as indicated, or if not indicated, not less than 15/32 inches.

2.03 JOINT SEALERS

- A. Fire-Resistant Joint Sealers: Two-part, foamed-in-place, silicone sealant formulated for use in through-penetration fire-stopping around cables, conduit, pipes, and duct penetrations through fire-rated walls and floors. Sealants and accessories shall have fire-resistance ratings indicated, as established by testing identical assemblies in accordance with ASTM E 814, by Underwriters' Laboratories, Inc., or other testing and inspection agency acceptable to authorities having jurisdiction.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. "Dow Corning Fire Stop Foam," Dow Corning Corp.
 - b. "Pensil 851," General Electric Co.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting installation of access panels. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.02 EXCAVATION

- A. Slope sides of excavations to comply with local codes and ordinances. Shore and brace as required for stability of excavation.
- B. Shoring and Bracing: Establish requirements for trench shoring and bracing to comply with local codes and authorities. Maintain shoring and bracing in excavations regardless of time period excavations will be open.
 - 1. Remove shoring and bracing when no longer required. Where sheeting is allowed to remain, cut top of sheeting at an elevation of 30 inches below finished grade elevation.
- C. Material Storage: Stockpile satisfactory excavated materials where directed, until required for backfill or fill. Place, grade, and shape stockpiles for proper drainage.
 - 1. Locate and retain soil materials away from edge of excavations. Do not store within drip-line of trees indicated to remain.
 - 2. Remove and legally dispose of excess excavated materials and materials not acceptable for use as backfill or fill.
- D. Trenching: Excavate trenches for electrical installations as follows:
 - 1. Excavate trenches to the uniform width, sufficiently wide to provide ample working room and a minimum of 3 to 6 inches clearance on both sides of raceways and equipment.
 - 2. Excavate trenches to depth indicated or required.
 - 3. Limit the length of open trench to that in which installations can be made and the trench backfilled within the same day.
 - 4. Where rock is encountered, carry excavation below required elevation and backfill with a layer of crushed stone or gravel prior to installation of raceways and equipment. Provide a minimum of 6 inches of stone or gravel cushion between rock bearing surface and electrical installations.
- E. Cold Weather Protection: Protect excavation bottoms against freezing when atmospheric temperature is less than 35 degrees F. (2 deg C).
- F. Backfilling and Filling: Place soil materials in layers to required subgrade elevations for each area classification listed below, using materials specified in Part 2 of this Section.
 - 1. Under walks and pavements, use a combination of sub base materials and excavated or borrowed materials.
 - 2. Under building slabs, use drainage fill materials.
 - 3. Under piping and equipment, use sub base materials where required over rock bearing surface and for correction of unauthorized excavation.
 - 4. All underground conduits shall be installed 24 inches below finished grade, measured to the top of the largest conduit in the group, unless otherwise noted, and shall be routed adjacent other underground piping as directed by the Engineer. The conduits shall be installed in trench per the details shown on the plans.
 - 5. Other areas, use excavated or borrowed materials.
- G. Backfill excavations as promptly as work permits, but not until completion of the following:
 - 1. Inspection, testing, approval, and locations of underground utilities have been recorded.
 - 2. Removal of concrete form work.
 - 3. Removal of shoring and bracing, and backfilling of voids.
 - 4. Removal of trash and debris.

- H. Placement and Compaction: Place backfill and fill materials in layers of not more than 8 inches in loose depth for material compacted by heavy equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.
- I. Before compaction, moisten or aerate each layer as necessary to provide optimum moisture content. Compact each layer to required percentage of maximum dry density or relative dry density for each area classification specified below. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.
- J. Place backfill and fill materials evenly adjacent to structures, piping, and equipment to required elevations. Prevent displacement of raceways and equipment by carrying material uniformly around them to approximately same elevation in each lift.
- K. Compaction: Control soil compaction during construction, providing minimum percentage of density specified for each area classification.

3.03 CUTTING AND PATCHING

- A. Cut, fit, and place miscellaneous metal fabrications accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
- B. Field Welding: Comply with AWS "Structural Welding Code."

3.04 ERECTION OF METAL SUPPORTS AN BACKBOARDS

- A. The Electrical Contractor shall furnish where shown metal structures or support mounted equipment. Where stainless steel, the steel shall be type 316 or better grade. All hardware and anchors shall be type 316 or better grade.
- B. Where stainless steel pipe and channel are shown on the plans the pipe shall be schedule 80 and channel shall be stainless steel, type 316.
- C. The aluminum backboards shall be a single sheet of the thickness and sizes shown on the plans. The aluminum backboards shall be attached to the stainless steel supports using 316 or better grade fasteners including bolts, washers, flat washers and lock nuts.
- D. All equipment shall be installed level and true.
- E. If welding is required, the aluminum or stainless steel shall be welded by a certified welder meeting project specifications.

3.05 ERECTION OF WOOD SUPPORTS AND ANCHORAGE

- A. Cut, fit, and place wood framing, nailers, blocking, and anchorage accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
- B. Select fastener sizes that will not penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood members.
- C. Attach to substrates as required to support applied loads.

END OF SECTION

SECTION 26 05 19

LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Building wire and cable.

1.02 REFERENCES

- A. ANSI/NFPA 70 – National Electrical Code.

1.03 SUBMITTALS

- A. Submit under provisions of Division 1.
 - 1. Submit six copies of shop drawings and samples of the following:
 - a. Wire connectors, of each type for both underground and above ground installations.
 - b. Wire identification markers or tags. See Specification section 26 05 53 for additional information on required products.
 - c. Insulation tape as specified within. Samples only need to be six inch cut-offs.
 - d. All samples will be retained by the Engineer.
- B. Test Reports: Indicate procedures and values obtained.
- C. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency specified under Regulatory Requirements.

1.04 REGULATORY REQUIREMENTS

- A. Conform to requirements of ANSI/NFPA 70.
- B. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and shown.

1.05 PROJECT CONDITIONS

- A. Verify that field measurements are as shown on Drawings.
- B. Conductor sizes are based on copper. Use 75°C ratings for all conductors. All conductors for power and lighting circuits shall be sized as shown on the plans or as required by the actual load to be served, whichever is larger. Article 310 of the NEC shall be the guide in determining conductor sizes. Long circuits shall be sized to prevent voltage drops in excess of 2 percent.
- C. Wire and cable routing shown on Drawings is approximate unless dimensioned. Route wire and cable as required to meet Project Conditions. Include wire and cable lengths within 10 feet of length shown.
- D. Where wire and cable routing is not shown, and destination only is indicated, determine exact routing and lengths required.

1.06 COORDINATION

- A. Coordinate Work under provisions of Division 1.
- B. Determine required separation between cable and other work.

- C. Determine cable routing to avoid interference with other work.

PART 2 PRODUCTS

2.01 BUILDING WIRE AND CABLE

- A. Description:
 - 1. Type; XLP insulated wire.
 - 2. Type; Thermo-plastic insulation, nylon jacket
- B. Conductor: Stranded Copper only.
- C. Insulation Voltage Rating: 600 volts.
- D. Insulation: ANSI/NFPA 70; Type XHHW insulation for feeders and branch circuits #8 AWG and larger. Type XHHW or THWN insulation for feeders and branch circuits #10 AWG and smaller. Where wiring is routed underground or wet and damp locations or classified locations (Class 1, Division 1 or Class 1, Division 2) provide XHHW only. VFD manufacturer's requirements require type XHHW insulation.
- E. Where conductors are shown to be installed into polyethylene duct, the insulation shall be type USE for direct burial applications.

2.02 WIRING CONNECTORS

- A. Split Bolt Connectors for #8 and larger wire and all motor connections. Use Vulcowrap insulating tape only as manufactured by TPC Wire and Cable Company and 3M Scotch 33 Tape as manufactured by 3M Company.
- B. Spring Wire Connectors for branch circuit #14, #12, and #10 wire. Use NSI Easy Splice Gel Tap Splice Kits below finished grade or in wet and damp location areas such as light fixture poles or similar installations where splicing is required.
- C. Compression Connectors required on all control wire and cable terminations. Control and metering wire terminations shall be completed using vinyl insulated, crimp terminals or terminal blocks designed for direct wire termination. Crimp type terminals shall not be installed on solid wires.
- D. All primary and/or secondary power cable conductor terminations for copper conductors No. 4/0 AWG size or larger shall be completed using cast bronze, two-bolt minimum, pressure type conductor terminals.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that interior of building has been protected from weather.
- B. Verify that mechanical work likely to damage wire has been completed.

3.02 PREPARATION

- A. Completely and thoroughly swab raceway before installing wire.

3.03 COMBINING OF CONDUCTORS IN RACEWAYS

- A. The following rules shall apply:
 - 1. Motor power conductors may be run together for two motors which are three horse power and less provided motors are deemed non-critical; or they may be critical but not back-ups of each other. Thus motors connected to pumps of a common type may not be run together.
 - 2. Power conductor for motors over three horse power and for critical loads without back-up should be run in separate individual conduits unless otherwise specified or approved.
 - 3. Conduit fill for power to motors shall meet the requirements of the National Electric Code.
 - 4. No more than SIX (6) current carrying conductors (including the neutral conductor) may be installed in a single conduit. Where motors are less than 10 HP, it would be permissible to combine up to 3 motor circuits into a common raceway if the conductors are derated accordingly per the current NEC code.

3.04 SPECIAL WIRING – SEE SPECIFICATION SECTION 26 05 23.01

3.05 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Use stranded conductor for feeders and branch circuits 10 AWG and larger.
- C. Use stranded conductors for control circuits.
- D. Use conductor not smaller than 12 AWG for power and lighting circuits.
- E. Use conductor not smaller than 14 AWG for control circuits.
- F. Use 10 AWG conductors for 20 ampere, 120 volt branch circuits longer than 75 feet, whether shown on the plans or not.
- G. Pull all conductors into raceway at same time.
- H. Use suitable wire pulling lubricant for building wire 8 AWG and larger.
- I. Protect exposed cable from damage.
- J. Support cables above accessible ceiling, using cable tray. Do not rest cable on ceiling panels.
- K. Use suitable cable fittings and connectors.
- L. Neatly train and lace wiring inside boxes, equipment, and panelboards.
- M. Clean conductor surfaces before installing lugs and connectors.
- N. Make splices, taps, and terminations to carry full capacity of conductors with no perceptible temperature rise.
- O. Use split bolt connectors for copper conductor splices and taps, 8 AWG and larger. Tape uninsulated conductors and connector with electrical tape to 150 percent of insulation rating of conductor.
- P. Use solderless pressure connectors with insulating covers for copper conductor splices and taps, 8 AWG and smaller.
- Q. Use insulated spring wire connectors with plastic caps for copper conductor splices and taps, 10 AWG and smaller. All wet location areas shall include the use of ideal twister DB wire connecting approved equal.

- R. Tag all wires at each end and at junction boxes. Do not change wire color at splices.

3.06 WIRING IN HAZARDOUS AREAS

- A. Wiring in hazardous areas as indicated by class, division and group on the drawings shall comply with the Electrical code requirements.
- B. All wiring shall be in PVC coated galvanized rigid steel conduit as required elsewhere in the specifications or as shown on the drawings with termination fittings approved for the class location.
- C. All boxes, fittings and joints shall be threaded for connection to conduit and shall be explosion proof and approved for the class location.
- D. Threaded joints shall be at least 5 threads fully engaged. Running threads will not be accepted.
- E. All connections to equipment which is subject to movement or vibration shall be with flexible fittings of the explosion proof type, where required.
- F. Seal-offs shall be provided in all conduit systems that enter or leave a Class 1, Division 1 or 2 locations to prevent the passage of vapors or flames from one portion of the installation to another through conduit in accordance with the code requirements.

3.07 CORROSION RESISTANT AREAS

- A. All connections and wiring shall be installed to eliminate or minimize corrosion of conductors and terminations installed in these areas.

3.08 INTERFACE WITH OTHER PRODUCTS

- A. Identify wire and cable under provisions of Section 26 05 53.
- B. Identify each conductor with its circuit number or other designation indicated on Drawings.

3.09 FIELD QUALITY CONTROL

- A. Perform field inspection and testing under provisions of Division 1.
- B. Inspect wire and cable for physical damage and proper connection.
- C. Measure tightness of bolted connections and compare torque measurements with manufacturer's recommended values.
- D. Verify continuity of each branch circuit conductor.

END OF SECTION

SECTION 26 05 23.01
SPECIAL SYSTEMS CABLE

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Analog instrument cable.
- B. Exterior rated Fiber Optic Cable. If shown on the plans.
- C. Interior rated Ethernet Copper Cable.

1.02 REFERENCES

- A. ANSI/NFPA 70 - National Electrical Code.

1.03 SUBMITTALS

- A. Submit under provisions of Division 1.
- B. Test Reports: Indicate procedures and values obtained.
- C. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency specified under Regulatory Requirements.

1.04 REGULATORY REQUIREMENTS

- A. Conform to requirements of ANSI/NFPA 70.
- B. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and shown.

1.05 PROJECT CONDITIONS

- A. Verify that field measurements are as shown on Drawings.
- B. Conductor sizes are based on copper.
- C. Wire and cable routing shown on Drawings is approximate unless dimensioned. Route wire and cable as required that meets Project Conditions. Include wire and cable lengths within 10 feet of length shown.
- D. Where wire and cable routing is not shown, and destination only is indicated, determine exact routing and lengths required.

1.06 COORDINATION

- A. Coordinate Work under provisions of Division 1.
- B. Determine required separation between cable and other work.
- C. Determine cable routing to avoid interference with other work.

PART 2 PRODUCTS

2.01 ANALOG INSTRUMENT CABLE; TRANSMITTERS INCLUDING VALVES, FLOW METERS AND SIMILAR EQUIPMENT UNLESS OTHERWISE NOTED ON THE PLANS

- A. Polyethylene insulated, tinned copper (19 by 27) stranding, 2/C #18 AWG shielded twisted pair, if length is less than 50 feet, if longer than 50 feet use 2/C #16 AWG shielded twisted pair where shown on the plans, cable with aluminum-polyester electrostatic shielding, stranded, tinned, copper drain wire, and chrome vinyl outer jacket. Provide shielding grounding at one end only.
- B. Where cables are supplied specifically for or by a manufacturer, provide the recommended cable for the project base on site conditions including length, location and temperature.
- C. Cables specified by Instrumentation Manufacturer's for equipment such as those required between level transducers or similar equipment, probes and other Instrument Transmitters or similar devices shall be provided by the Electrical Contractor whether specified or not on the plans. Coordinate with various suppliers and manufacturers.

2.02 EXTERIOR GRADE FIBER OPTIC CABLE

- A. The Fiber Optic cable(s) shall be rodent protected, loose tube indoor/outdoor and riser rated. The cable(s) shall contain 6 fiber strands in a gel filled thermoplastic tube, central E-Glass Strength Member, overall water blocking tape, fiberglass Yarn Strength Members and black PVC jacket. All fiber optic cable(s) shall be installed in polyethylene duct or conduit. Maximum recommended installation load shall be 600 lbs and 180 lbs for long term.
- B. The fiber size shall be 62.5um with max attenuation (dB/km @ 850/km/1300nm) of 3.5/1.0 with a min bandwidth (MHz-km @ 850/1300nm) of 220/600 with a numerical aperture of 0.275.

The cable(s) shall be Laser optimized and certified for Gigabit Ethernet light sources.

The Cable(s) shall be MULTI-MODE meeting IEEE 383 and UL 1581 Vertical Tray Flame Tests. The cable shall carry an OFNR FT4 rating.

- C. The SCADA System Integrator shall mate SC connectors at each end of the cable as required. The connector ferrule shall be ceramic or glass-in-ceramic, metallic, or equivalent. The optical fiber within the connector ferrule shall be secured with an adhesive or mechanical process to prevent pistoning and other movement of the fiber strand. The connector body shall be of metal or a composite material. Each cable and connector shall be tested as a completed assembly before turning over to others. If the assembly does not meet testing, provide new connectors and retest until assembly passes the attenuation tests.
- D. Multi-mode fibers shall be tested in accordance with the EIA/TIA 526-7-1998. Method A.1. Testing shall be at 1300±20 nm. Attenuation of optical fibers shall not exceed the values calculated at follows:

Attenuation (max.) = 2*C+L*F+S dB

Where C is the maximum allowable Connector Loss (in dB), L is the length of the run (in kilometers) and F is the maximum allowable fiber loss (in dB/km). S is the total splice loss (# of splices * max. attenuation per splice).

OTDR Testing

All fibers even those that are left unterminated (if applicable) shall be documented in one direction of transmission using an Optical Time Domain Reflectometer (OTDR). Multi-mode fibers shall be tested at 850-nm (nominal). Single mode fibers (if applicable) shall be tested at 1300nm (nominal). The OTDR(s) shall incorporate high-resolution optics optimized for viewing of short cable sections. Access Jumpers of adequate length to allow viewing of the entire length of the cable, including the connectors at the launch and receive end, shall be used.

OTDR traces revealing a point discontinuity greater than 0.2-dB in a multi-mode fiber, or 0.1-dB in a single mode fiber (if applicable) at any of the tested wavelengths or any discontinuity showing a reflection at that point shall be a valid basis for rejection of that fiber by the Engineer. The installation of that cable shall be reviewed in an effort to remove any external stress that may be causing the fault. If such efforts do not remove the fault, that cable and the associated terminations shall be replaced at the expense of the Electrical Contractor.

- E. The operating temperature range shall be –40 to +75 Degrees C.
- F. The cables shall be tested for the crush resistance of 750 lbs./in. min.
- G. The Electrical Contractor shall route all cables in conduit, unless otherwise noted on the plans. The conduit sweeps shall be wide radius type, as not to sever or bend cables. The cables shall be installed from the existing SCADA Panel to Hand Hole No.1 and then onto the Fine Screen Control Panel.
- H. The fiber optic cables shall be Anixter I100655 (6 strand) 62.5 micron with most current part number or Engineer approved equal.

2.03 COPPER ETHERNET CABLE

- A. A four pair #23 AWG bonded pair Category 6 cable shall be furnished and installed if required.
- B. The Cable shall be jacketed with a PVC .035" inner jacket and polyolefin insulation over the conductor. The cable shall be ANIXTER part # 11872A or Engineer approved equal.
- C. Provide RJ 45 jacks for all Ethernet copper cables when connecting to Ethernet switches and internet services jacks.
- D. A four pair #23 AWG bonded pair Category 6 cable is acceptable for telephone communications where installing telephone service using RJ 11 jacks. Tape off spare conductors.

2.04 WIRING CONNECTORS

- A. Crimp-on type fork connectors shall be used on all control wires and cables. Install connectors at all origination and termination points and in each termination/pull box (TPB) or PLC panel that cable is routed through, unless specifically stated otherwise on the floor plans.

PART 3 EXECUTION

3.01 INSTRUMENTATION OF CONDUCTORS IN RACEWAYS

- A. Separate conduit systems shall be as follows:
 - 1. Analog instrumentation.
 - 2. Digital input instrumentation (low voltage digital signals).
 - 3. Digital output instrumentation (120 volt digital cables).
- B. Conduit Locations: As shown on plans.
- C. A #14 AWG monofilament plastic pullwire shall be installed in all instrumentation conduits installed as a part of this project. This wire shall include be put into all empty and filled conduits. Pull wires shall be accurately marked at each end with a laminated tag indicating that it is a pullwire.

3.02 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.

- B. Analog instrumentation cable shall only be grounded at the control panel end.
- C. Pull all conductors into raceway at same time.
- D. Protect exposed cable from damage.
- E. Support cables above accessible ceiling, using cable tray. Do not rest cable on ceiling panels.
- F. Use suitable cable fittings and connectors.
- G. Neatly train and lace wiring inside boxes, equipment, and panelboards.
- H. Clean conductor surfaces before installing lugs and connectors.
- I. Maximum conduit fill shall be 25%.

3.03 IDENTIFICATION

- A. Identify wire and cable under provisions of Section 26 05 53.
- B. Identify each conductor with its circuit number or other designation indicated on Drawings.

3.04 TESTING COPPER & FIBER OPTIC CABLES

- A. As noted above.

3.05 INTERFACE WITH ENGINEER

- A. Prior to installing any instrumentation cable, the Contractor shall verify routing and termination type with the Engineer. The Contractor shall assume that all terminations onto terminal blocks or outlets are to be done by the Contractor unless specifically delineated otherwise on the drawings or in the specifications.

3.06 FIELD QUALITY CONTROL

- A. Perform field inspection and testing under provisions of Division 1.
- B. Inspect wire and cable for physical damage and proper connection.
- C. Verify continuity of each cable conductor. Provide written report to the Engineer that each cable has been verified.

END OF SECTION

SECTION 26 05 26

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Grounding electrodes and conductors.
- B. Equipment grounding conductors.
- C. Bonding.

1.02 REFERENCES

- A. ANSI/NFPA 70 - National Electrical Code.

1.03 GROUNDING ELECTRODE SYSTEM

- A. Ground Rod and/or Ground Electrode Plates.

1.04 PERFORMANCE REQUIREMENTS

- A. Grounding System Resistance: 5 ohms.

1.05 PROJECT RECORD DOCUMENTS

- A. Submit under provisions of Division 1.
- B. Accurately record actual locations of grounding electrodes.

1.06 REGULATORY REQUIREMENTS

- A. Conform to requirements of ANSI/NFPA 70.
- B. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and shown.
- C. UL Standard: UL standard 467 "Grounding and Bonding Equipment."

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Subject to compliance with requirements, provide products by the following:
 - 1. Anixter Bros. Inc.
 - 2. A.B. Chance Co.
 - 3. Erico Products, Inc.
 - 4. O-Z/Gedney Co.
 - 5. Raco, Inc.
 - 6. Thomas & Betts Corp.
 - 7. Or approved equal submitted in compliance with section 01 255 13.

2.02 MATERIALS

- A. Grounding and Bonding Products: Types as indicated. Where types, sizes, ratings, and quantities indicated differ from NEC requirements, the more stringent requirements and the greater size, ratings, and quantities indicated differ from NEC requirements, the more stringent requirements and the greater size, rating, and quantity indications govern.
- B. Conductor Materials: Copper.
- C. Wire and Cable Conductors: Comply with Section 26 05 19. Conform to NEC Table 8, except as otherwise indicated, for conductor properties, including stranding.
- D. Equipment Grounding Conductor: Green insulated.
- E. Grounding Electrode Conductor: Bare stranded copper conductor.
- F. Bare Copper Conductors: Conform to the following:
 - 1. Solid Conductors: ASTM B-3.
 - 2. Assembly of Stranded Conductors: ASTM B-8.
 - 3. Tinned Conductors: ASTM B-33.
- G. Ground Bus: Bare annealed copper bars of rectangular cross-section.
- H. Braided Bonding Jumpers: Copper tape, braided from No. 30-gage bare copper wire and terminated with copper ferrules.
- I. Bonding Strap Conductor/Connectors: Soft copper, 0.05 inch thick and 2 inches wide, except as indicated.
- J. Connector Products: Listed and labeled as grounding connectors for the materials with which used.
- K. Pressure Connectors: High-conductivity plated units.
- L. Bolted Clamps: Heavy-duty units listed for the application.
- M. Exothermic Welded Connections: Provided in kit form and selected for the specific types, sizes, and combinations of conductors and other items to be connected.
- N. Ground Rods: Copper-clad steel, 3/4 inch by 10 feet, minimum.
- O. Ground Plates if shown on the plans. The plates shall be 36 inch X 36 inch X 1/8 inch thick tinned copper with pigtails exothermically welded to the plate before the tinning occurs.
- P. Concrete encased grounding electrode system shall be bonded to building steel.

PART 3 INSTALLATION

3.01 EQUIPMENT GROUNDING CONDUCTOR APPLICATION

- A. Comply with NEC Article 250 for sizes and quantities of equipment grounding conductors, except where larger sizes or more conductors are indicated. Apply equipment ground conductors in accordance with the following:
 - 1. Install in separate insulated equipment grounding conductors with all circuit conductors.
 - 2. Nonmetallic Raceways: Install an insulated equipment grounding conductor in nonmetallic raceways except as otherwise indicated or unless they are designated for telephone or data cables.

3. Metal Piping Equipment Circuits: Install a separate insulated equipment grounding conductor to electrical devices connected to metallic piping systems and operating at 120 V and above, including pumps, heaters, heat tracing, and surface anti-frost heating cable. Bond the conductor to each such unit and to the piping.
- B. Underground Conductors: Bare, tinned, stranded copper except as otherwise indicated.
 - C. The Electrical Contractor shall bond to all building, process or other equipment such as steel filter tanks, pressure tanks and similar equipment when required by the process contractor or manufacturer that may not be noted on the plans at no additional cost to the contract.
 - D. Signal and communications: For telephone, alarm, and communication systems, provide a #4 AWG minimum green insulated copper conductor in raceway from the grounding electrode system to each terminal cabinet or central equipment location.
 - E. Separately derived systems required by NEC to be grounded shall be grounded as approved by the authority having jurisdiction.
 - F. Installation, General: Ground electrical systems and equipment in accordance with NEC except where grounding in excess of NEC requirements is indicated.
 - G. Ground Rods: Locate a minimum of one-rod length from each other and at least the same distance from any other grounding electrode. Interconnect ground rods with bare conductors buried at least 12 inches below grade. Connect bare-cable ground conductors to ground rods by means of exothermic welds except as otherwise indicated. Make these connections without damaging the copper coating or exposing the steel.
 - H. Ground Plates: The plates shall be horizontally installed 48 inches below finished grade.
 - I. Concrete encased electrode shall be provided as shown on the plans. The conductors shall be the size shown and shall be exothermically welded to the building rebar or mesh as detailed on the plans. The minimum length shall be 20 feet.
 - J. Grounding Electrode Conductor: Provide insulated copper conductor, sized as indicated, in conduit. Bond the ground conductor conduit to the conductor, sized as indicated, in conduit. Bond the ground conductor conduit to the conductor at each end. Where a dielectric fitting is installed in the main metallic water service pipe, connect the ground conductor to the street side of the fitting. Do not install a grounding jumper around dielectric fittings. Bond the ground conductor conduit to the conductor at each end.
 - K. Braided-Type Bonding Jumps: Install to connect ground clamps on water meter piping to electrically bypass water meters. Use elsewhere for flexible bonding and grounding connections.
 - L. Route grounding and bonding conductors using the shortest and straightest paths possible without obstructing access or placing conductors where they may be subjected to strain, impact, or damage, except as indicated.
 - M. Connections: Make connections in such a manner as to minimize possibility of galvanic action or electrolysis. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.
 1. Use electroplated or hot-tin-coated materials to assure high conductivity and make points of contact closer in order of galvanic series.
 2. Make connections with clean bare metal at points of contact.
 3. Coat and seal connections involving dissimilar metals with inert material such as red lead paint to prevent penetration of moisture to contact surfaces.
 - N. Exothermic Welded Connections: Use for connections to structural steel and for underground connections. Install at connections to ground rods. Comply with manufacturer's written

recommendations. Welds that are puffed up or that show convex surfaces indicating improper cleaning are not acceptable. Bolted ground connectors shall not be used underground or in concrete encased areas unless specified.

- O. Tighten grounding and bonding connectors and terminals, including screws and bolts, in accordance with manufacturer's published torque tightening values for connectors and bolts. Where manufacturer's torquing requirements are not indicated, tighten connections to comply with tightening torque values specified in UL 486A and UL 486B.
- P. 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 conductor.
- Q. Moisture Protection: Where insulated conductors are connected to ground rods or ground buses, insulate the entire area of the connection and seal against moisture penetration of the insulation and cable.
- R. Tests: Subject the completed grounding system to a megger test at each location where a maximum ground resistance level is specified, at service disconnect enclosure ground terminal, and at ground test wells. 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. Perform tests by the 2-point method in accordance with Section 9.03 of IEEE 81, "Guide for Measuring Earth Resistivity, Ground Impedance and Earth Surface Potentials of a Grounding System."
 - 1. Ground/resistance maximum values shall not exceed 5 ohms measured at the service entrance.
 - 2. Deficiencies: Where ground resistance exceeds specified values, and if directed, modify the grounding system to reduce resistance values. Where measures are directed that exceed those indicated the provisions of the Contract, covering changes will apply.
 - 3. Report: Prepare test reports, certified by the testing organization, of the ground resistance of each test location. Include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.

END OF SECTION

SECTION 26 05 29

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 WORK INCLUDED

- A. Conduit and equipment supports.
- B. Anchors and fasteners.
- C. Comply with NFP 70 "National Electrical Code."
- D. Electrical components shall be listed and labeled by UL, ETL, CSA, or other approved, nationally recognized testing and listing agency that provides third-party certification follow-up services.

PART 2 PRODUCTS

2.01 PRODUCT REQUIREMENTS

- A. Materials and Finishes: As a minimum, all conduit straps and hangers shall be hot dipped galvanized. All exterior mounted unistrut, and any other "wet" location, "corrosive" locations shall be stainless steel. Where shown on the drawings, provide stainless steel, or PVC coated supports and hardware.
- B. Provide materials, sizes and types of anchors, fasteners and supports to carry the loads of equipment and conduit. Consider weight of wire in conduit and conduit fittings when selecting products. Use only stainless steel hardware on exterior installations.
- C. Anchors and Fasteners:
 - 1. Concrete and Structural Elements: Use expansion anchors and preset insert channels.
 - 2. Steel Structural Elements: Use beam clamps.
 - 3. Concrete Surfaces: Use expansion anchors.
 - 4. Hollow Masonry, Plaster, and Gypsum Board Partitions: Use toggle bolts.
 - 5. Solid Masonry Walls: Use expansion anchors.
 - 6. Sheet Metal: Use stainless steel sheet metal screws.
 - 7. Wood Elements: Use stainless steel wood screws.
 - 8. All anchors and fasteners located on the exterior of buildings, electrical room, fine screen room, wet wells, dry wells shall be stainless steel.

2.02 SUPPORT CHANNEL

- A. Manufacturer:
 - 1. B-Line.
 - 2. Unistrut.
 - 3. Approved Equal.
- B. Special Requirements.
 - 1. See drawings for special requirements.
- C. Description: Galvanized steel shall be used in building interiors, except below grade applications and chemical or Class 1, Division 1 rooms, where stainless steel shall be used. Stainless steel shall be provided, as specified in Specification Section 26 05 33.01 for all exterior mounting locations. Where Stainless Steel channel is used, conduit support clamps shall be stainless steel or PVC coated.

2.03 SUPPORT RODS

- A. Manufacturer:
 - 1. B-Line.
 - 2. Unistrut.
 - 3. Approved equal.

- B. Description:
 - 1. Stainless steel with all stainless steel hardware.
 - 2. U-Channel Systems: 12-gage stainless steel channels and galvanized steel shall be 1 5/8 inches wide by 1 5/8 inches deep or 1 5/8 inches wide x 3 inches deep, with 9/16-inch-diameter holes, at a minimum of 8 inches on center, in top surface. Provide fittings and accessories that mate and match with U-channel and are of the same manufacturer.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.

- B. Install supporting devices to fasten electrical components securely and permanently in accordance with NEC requirements.

- C. Coordinate with the building structural system and with other electrical installation.

- D. Provide anchors, fasteners, and supports in accordance with NECA "Standard of Installation".

- E. Do not fasten supports to pipes, ducts, mechanical equipment, or conduit.

- F. Raceway Supports: Comply with the NEC and the following requirements:
 - 1. Conform to manufacturer's recommendations for selection and installation of supports.
 - 2. Strength of each support shall be adequate to carry present and future load multiplied by a safety factor of at least four. Where this determination results in a safety allowance of less than 200 lbs, provide additional strength until there is a minimum of 200 lbs safety allowance in the strength of each support.

- G. Do not use powder-actuated anchors.

- H. Do not drill or cut structural members.

- I. Install individual and multiple (trapeze) raceway hangers and riser clamps as necessary to support raceways. Provide U-bolts, clamps, attachments, and other hardware necessary for hanger assembly and for securing hanger rods and conduits.

- J. All conduits supports shall be hot dipped galvanized or stainless steel where otherwise noted. All hardware, including threaded rods, washers, bolts, and nuts shall be stainless steel.

- K. Support parallel runs of horizontal raceways together on trapeze-type hangers.

- L. Support individual horizontal raceways serving by separate pipe hangers. Spring steel fasteners may be used in lieu of hangers only for 1-1/2-inch and smaller raceways serving lighting and receptacle branch circuits above suspended ceilings only. For hanger rods with spring steel fasteners, use 1/4-inch-diameter or larger threaded steel. Use spring steel fasteners that are specifically designed for supporting single conduits or tubing.

- M. Space supports for raceways in accordance with Table I of this section. Space supports for raceway types not covered by the above in accordance with NEC.

- N. Support exposed and concealed raceway within of an unsupported box and access fittings. In horizontal runs, support at the box and access fittings may be omitted where box or access fittings are independently supported and raceway terminals are not made with chase nipples or threadless box connectors.
- O. In vertical runs, arrange support so the load produced by the weight of the raceway and the enclosed conductors is carried entirely by the conduit supports with no weight load on raceway terminals.
- P. Vertical Conductor Supports: Install simultaneously with installation of conductors.
- Q. Miscellaneous Supports: Support miscellaneous electrical components as required to produce the same structural safety factors as specified for raceway supports. Install metal channel racks for mounting cabinets, panelboards, disconnects, control enclosures, pull boxes, junction boxes, transformers, and other devices.
- R. In open overhead spaces, cast boxes threaded to raceways need not be supported separately except where used for fixture support; support sheet metal boxes directly from the building structure or by bar hangers. Where bar hangers are used, attach the bar to raceways on opposite sides of the box and support the raceway with an approved type of fastener not more than 24 inches from the box.
- S. Sleeves: Install in concrete slabs and walls and all other fire-rated floors and walls for raceways and cable installations. For sleeves through fire rated-wall or floor construction, apply UL-listed firestopping sealant in gaps between sleeves and enclosed conduits and cables in accordance with "Fire Resistant Joint Sealers" requirement of Section 26 05 06. Conduit Seals: Install seals for conduit penetrations of slabs on grade and exterior walls below grade and where indicated. Tighten sleeve seal screws until sealing grommets have expanded to form watertight seal.
- T. Fastening: Unless otherwise indicated, fasten electrical items and their supporting hardware securely to the building structure, including but not limited to conduits, raceways, cables, cable trays, busways, cabinets, panelboards, transformers, boxes, disconnect switches, and control components in accordance with the following:
 - 1. Holes cut to depth of more than 1-1/2 inches in reinforced concrete beams or to depth of more than 3/4 inch in concrete shall not cut the main reinforcing bars. Fill holes that are not used.
- U. Ensure that the load applied to any fastener does not exceed 25 percent of the proof test load. Use vibration- and shock-resistant fasteners for attachments to concrete slabs.

TABLE 1: SPACING FOR RACEWAY SUPPORTS

Raceway Size (Inches)	No. of Conductors in Run	Location	Maximum Spacing of Supports (Feet)		
			RMC & IMC	EMT & ALU	RNC
HORIZONTAL RUNS					
1/2,3/4	1 or 2	Flat ceiling or wall	5	5	3
1/2,3/4	1 or 2	Where it is difficult to provide supports except at intervals fixed by the building construction.	7	7	...
1/2,3/4	3 or more	Any location.	7	7	...
1/2-1	3 or more	Any location.	6	6	...
1 & larger	1 or 2	Flat ceiling or wall.	6	6	...
1 & larger	1 or 2	Where it is difficult to provide supports except at intervals fixed by the building construction.	10	10	...
Any	...	Exposed.	7	7	...
VERTICAL RUNS					
1/2,3/4	...	Exposed.	7	7	...
1,1-1/4	...	Exposed.	8	8	...
1-1/2 and larger	...	Exposed.	10	10	...
Up to 2	...	Shaftway.	14	10	...
2-1/2	...	Shaftway.	16	10	...
3 & larger	...	Shaftway.	20	10	...
Any	...	Concealed.	10	10	...

NOTES:

- (1) Maximum spacing of supports (feet).
- (2) Maximum spacings for IMC above apply above apply to straight runs only. Otherwise the maximum for EMT apply.

Abbreviations:

EMT Electrical metallic tubing.
 IMC Intermediate metallic conduit.
 RMC Rigid metallic conduit.
 RNC Rigid nonmetallic conduit.

END OF SECTION

SECTION 26 05 33.01

CONDUIT AND RACEWAYS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Applicable provisions of Division 1 shall govern work of this section.
- B. Rigid steel galvanized conduit.
- C. Rigid galvanized steel conduit, PVC coated.
- D. Non-Metallic, schedule 80 PVC.
- E. Liquid tight flexible metal conduit.
- F. Flexible metal conduit.
- G. Fittings and conduit bodies.
- H. Rigid aluminum conduit.
- I. Electrical Metallic Conduit (EMT).
- J. Electrical Metallic Tubing (EMT)
- K. Wireways.
- L. Polyethylene Duct, Type TC-7.

1.02 REFERENCE

- A. ANSI C80.1 - Rigid Steel Conduit, Zinc Coated.
- B. ANSI C80.3 - Electrical Metallic Tubing, Zinc Coated.
- C. ANSI/NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies.
- D. ANSI/NFPA 70 - National Electrical Code.
- E. NECA "Standard of Installation."
- F. NEMA RN 1 - Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.
- G. NEMA TC 2 - Electrical Plastic Tubing (EPT) and Conduit (EPC-40 and EPC-80).
- H. NEMA TC 3 - PVC Fittings for Use with Rigid PVC Conduit and Tubing.
- I. ANSI TC3 - Rigid Aluminum Conduit.

1.03 DESIGN REQUIREMENTS

- A. Conduit Size: ANSI/NFPA 70.

1.04 PROJECT RECORD DOCUMENTS

- A. Submit under provisions of Division 1.
- B. Accurately record actual routing of conduits larger than 2 inches.

1.05 REGULATORY REQUIREMENTS

- A. Conform to requirements of ANSI/NFPA 70.
- B. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and shown.

1.06 DELIVERY, STORAGE AND HANDLING

- A. Deliver, store, protect, and handle Products to site under provisions of Division 1.
- B. Accept conduit on site. Inspect for damage.
- C. Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.
- D. Protect PVC conduit from sunlight.

1.07 PROJECT CONDITIONS

- A. Verify that field measurements are as shown on Drawings.
- B. Verify routing and termination locations of conduit prior to rough-in.
- C. Conduit routing is shown on Drawings in approximate locations unless dimensioned. Route as required to complete wiring system.

PART 2 PRODUCTS

2.01 CONDUIT REQUIREMENTS-GENERAL

- A. Minimum Size: Interior mounted raceways; 3/4 inch unless otherwise specified. Exterior mounted raceways; 1 inch unless otherwise specified.
- B. Underground Installations:
 - 1. Use Schedule 80 PVC conduit for all underground installations unless otherwise noted. Where conduits extend from below the floor or grade shall be rigid steel conduit from the elbow up 12 inches AFF or AFG.
 - 2. Exposed and in wall conduits in the entry, deep well and pump/electrical rooms shall be galvanized rigid steel.
 - 3. Conduits in the chemical rooms shall be schedule 80 PVC coated galvanized rigid steel.
 - 4. Conduits exposed on the exterior or on existing water storage tank shall be galvanized rigid steel.
- C. Outdoor Locations, Above Grade: Use Galvanized Rigid Steel.
- D. Flexible Conduit: Use for lighting fixture whips only.
- E. Liquid-Tight Flexible Conduit:
 - 1. Use liquid-tight flexible metal conduit for all motors, control valves, solenoids and transformer connections or where flexibility is required for other equipment per the manufacturers requirements.
 - 2. Use in all areas for flexible connection except where flexible conduit is allowed as stated above.

- 3. Maximum length shall be 3 feet.
- F. Each conduit shall have internal grounding conductor installed.
- G. Each conduit stub-ups at the locations where conduits enter buildings shall include expansion fittings in the vertical portions above grade for the installation.
- H. Underground conduits that are longer than 75 feet shall have an expansion fitting installed near the center of the run.

2.02 CONDUIT REQUIREMENTS – FIBER OPTIC CABLES

- A. Schedule 80 PVC with long sweep elbows, extend up through the floor with steel conduit.

2.03 PVC COATED METAL CONDUIT

- A. Manufacturers:
 - 1. OCAL-Blue.
 - 2. Permacote.
 - 3. NO SUBSTITUTES.
- B. Description: NEMA RN 1; rigid steel conduit with external PVC coating, 40 mil thick. Conduit shall be provided with an internal epoxy coating.
- C. Straps and supports, Fittings, Seal-offs, Conduit Bodies and Junction Boxes: ANSI/NEMA FB 1; steel fittings with external PVC coating to match conduit.

2.04 FLEXIBLE METAL CONDUIT

- A. Description: Interlocked steel construction.
- B. Fittings: ANSI/NEMA FB 1.

2.05 LIQUIDTIGHT FLEXIBLE METAL CONDUIT

- A. Description: Interlocked steel construction with PVC jacket.
- B. Fittings: ANSI/NEMA FB 1.

2.06 ELECTRICAL METALLIC TUBING (EMT)

- A. Electrical Metallic Tubing, Zinc Coated.
- B. Fittings and Conduit Bodies: UL Listed.
- C. Couplings to be set screw type.

2.07 NONMETALLIC CONDUIT

- A. Description: NEMA TC 2; Schedule 80 PVC.
- B. Fittings and Conduit Bodies: NEMA TC 3.

2.08 POLYETHYLENE DUCT. (WHEN SPECIFIED ON THE PLANS)

- A. Description: NEMA TC-7, Schedule 40 Duct, with either trench or plow installation. The duct shall be 2 inch diameter, black in color and shall be installed at the depths shown on the plans.

2.09 WIREWAYS

- A. Electrical wire way shall be of types, sizes, and number of channels as indicated. Fittings and accessories including but not limited to couplings, accessories including but not limited to couplings, offsets, elbows, expansion joints, adapters, hold-down straps, and end caps shall match and mate with wireway as required for complete system. Where features are not indicated, select to fulfill wiring requirements and comply with applicable provisions of NEC.
- B. Wireway covers shall be hinged type.

2.10 LINKSEALS

- A. Where conduit is installed through an existing wall, floor or where water-proofing is required or where temperature extremes or corrosive conditions exist, furnish and install linkseals.
- B. Where concrete block is encountered use thermo-plastic sleeves and non-shrink grout with linkseals.
- C. All threaded hardware shall be stainless steel.
- D. Provide Thunderline linkseals or approved equal.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install electrical raceways in accordance with manufacturer's written installation instructions, applicable requirements of NEC, and as follows:
- B. Do not conceal Conduit, unless indicated otherwise. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot water pipes. Install raceways level and square and at proper elevations.
- C. Elevation of Raceway: Where possible, install horizontal raceway runs above water and steam piping.
- D. Complete installation of electrical raceways before starting installation of conductors within raceways.
- E. Provide supports for raceways as specified elsewhere in Division 26.
- F. Prevent foreign matter from entering raceways by using temporary closure protection.
- G. Protect stub-ups from damage where conduits rise from floor slabs. Arrange so curved portion of bends is not visible above the finished slab.
- H. Make bends and offsets so the inside diameter is not effectively reduced. Unless otherwise indicated, keep the legs of a bend in the same plane and the straight legs of offsets parallel.
- I. Use raceway fittings that are of types compatible with the associated raceway and suitable for the use and location.
- J. Run concealed raceways where otherwise noted with a minimum of bends in the shortest practical distance considering the type of building construction and obstructions except as otherwise indicated.
- K. Install exposed raceways parallel and perpendicular to nearby surfaces or structural members and follow the surface contours as much as practical. Where conduits are routed underground, slope all conduits to provide proper drainage.

- L. Run exposed, parallel, or banked raceways together. Make bends in parallel or banked runs from the same centerline so that the bends are parallel. Factory elbows may be used in banked runs only where they can be installed parallel. This requires that there be a change in the plane of the run such as from wall to ceiling and that the raceways be of the same size. In other cases provide field bends for parallel raceways.
- M. Join raceways with fittings designed and approved for the purpose and make joints tight. Where joints cannot be made tight, use bonding jumpers to provide electrical continuity of the raceway system. Make raceway terminations tight. Where terminations are subject to vibration, use bonding bushings or wedges to assure electrical continuity. Where subject to vibration or dampness, use insulating bushings to protect conductors.
- N. Terminations: Where raceways are terminated with locknuts and bushings, align the raceway to enter squarely and install the locknuts with dished part against the box. Where terminations cannot be made secure with one locknut, use two locknuts; one inside and one outside the box.
- O. Where terminating in threaded hubs, screw the raceway or fitting tight into the hub so the end bears against the wire protection shoulder. Where chase nipples are used, align the raceway so the coupling is square to the box, and tighten the chase nipple so no threads are exposed.
- P. Install pull wires in empty raceways. Use no. 14 AWG zinc-coated steel or monofilament plastic line having not less than 200-lb tensile strength. Leave not less than 12 inches of slack at each end of the pull wire.
- Q. Telephone and Signal System Raceways, if specified, use 2-Inch Trade Size and Smaller: In addition to the above requirements, install raceways 2-inch and smaller trade size in maximum lengths of 150 feet and with a maximum of two, 90-deg bonds or equivalent. Install pull or junction boxes where necessary to comply with these requirements.
- R. Install raceway sealing fittings in accordance with the manufacturer's written instructions. Locate fittings at suitable, approved, accessible locations and as indicated on plans, and fill them with UL-listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points and elsewhere as indicated:
 - 1. Where conduits enter or leave hazardous locations.
 - 2. Where conduits pass from warm locations to cold locations, such as the boundaries of refrigerated spaces and air-conditioned spaces.
 - 3. Where required by the NEC.
- S. Stub-up Connections: Extend conduits through concrete floor for connection to freestanding equipment with an adjustable top or coupling threaded inside for plugs and set flush with the finished floor. Extend conductors to equipment with rigid steel conduit; flexible metal conduit may be used 6 inches above the floor. Where equipment connections are not made under this contract, install screwdriver-operated threaded flush plugs flush with floor.
- T. Flexible Connections: Use short length (maximum of 6 ft.) of flexible conduit for recessed and semi-recessed lighting fixtures, for equipment subject to vibration, noise transmission, or movement; and for all motors. Use liquid tight flexible conduit in wet locations. Install separate ground conductor across flexible connections.
- U. Provide equipment grounding conductors in all raceways. Conduit shall not be the sole grounding method.
- V. Conduit expansion fittings shall be installed in all conduit runs which cross a structural expansion joint or are in excess of 100 feet without a 90 degree bend or where conduits are stubbed up on exterior applications. The expansion fittings shall match the conduit type used and shall be installed within 12 inches of finished grade or concrete slabs. Polyethylene duct does not require expansion fittings.

- W. The Engineer/Owner reserves the right to make reasonable changes in the location of outlets, apparatus, or other equipment up to the time of rough-in. Such changes, as directed by the Engineer, shall be made by the Contractor without additional compensation.
- X. Provide dux-seal in all conduits that are routed through exterior walls, underground conduits or conduits routed through areas that are air conditioned or corrosive. Where conduits are installed in explosion-proof areas provide seal-offs for each conduit. Install dux-seal in both ends of conduit where used.
- Y. Use long sweep 90 degree elbows for all fiber optic cables and service entrance conduits as shown on the plans.

3.02 SUPPORTING DEVICES

- A. Supporting devices shall be as specified in Section 26 05 29.

END OF SECTION

SECTION 26 05 33.02

BOXES AND HAND HOLES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Wall and ceiling outlet boxes.
- B. Pull and junction boxes.
- C. Hand holes.

1.02 REFERENCES

- A. ANSI/NEMA FB 1 - Fittings and Supports for Conduit and Cable Assemblies.
- B. ANSI/NEMA OS 1 - Sheet-steel Outlet Boxes, Device Boxes, Covers, and Box Supports.
- C. ANSI/NFPA 70 - National Electrical Code.
- D. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

1.03 PROJECT RECORD DOCUMENTS

- A. Submit under provisions of Division 1.
- B. Accurately record actual locations and mounting heights of outlet, pull and junction boxes.

1.04 REGULATORY REQUIREMENTS

- A. Conform to requirements of ANSI/NFPA 70.
- B. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and shown.

1.05 PROJECT CONDITIONS

- A. Verify that field measurements are as shown on Drawings.
- B. Electrical boxes are shown on Drawings in approximate locations unless dimensioned. Install at location required for box to serve intended purpose. The contractor shall include in his bid the cost to allow the Owner/Engineer to move the outlet up to 10' from the location shown on the floor plans. See plans for installation of flush or surface mounting.
- C. In existing areas it is permitted to mount the metal box on the face of the block wall, but in areas of new construction all boxes shall be recessed into the block. A sealing gasket and cover or stainless steel box shall be used where the box is located in a corrosive area.

PART 2 PRODUCTS

2.01 OUTLET BOXES

- A. Cast Iron Boxes shall be provided in all classified areas: NEMA FB 1, Type FD or other types. Provide gasketed cover by box manufacturer. Provide threaded hubs. Where PVC coated galvanized rigid steel is used, all pull boxes, cast boxes and condulets that are installed, shall be PVC coated as manufactured by OCAL Company. See conduit Specification Section 26 05 33.01 for additional requirements. Coating shall match conduit system. Brush on PVC coating will not be accepted. Where Luminaires and other equipment are supported by cast boxes, they shall be rated for the weight they are supporting.
- B. Where rigid aluminum conduit is required, use only cast aluminum fittings, boxes and condulets shall be used.
- C. Where PVC coated galvanized rigid steel conduit is specified for corrosive locations, provide NEMA 4X Stainless Steel junction boxes, pull boxes, receptacle boxes, covers and conduit fittings unless specified differently on the drawings.
- D. Where boxes are required, if shown or not on the plans and surface mounted conduits are necessary, use a Thomas & Betts cast aluminum IHEF2-2 extension ring with 3/4 inch conduit hubs in non-corrosive areas only.

2.02 PULL, JUNCTION BOXES AND SEALING FITTINGS

- A. Sheet Metal Boxes: NEMA OS 1, installed in block walls. Where PVC conduit is installed in Chemical rooms, the boxes shall be surface mounted PVC or stainless steel as required.
- B. The drawings have details indicating the type of pullboxes required where conduits enter or exit the building. If the box type is not shown it is assumed to be a NEMA 1 type for receptacles and light switches.
- C. Where junction and pull boxes are listed on the plans for interior applications as NEMA 12, provide same.
- D. Where junction and pull boxes are listed on the plans for exterior and wet locations applications as NEMA 4X, 316 stainless steel, provide same.
- E. Surface-Mounted Cast Iron Boxes: NEMA 250, Type 4X and 7; flat-flanged, surface-mounted junction boxes shall be *Feraloy* iron with PVC coating.
 - 1. Material: Feraloy cast iron.
 - 2. Cover: Furnish with ground flange, neoprene gasket, and stainless steel cover screws.
 - 3. The general sizes of junction and pull boxes are shown on the plans, if the quantity of conduits or conductor count becomes too great for those size enclosures shown on the plans or listed within, increase the size or include another junction box as necessary. IN all cases, meet the NEC for fill and conduit sizes. Where conductors are routed into these enclosures, provide terminal blocks for landing all wiring. Wire nuts shall not be used. All wiring shall be identified per electrical specifications.
- F. All contractor fabricated pull and junction boxes shall be stainless steel, type 316 or better.
- G. All sealing fittings if shown on the plans shall be made from iron and shall be PVC coated.

2.03 HAND HOLES, COMPOSITE TYPE, IF SHOWN ON THE PLANS

- A. Each hand hole shall be the size specified within and as shown on the plans. The hand holes shall be the sizes shown on the plans. The hand holes shall be installed onto a 4 inch thick concrete base with 6" X 6" square galvanized metal mesh of the size shown on the plans. Two 1-inch drain holes shall be

installed into the concrete base to permit proper drainage. The holes shall be provided by using 1 inch diameter PVC conduit as a sleeve. The bottom shall be open and shall be caulked completely around both the interior and exterior bottom.

- B. Construction. Enclosures shall be made of "composolite" type material as manufactured by Quazite Corporation or approved equal.
 - 1. Enclosure with cover shall be concrete gray color and rated for 37,500 pound design load over a space 10" x 10" area and design and tested to temperatures of -50F. Material compressive strength shall not be less than 11,000 psi.
 - 2. Box shall include factory installed divider located at the center of the long sides shown on the plans with one section for power and the other section for communications.
 - 3. The cover shall contain the logo "Electric."
 - 4. All hardware shall be stainless steel including inserts and bolts.
 - 5. The hand hole shall be UL Listed.
 - 6. The openings in the hand holes for the conduits shall be made using a holesaw or knock-out punch per the manufacturer's recommendations. The opening shall not be larger than the 1/8 inch greater than the outer diameter of the conduit. The area between the conduit and the sidewall opening shall be caulked with a silicon 30 year warranty caulk. Any other openings made by other means. If holes are cut by the use of a circular saw or similar type saw, the hand hole will be replaced with a new hand hole as directed by the Engineer at no additional cost to the contract.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install electrical boxes as shown on Drawings, and as required for splices, taps, wire pulling, equipment connections and compliance with regulatory requirements.
- B. Install electrical boxes to maintain headroom and to present neat mechanical appearance.
- C. Install pull boxes and junction boxes above accessible ceilings and in unfinished areas only.
- D. Inaccessible Ceiling Areas: Install outlet and junction boxes no more than 6 inches from ceiling access panel or from removable recessed luminaire.
- E. Install boxes to preserve fire resistance rating of partitions and other elements, using materials and methods under the provisions of NFPA-70.
- F. Align adjacent wall-mounted outlet boxes for switches, thermostats, and similar devices with each other.
- G. Use flush mounting outlet boxes in finished areas.
- H. Do not install flush mounting boxes back-to-back in walls; provide minimum 6 inch separation. Provide minimum 24 inches separation in acoustic rated walls.
- I. Secure flush mounting box to interior wall and partition studs. Accurately position to allow for surface finish thickness.
- J. Use stamped steel bridges to fasten flush mounting outlet box between studs.
- K. Install flush mounting box without damaging wall insulation or reducing its effectiveness.
- L. Use adjustable steel channel fasteners for hung ceiling outlet box.
- M. Do not fasten boxes to ceiling support wires.

- N. Support boxes independently of conduit.
- O. Use gang box where more than one device is mounted together. Do not use sectional box.
- P. Use gang box with plaster ring for single device outlets.
- Q. Use cast outlet box in exterior locations exposed to the weather and wet locations.
- R. Large Pull Boxes in non-classified areas: Boxes larger than 100 cubic inches, in volume or 12 inches in any dimension.
 - 1. Interior Dry Locations: Use hinged enclosures, NEMA 12 rated.
 - 2. Outdoor Locations: Use surface-mounted NEMA 4X stainless steel, type 316, with hinged covers. Mount using stainless steel hardware only.

3.02 INSTALLATION

- A. The contractor is responsible for providing the proper mounting surface for all equipment. It shall be assumed that boxes shall attach directly to the walls unless otherwise noted. For outside walls, provide minimum 3/8 spacers. For interior walls and where allowed by the Owner and Engineer, the Contractor may use plywood backer boards. All plywood backer boards shall be painted on all sides and ends with a minimum of 2 coats of grey enamel paint unless otherwise noted on the plans.

3.03 INTERFACE WITH OTHER PRODUCTS

- A. Coordinate mounting heights and locations of outlets mounted above counters, benches and backsplashes.
- B. Position outlet boxes to locate luminaires as shown on reflected ceiling plan.

3.04 ADJUSTING

- A. Adjust flush-mounting outlets to make front flush with finished wall material.
- B. Install knockout closure in unused box opening.

END OF SECTION

SECTION 26 05 53

IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 WORK INCLUDED

- A. Nameplates and labels.
- B. Wire and cable markers.
- C. Conduit markers.

1.02 REFERENCES

- A. Comply with NFPA 70- National Electric Code.
- B. Comply with ANSI Standard A13.1, "Scheme for the Identification of Piping Systems," with regard to type and size of lettering for raceway and cable labels.

PART 2 PRODUCTS

2.01 NAMEPLATES AND LABELS

- A. Nameplates and Labels: Engraved three-layer laminated plastic, black letters on white background. Supply for all equipment F.B.O. and furnished by electrical contractor.
- B. Locations: Install equipment/system circuit/device identification as follows:
 - 1. Apply equipment identification labels made of engraved plastic-laminate on each major unit of electrical equipment in building. This includes communication/signal/alarm systems, unless unit is specified with its own self-explanatory identification. Except as otherwise indicated, provide single line of text, with 1/2-inch-high lettering on 1-1/2-inch high label (2-inch-high lettering on 1-1/2-inch-high where two lines are required), white lettering in black field. Text shall match terminology and numbering of the Contract Documents and shop drawings. Apply labels for each unit of the following categories of electrical equipment.
 - 2. Each electrical distribution and control equipment enclosures.
 - 3. Communication cabinets and PLC Control panels.
 - 4. Each motor control center and unit.
 - 5. Each disconnect switch.
 - 6. Each switchboard breaker.
 - 7. Each switchboard section.
 - 8. Each motor combination starter/disconnect switches.
 - 9. Each separately mounted motor starters.
 - 10. Each separately mounted motor control station, such as PB and LO.
 - 11. Panel boards.
 - 12. Transformers.
 - 13. Contactors.
- C. Cable labels shall be engraved, laminated plastic plates suitable for use from -40 deg. F. to 150 deg. F., and shall be self-extinguishing, resistant to oil, water and solvents. Nameplate shall be minimum size 1-1/2" X 4". Face shall be white and the letters shall be black. Fasten label to cable with nylon tie-wraps.

Cable Ties: Fungus-inert, self-extinguishing, one-piece, self-locking nylon cable ties, 0.18-inch minimum width, 50-lb minimum tensile strength, and suitable for a temperature range from minus 50 deg F to 350 deg F. Provide ties in specified colors when used for color coding.

- D. Letter Size:
 - 1. Use 1/8 inch letters for identifying individual equipment and loads.
 - 2. Use 1/4 inch letters for identifying grouped equipment and loads.

2.02 WIRE AND CABLE MARKERS

- A. Manufacturer: Computerized Brady tags. Use Brady marker XC plus printer or equal with self-laminating vinyl tags.
- B. Description: All wire and cable numbers shall match shop drawings that have been provided with the equipment and have been provided as part of the electrical contractor's cable and wire layout submittal.
- C. Locations: Each conductor at panelboard gutters, terminal junction boxes, motor control center, local control panels (LCP), remote hand switch, push buttons or similar controls, and at each control and instrumentation device.
- D. Legend:
 - 1. Power and Lighting Circuits: Branch circuit or feeder number as indicated on the layout drawings provided to the owner by the contractor.
 - 2. Control Circuits: Control wire number and "To" and "From" indicated on schematic and interconnection diagrams on shop and approval drawings.

2.03 CONDUIT MARKERS

- A. Description: Hand written in non-erasable marker, put on conduit. Put on each duct bank and feeder conduit, at both ends write conduit number on duct bank wall where conduit enters. Put conduit numbers on all communication control and instrumentation conduits in all areas to be visible where normally viewed from.
- B. Location: Furnish markers for each conduit at each termination.
- C. All conduit markers shall match the conduit schedule that is provided to the owner by the Electrical Contractor.
- D. All fire alarm conduits and junction boxes shall be painted red.

2.04 EQUIPMENT LOCATIONS

- A. Engraved, Plastic-Laminated Labels, Signs, and Instruction Plates: Engraving stock melamine plastic laminate, 1/16-inch minimum thick for signs up to 20 square inches, or 8 inches in length; 1/8-inch thick for larger sizes. Engraved legend in white letters on black face and punched for mechanical fasteners.

PART 3 EXECUTION

3.01 PREPARATION

- A. Coordinate names, abbreviations, colors, and other designations used in electrical identification work with corresponding designations specified or indicated. Install numbers, lettering, and colors as approved in submittals and as required by code.

- B. Install identification devices in accordance with manufacturer’s written instructions and requirements of NEC.
- C. Sequence of Work: Where identification is to be applied to surfaces that require finish, install identification after completion of finish work.
 - 1. The following areas shall be identified:
 - a. On entire floor area directly above conduits running beneath and within 12 inches of a ground floor that is in contact with earth or is framed above un-excavated space.
 - b. On wall surfaces directly external to conduits run concealed within wall.
 - c. On all accessible surfaces of concrete envelope around conduits in vertical shafts, exposed at ceilings or concealed above suspended ceilings.
 - d. On entire surface of exposed conduits.
 - 2. Apply identification to areas as follows:
 - a. Clean surface of dust, loose material, and oily films before painting.
 - b. Prime surfaces: For galvanized metal, use single-component acrylic vehicle coating formulated for galvanized surfaces. For concrete masonry units, use heavy-duty acrylic resin block filler. For concrete surfaces, use clear alkali- resistant alkyd binder-type sealer.
 - c. Apply one intermediate and one finish coat of orange silicone alkyd enamel.
 - d. Apply primer and finish materials in accordance with manufacturer’s instructions.
- D. Band exposed or accessible raceways of the following systems for identification. Bands shall be pre-tensioned, snap-around colored plastic sleeves, colored adhesive marking tape, or a combination of the two. Make each color band 2 inches wide, completely encircling conduit, and place adjacent bands of two-color markings in contact, side by side. Install bands at changes in direction, at penetrations of walls and floors, and at 40-foot maximum intervals in straight runs. Apply the following colors:
 - 1. Mechanical and Electrical Supervisory System: Green and Blue.
 - 2. Telephone System: Green and Yellow.
- E. Identify Junction, Pull, and Connection Boxes: Code-required caution sign for boxes shall be pressure-sensitive, self-adhesive label indicating system voltage in black, preprinted on orange background. Install on outside of box cover. Also label box covers with identity of contained circuits. Use pressure- sensitive plastic labels at exposed locations and similar labels or plasticized card stock tags at concealed boxes.
- F. Underground Electrical Line Identification: During trench backfilling, for exterior underground power, signal, and communications lines, install continuous underground plastic line marker indicating “Caution-Buried Cable”, located directly above the center conduit at 6 to 8 inches below finished grade. Where multiple lines installed in a common trench or concrete envelope, do not exceed an overall width of 16 inches; install a single line marker.
- G. Install line marker tape for underground conduit and wiring, (both direct-buried and in raceway).
- H. Conductor Color Coding: Provide color coding for primary service, feeder, and branch circuit conductors throughout the project. Primary and secondary electrical system shall be designated as follows:

Wire Colors:

System Voltage:	208/120	4160	480/277
Phase A:	Black	Black	Brown
Phase B:	Red	Red	Orange
Phase C:	Blue	Blue	Yellow
Neutral:	White	White	Grey
Ground:	Green	Green	Green

Control Wiring:

24 Volt AC and DC: Blue

120 Volt AC: Red

All intrinsically safe wiring shall be identified with the label "INTRINSIC SAFETY WIRING" and by using light blue wire color.

- I. Use conductors with color factory-applied the entire length of the conductors except as follows:
 1. The following field-applied color-coding methods may be used in lieu of factory-coded wire for sizes larger than No. 10 AWG.
 - a. Apply colored, pressure-sensitive plastic tape in half-lapped turns for a distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply the last two laps of tape with no tension to prevent possible unwinding. Use 1-inch-wide tape in colors as specified. Do not obliterate cable identification markings by taping. Tape locations may be adjusted slightly to prevent such obliteration.
 - b. In lieu of pressure-sensitive tape, colored cable ties may be used for color identification. Apply three ties of specified color to each wire at each terminal or splice point starting 3 inches from the terminal and spaced 3 inches apart. Apply with a special tool or pliers, tighten for snug fit, and cut off excess length.
- J. Power Circuit Identification: Securely fasten plastic labels to cables, feeders, and power circuits in vaults, pull boxes, junction boxes, manholes, and switchboard rooms. Legends to correspond with designations on Drawings. If metal tags are provided, attach them with approximately 55-lb test monofilament line or one-piece self-locking nylon cable ties.
- K. Tag or label conductors as follows:
 1. Future Connections: Conductors indicated to be for future connection or connection under another contract with identification indicating source and circuit numbers.
 2. Multiple Circuits: Where multiple branch circuits or control wiring or communications/signal conductors are present in the same box or enclosure (except for three-circuit, four-wire home runs), label each conductor or cable. Provide legend indicating source, voltage, circuit number, and phase for branch circuit wiring. Phase and voltage of branch circuit wiring may be indicated by mean of coded color of conductor insulation. For control and communications/signal wiring, use color coding or wire/cable marking tape at terminations and at intermediate locations where conductors appear in wiring boxes, troughs, and control cabinets. Use consistent letter/number conductor designations throughout on wire/cable marking tapes.
 3. Match identification markings with designations used in panelboards shop drawings, Contract Documents, and similar previously established identification schemes for the facility's electrical installations.
- L. Apply warning, caution, and instruction signs and stencils as follows:
 1. Install warning, caution, or instruction signs where required by NEC, where indicated, or where reasonably required to assure safe operation and maintenance of electrical systems and of the items to which they connect. Install engraved plastic-laminated instruction signs with approved legend where instructions or explanations are needed for system or equipment operation. Install butyrate signs with metal backing for outdoor items.
- M. Apply circuit/control/item designation labels of engraved plastic laminate for disconnect switches, breakers, pushbuttons, pilot lights, motor control centers, and similar items for power distribution and control components above, except panelboards and alarm/signal components, where labeling is specified elsewhere. For panelboards, provide framed, typed circuit schedules with explicit description and identification of items controlled by each individual breaker. All wiring shall match full description of device or load. For example: M-1B-1 for MCC1B; all field wiring and terminations shall be configured to M-2-1-1 for MCC2, etc. Wiring in MCC's and other related equipment shall be identified as shown above. Color coding shall be as listed in this Specification Section. All labeling shall be identified on the shop drawings. Coordinate all identification requirements with Owner/ Engineer.
- N. Install labels at locations indicated and at locations for best convenience of viewing without interference with operation and maintenance of equipment.

END OF SECTION

SECTION 26 09 01

PROCESS INSTRUMENTATION AND CONTROL EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. This section covers all materials and work necessary for providing the SCADA control panel, HMI, software and programming, constructing, furnishing, installation, testing and startup of the instruments, controls and control panel(s), as specified hereinafter complete and at the existing to be modified Well Unit No.12 located in Madison, Wisconsin referred within as Well Unit No.12 and associated Master SCADA system located at existing Water Utility Office.
- B. The System Integrator shall provide Motor Control Centers MCC-1A, MCC-1B and MCC-2, SCADA Control Panel CP-12, all software, programming and equipment required for the installation(s) and the pre-manufactured control panel(s). Where the System Integrator and Electrical Contractor are referenced, it shall be construed to mean that the work shall include both the System Integrator and Electrical Contractor to satisfy the contract. Other associated building electrical and mechanical work that is in this contract is described elsewhere in these Division 26 specifications.

The System Integrator shall provide the complete SCADA System programming at the Master HMI software located in the existing Water Utility Office to match the proposed systems changes as specified within.

The System Integrator shall be:

L.W. Allen

Contact: Mr. Mark Kane

4633 Tompkins Drive

Madison, WI 53716

(800) 362-7266

No Approved Equal

It is the intent of these Contract Documents that all equipment, software and responsibility in this Section of the specifications be supplied by the System Integrator. The System Integrator shall assume full responsibility for furnishing, installing, and startup procedures to make the system operate per the intent of the Contract Documents.

The work includes furnishing and installing the specified instruments, motor control centers, control panels, SCADA radio equipment, networking switches, and all modifications to the existing City of Madison SCADA system for a complete and operational water control system. The work shall include all software including I/O drivers, communications, graphical interface, alarming, trending, data and report software modifications to meet the requirements of the project.

In addition, the System Integrator shall include in his bid the cost for the Longwatch Camera Integration Contractor and the Security Integration Contractor to provide the following services:

Longwatch Camera Integration:

Security System Integration:

The new SCADA control panel shall consist of Allen Bradley programmable logic controllers (PLC's) on a local area network with communications using Spread Spectrum Ethernet radio to match the existing SCADA system architecture as shown on the plans.

The System Integrator/Electrical Contractor shall be responsible for the supply and installation of all power, status, monitoring, control, alarm, and communications circuits including all wiring interconnections. The System Integrator shall be responsible for supplying the instrumentation, motor control centers, VFD's, control panels, networking switches, and radio antenna for installation by the Electrical Contractor as specified within and shown on the drawings. The System Integrator shall provide the following technical expertise to interface of the new chemical feed systems, and process pumping into the existing PLC based SCADA system as shown on the plans and as specified within.

The System Integrator shall provide all necessary programming and configuration modifications to the existing master PLC and control logic to provide radio communications to the existing Water Utility Office. Provide all necessary programming/configuration modifications to the existing master SCADA graphical interface software (including all remote located computer workstation locations). Provide all software license upgrades to allow multiple I/O server capability into the SCADA software architecture.

The System Integrator shall include all necessary programming/configuration modifications to the existing master SCADA graphical interface software as follows:

1. Well Unit specific site graphic displays
2. Process control & monitoring display(s)
3. Pumping displays.
4. Chemical feed system displays.
5. Well Unit alarm summary/history.
6. Well Unit status signals.
7. Well Unit signal trending of all analog parameters for the project.
8. Water reports.

C. REFERENCES:

1. NFPA 70, National Electrical Code (NEC) 2002.
2. National Electrical Manufacturers Association (NEMA).
3. National Fire Protection Association (NFPA).
4. NEMA ICS-2 Industrial Control Devices, Controllers, and Assemblies.
5. NEMA 250, Enclosures for Electrical Equipment. ISA:
6. Instrument Society of America.
7. UL: Underwriter's Laboratories.

D. The work specified in this Section includes furnishing, installing, start-up, testing and adjusting of all required equipment, including instruments, equipment, hardware, software, wiring, accessory equipment, and training to provide a completely operational process instrumentation and control system.

E. It shall be the responsibility of the System Integrator/Electrical Contractor to furnish a complete and fully operating system. The System Integrator/Electrical Contractor shall be responsible for all details which may be necessary to properly install, adjust and place in operation the complete installation. The System Integrator/Electrical Contractor shall assume full

responsibility for additional costs which may result from unauthorized deviations from the Contract Documents.

- F. It shall be the responsibility of the System Integrator/Electrical Contractor to examine all new and existing equipment that is transmitting a signal to, or receiving a signal from, equipment specified in this Section. The System Integrator/Electrical Contractor shall be responsible for furnishing and installing signal converters, buffer amplifiers, and isolation devices to make signal levels, reference to ground, etc. compatible between devices specified in this Section and existing equipment, if any.
- G. The major components to be furnished by the System Integrator and installed by the Electrical Contractor shall include the following:
1. SCADA Control Panel CP-12.
 2. Chlorine Room Lighting/Exhaust Fan Control Panel.
 3. Fluoride Room Lighting/Exhaust Fan Control Panel.
 4. See Specification Section 26 24 19 (Motor Control Centers) and referenced in that section for additional System Integrator/Electrical Contractor requirements.
 5. A "Bill of Materials" has been provided on the drawings for the control panels as a means of establishing standards for the equipment and the control diagrams as a means of determining system logic and panel and MCC sizes and configurations. Additional control requirements may be required for final operation of the logic and for the equipment shown on the plans. The final logic will be determined at shop drawing review once all equipment and manufacturers of equipment has been determined and therefore some control logic may change due to these factors. These changes shall be considered incidental to the contract.
 6. The SCADA system programming modifications that are required at the existing Master SCADA location HMI and PLC panel are also included in this contract. It is the System Integrator's responsibility to provide the necessary radio communications, and to upgrade the existing controls to include the proposed Well Unit No.12 into the existing SCADA system control scheme. The contract shall include all equipment, materials, labor and programming for proper operation as described within and as shown on the plans. It is the System Integrator's responsibility to field verify the radio path and provide a radio path study to determine the antenna height and location at the existing well house before submitting shop drawings for the project. If the antenna is required to be higher than shown on the plans, it is the System Integrator's responsibility to provide the Engineer with the recommended antenna structure or brackets during shop drawing review. This additional work and materials shall be considered incidental to this contract. The antenna cable provide for this project shall be rated for outdoor use and sunlight resistant.
 7. The control panels listed above and shown on the plans shall be constructed with the same standards through-out. A "Bill of Materials" is listed on the plans for the SCADA Panel.
 8. The plans also provide a layout for the Chlorine Room Lighting/Exhaust Fan Control Panel, and Fluoride Room Lighting/Exhaust Fan Control Panel is shown on the plans.
 9. Note that the Chlorine Detector is furnished by a separate supplier, but shall be installed and wired per this specification.
 10. See Specification Section 26 24 19 (Motor Control Center) for each MCC to be furnished by the System Integrator and installed by the Electrical Contractor.
 11. The I/O is shown at the back of this section. Where control wiring is located in each MCC, the wiring is referenced in the control diagrams and within these specifications.
- H. The plans and specifications are not intended to include all details of a complete equipment installation for the purpose specified. The System Integrator/Electrical Contractor shall be

responsible for all details, which may be necessary to properly install, adjust, and place in successful and continuous operation the complete installation.

- I. The work includes the furnishing of all components and functions as required on the plans and specifications.
- J. The System Integrator/Electrical Contractor shall coordinate the work specified within, with any other projects currently under construction.
- K. All electrical equipment shall include the calculations and listing of the available fault current, fuse/circuit breaker coordination and Arc Flash boundaries for each MCC, panel, panelboard, and control panel required under this contract. The Electrical Contractor shall verify the fault current calculations shown on the plans for the equipment. See Specification Section 26 05 04 "Cleaning, Inspection and Testing Electrical Equipment" for required Arc Flash Warning Labels and other requirements. Submit this information on the shop drawings. If the information is not included, the shop drawings will be sent back as an incomplete submittal.
- L. All control panels and motor control center (MCC) equipment shall be constructed in accordance with Underwriter Laboratories UL Standard 508 for "Industrial Control Panels" and shall be built in a UL recognized facility.

1.02 SUBMITTAL AND SHOP DRAWINGS

- A. Submit shop drawings in accordance with procedures of Section 01 33 00. Before any components are fabricated and/or integrated into assemblies, or shipped to the site, the Contractor/System Integrator shall furnish to the Engineer and receive his review of full details, shop drawings, catalog cuts, inter-connecting wiring diagrams, and such other descriptive matter and documentation as described herein to fully describe the equipment and to demonstrate its conformity to these Specifications.
- B. The submittal shall follow the specified format listed in C below. Incomplete submittals or submittals not as described in the specifications shall be returned "not reviewed".
- C. System Manual: A 3-ring binder shall be provided indexed as follows to organize the required submittal and shop drawing information.
- D. All equipment descriptive documentation shall be typed and the drawings shall be produced in AutoCAD format.
 - 1. The manual shall be sectioned for each project location and by each motor, instrument or other load shown on the plans. Each section shall contain control drawings and equipment required for each specified control panel located at Proposed Water Treatment Plant, PLC program and any other information pertaining to the project location.
 - 2. The format and content of each section is described in detail in this section.
 - 3. System Manual organization:
 - a. Backbone and cover project identification.
 - b. Numbered indexes as follows:
 - 1) Introduction; general project and contractor references.
 - 2) Contents.
 - 3) Component listing. The Vendors exact "Bill of Materials" as referenced to the "Bill of Materials" referenced in the plans. Note that the "Bill of Materials" referenced on the plans may not include all items required for the project.

- 4) Components (A through end).
 - a) With alpha numbered tab for each component, each section to include a Vendor produced data sheet and manufacturers product literature annotated for this application.
 - b) One section for each component code and one each for spares, test equipment, expendables.
- 5) Instrument loop functional diagrams, with written loop descriptions.
- 6) Shop drawings - drawing list and mechanical diagrams.
- 7) Shop drawings - drawing list, symbol sheets, electrical diagrams, block diagrams, interconnecting wiring, panel power and equipment wiring.
- 8) Programmable Logic Controller program documentation in ladder logic format and each HMI display layouts and screens for the existing well unit and the HMI and remote computer/HMI at the existing master control panel. Assign point numbers to all inputs and outputs and indicate in the PLC program.
- 9) Description of operation documentation and layouts. Panel and equipment sequence of operation. See item 5 above.
- 10) PLC program documentation - written sequence of operation and computer generated ladder diagrams for each location.
- 11) Shop drawings - drawing list, symbol sheets, and installation details.
- 12) Identification listings.
 - a) Panel nameplate legends.
 - b) Terminal block numbers.
 - c) Field device tag legends.
- 13) Test procedures.
- 14) Calibration and test records.
- 15) Training materials.
- 16) O&M manual outline.

E. Documentation Requirements:

1. "Bill of Material" with complete description of items supplied in sufficient detail to order spare parts; quantity used; manufacturers catalog, style, or part number; and tag or other cross reference to permit easy correlation with material appearance in specification and drawings. Catalog information shall be submitted for all equipment, regardless of whether or not it is of the same manufacturer as that listed in the specifications and in the plans. The list shall be in Excel spreadsheet format or approved equal.
2. Drawings: Provide the following:
 - a. Loop diagrams, which shall consist of an individual wiring diagram for each analog loop showing all terminal numbers, the location of the DC power supply(s), the location of any interface relays and common dropping resistors, etc. The loop diagrams shall meet the minimum requirements of ISA S5.4 plus the following requirements: Each loop diagram shall be divided into three areas for identification of element locations: panel face, back-of-panel, and field, respectively. Loop diagrams shall be on individual 11-inch by 17-inch Drawings. On each diagram present a tabular summary of:
 - 1) The output capability of the transmitting instruments.
 - 2) The input impedance of each receiving instrument.
 - 3) An estimate of the loop wiring impedance based on the wire sizes and lengths shown.
 - 4) The total loop impedance.
 - 5) Reserve output capacity.
 - b. Each operator interface (HMI) application programming shall fully describe the operation and functions of each key and display. This includes all legends, tags, ranges, alarms

etc. A written description and sequence shall also be provided. Submit HMI graphics in "Hand" sketched or computer generated format for preliminary review and then again for final review.

- c. Interconnecting wiring diagrams, showing all component and panel terminal board identification numbers and external wire numbers. This diagram shall include all intermediate terminations between field elements and panels (e.g., terminal junction boxes, motor controls, etc.). Diagrams, device designations, and symbols shall be in accordance with NEMA ICS 1-101. The drawings shall contain the drawing number and terminal numbers of the interfaced equipment.
- d. Panel mechanical drawings shall show top, front, side and back sections with dimensions. The instrument arrangement drawing shall be scaled. Internal and sub-panel equipment layout shall be provided. Include material lists, legends, scales. All drawings shall be scaled. A separate cutout detail drawing shall be provided. The HMI screens shall be provided in hard copy of graphics. The Engineer shall determine at the time of the shop drawing submittal if the HMI screens shall be modified. These modifications shall be provided by the System Integrator at no additional cost to the Owner.
- e. Instrument installation detail drawings shall be provided for field process installed devices. Custom drawings shall be provided for each installation. Copies of the manufacturer's product literature shall not be acceptable. These shall be submitted for approval.
- f. Functional loop diagrams shall be shown in the ISA standards.
- g. The Contractor/System Integrator shall submit shop drawings to the Engineer in accordance with the requirements of the General Conditions and Section 01 33 00.
- h. All submittals shall be complete, neat, orderly and indexed. Partial submittals will not be accepted. All components shall be referenced by the instrument name-tag designations shown.
- i. The SCADA Panel CP-12, Chlorine Room Lighting/Exhaust Fan Control Panel, Fluoride Room Lighting/Exhaust Fan Control Panel shall be constructed using the same standards listed throughout this specification.

1.03 OPERATION AND MAINTENANCE (O&M)MANUALS

- A. Submit operation and maintenance manuals under provisions of Section 01 78 23.
- B. The manuals shall be furnished at least 15 calendar days before the scheduled delivery of equipment. The manuals shall include a table of contents.
- C. The O&M manual shall exactly follow the format of the submittal manual and include the shop drawings and other documentation as specified.
- D. The O&M manual shall in addition contain an indexed section to house the calibration and loop testing documentation that shall be provided for the project.
- E. The Contractor/System Integrator shall provide four sets of "record" shop drawings to the Engineer after the installation. The Engineer shall provide those drawings to the Owner.
- F. Spare parts required, see 2:14 "Spare Parts" for additional information.

1.04 TESTING

- A. The System Integrator/Electrical Contractor shall coordinate testing with all other subcontractors and suppliers. The following tests are required:
1. **Factory Tests:** Before shipment all control panels (enclosures) shall be tested for proper operation at the System Integrator's panel shop before shipping to the jobsite. Results of the tests shall be recorded and submitted for approval before shipment of any control panel.
 2. **Field Operational Acceptance Tests:** The objective of these tests is to demonstrate that the system of Process Instrumentation and Control is ready for final operation. The I&C System shall be checked for proper installation, adjusted, and calibrated on a loop-by-loop basis to verify that it is ready to function as specified. All system elements shall be checked to verify that they have been installed properly and that all terminations have been made correctly. All discrete elements and systems shall have their set points adjusted and shall be checked for proper operation (e.g., interlock functions, contact closure on rising/falling P.V., etc.). All continuous elements and systems shall have three-point calibrations performed. All controller tuning constants shall be adjusted to preliminary settings. The operational acceptance tests shall be completed before starting the functional acceptance tests. The actual testing program shall be conducted in accordance with prior approved procedures and shall be documented as required hereinafter.
 3. **Functional Acceptance Tests:** The objective of these tests is to demonstrate that the system of Instrumentation and Controls is operating and complying with the specified performance requirements. A witnessed, functional acceptance test shall be performed on the complete system of Instrumentation and Controls. Each function shall be demonstrated to the satisfaction of the Engineer on a paragraph-by-paragraph and loop-by-loop basis. Each test shall be witnessed and signed off by the System Integrator/Electrical Contractor and the Engineer upon satisfactory completion. The actual testing program shall be conducted in accordance with prior approved procedures and shall be documented as required hereinafter.
 4. The contractor/System Integrator shall notify the Engineer at least 2 weeks before the date of the functional acceptance test.
- B. **Test Procedure Development and Test Documentation:** The System Integrator/Electrical Contractor shall perform testing procedures as approved by the Engineer. The Contractor shall include in the submittal, the test procedures proposed.
- C. The Engineer may participate in many of the tests. The Engineer reserves the right to test or retest any and all specified functions whether or not explicitly stated in the prior-approved Test Procedures.
- D. The Engineer's decisions shall be final regarding the acceptability and completeness of all testing.

1.05 RESPONSIBILITY FOR COMPLETE_SYSTEM

- A. The System Integrator/Electrical Contractor shall provide and be ultimately responsible for the supply, installation certification, adjustment, and startup of a complete, coordinated system that shall reliably perform the specified functions.
- B. The System Integrator/Electrical Contractor shall obtain the required information on those primary elements, including Flow Transmitters, Level transmitters, Float Controls, Pressure

Transmitters, Valves and Valve Switches, VFD'S and other control equipment or devices that are required to be interfaced with, but that are not provided under this section.

- C. The System Integrator/Electrical Contractor shall coordinate his work with the electrical and mechanical subcontractors to ensure that:
 - 1. All components provided under this section are properly installed.
 - 2. The proper type, size, and number of control wires with their conduits are provided and installed.
 - 3. Proper electric power circuits are provided for all components and systems.
- D. Specific special control cables shall be provided as required in this section, whether shown on the plans or not.

1.06 SEQUENCE OF WORK

- A. The process control panels shall be installed and pre-tested with each MCC and the SCADA control panel at the shop to determine equipment operation and then re-tested at the Well Unit. Once testing is completed it shall be placed in service. The programming at the existing Master SCADA panel shall be programmed and the complete system fully tested for communications.
- B. Other programming work shall all system programming at the existing master SCADA panel as required.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Functional Requirements:
 - 1. The control system structure and hierarchy of control and the functional operation are as shown on the drawings and described within the various specifications.
 - 2. The main elements of the control system include SCADA Control Panel CP-12. It monitors and controls process variables and equipment via Ethernet communications to the proposed SCADA panel plant control panels that in turn communicates to the existing remote master SCADA panel. The control panel programmable logic controllers (PLC) that shall monitor and perform the data gathering and communication of process signals and provides the intelligence to control and monitor the well pumps, high service pumps, valve control, level transmitters, flow transmitters, pressure transmitters, security intrusion switches and control devices, float switches, chemical feed panels and systems, other control equipment shown on the plans. The PLC's located in plant control panels shall perform the control functions required. The polling shall be performed by the PLC processor located in the SCADA Panel for outside communications to provide a fully integrated city wide telemetry system.
 - 3. The signal processing shall be designed for maximum system integrity. This affects the circuit design and wiring termination, Motor control circuitry and component and PLC I/O module selection. The operation shall have manual control via the HOA switches located at the various VFD and starter units. Any HMI failure shall not disable the ability to control system operation.
 - 4. Each PLC shall be equipped with 24VDC inputs and 120VAC outputs to drive the interposing relays for motor control and other output devices. Analog input and analog output and high speed digital cards shall also be provided as shown on the plans. The

24VDC required for the remote PLC's internal power and 24VDC inputs shall be provided by external 120VAC/24VDC power supplies as shown on the plans for all the field instrumentation. The power supplies shall be equipped with both primary and secondary internal fusing.

5. The control system shall provide continuous measurement, indication and automatic control of the flow through the well unit based upon pre-selected values as set on either HMI screen. For further discussion on system operation see Part 2.2 well unit distribution system control strategies. If either or both HMI'S should fail, the PLC shall continue to provide system control for both the automated mode and manual modes of operation. Each HMI shall be programmed the same so if one has failed, plant operation can continue with the other. The control points shall be fully adjustable over the entire range. The pumps shall be capable of being controlled in both a manual mode and in remote-auto mode. The PLC and each HMI shall provide automated and manual operation of the equipment and shall include remote mounted start stop control and speed control as shown on the plans. Normally the HOA switches located on the MCC mounted equipment will be placed in the "Auto" position. If any of these HOA switches are set to either the "Off" or "Hand" positions this information shall be sent to SCADA Control Panel CP-12 and displayed at each HMI. All status alarms will be available to the operator from either HMI and the status shall also be transmitted to the existing remote master SCADA Panel. The System Integrator shall coordinate this work with the Engineer and Owner.
 6. Note that the "Hand" position for each of the pumps shall not be connected to the PLC and shall be wired directly to the motor starters and VFD'S via interposing control relays.
 7. The system and panel design shall allow for future expansion. The panel construction shall take this into account (not directly shown on the plans) and indicate the future space and electrical power and support materials in the required submittal information. This shall be coordinated with the Engineer during shop drawing review. The control panel expansion shall account for future control strategies.
 8. 3-pole control relays shall be provided for all signals such that one contact each is available for future use.
 9. The PLC shall be totally isolated from external field signals. All outputs to inductive loads shall have surge suppressors.
 10. All new field transmitters shall have separable-unit transient surge protectors, for power line protection and signal line protection. Note that they are not shown on the plans. The communication equipment shall also have the same types of protection in the panel.
 11. The control panels as completed assemblies shall be UL listed by a single supplier. Non-UL components shall be installed according to UL requirements including all the required power distribution wiring components and installation practices. All panels constructed under this contract shall bear the UL Label.
 12. The signal processing shall be such that all field signals shall be 4-20 MADC and/or Pulse.
 13. These current signals shall have loop resistors installed at the terminal blocks for 1-5 VDC signaling to each component in the loop, individually from the terminal block.
 14. The control panel shall have an alarm annunciation system complete with horn, horn shutoff switch (front of panel). The horn shall be controlled and reset directly through the PLC. The shut off switch shall be hard wired to the horn. See the plans for other required equipment.
 15. Refer to the Drawings for the I/O required for the PLC.
- B. The specified components have been selected for their form, fit and function for the project design. The named products and specified methods are provided as a means to establish standards.

- C. The component specifications are defined by the component code description, the installation details, the loop functions, the overall system integrity design, and any other project document defining the work.
- D. Graphics shall show current analog values (in engineering units), digital values and equipment status. Graphics showing process equipment (e.g., pumps, blowers, valves, etc.) shall be interfaced with all related input/output points so that current status of the equipment is shown:
- 1) White - valve closed.
 - 2) Green - valve open.
 - 3) Red - alarm condition.
 - 4) Flashing - valve in intermediate position.
 - 5) Yellow - motor required. Control Graphics.
- See Part 2.05 for additional requirements.
- E. The System Integrator shall construct approximately twenty (20) or more graphic screens for operator control of pumps, valves and equipment as specified. Each graphic screen shall allow operator to place equipment in "AUTO" mode and adjust set points and timing values as specified in the functional descriptions for each equipment item.
- F. Alarms
1. Each HMI shall have screen(s) to display all current system alarms, including PLC inputs and PLC software-generated alarms. This shall include screens dedicated to listing alarms and to the individual process screens which shall show the associated alarms. When an alarm occurs, display the alarm description, location and time of occurrence. Store all alarms in the PLC for 90 days before automatically clearing the alarm from the log.
 2. Permit the operator to acknowledge alarms at both HMI units.
 3. Provide screen(s) showing all alarm points, including PLC inputs and software-generated alarms.
 4. Allow the operator to disable individual alarms at each HMI. Provide password protection for this feature.
 5. Initiate an alarm if a piece of equipment is called to operate and a "running" signal is not returned after the timed sequencing shown on the plans, or if not shown, five (5) seconds, configurable.
 6. Provide time delays for all alarm inputs. Time delay shall be adjustable at each HMI.
- G. Analog Value Alarms
1. Allow operator to assign "high" and "low" software setpoints to all analog inputs. If measured value exceeds the high setpoint or falls below the low setpoint, energize an associated alarm at the HMI. All displays and software setpoints shall be in engineering units.
 2. Analog value alarms shall function as described above for plant alarms.
- H. Software Control Switch
1. All equipment controlled by the PLC shall have a hard wired Hand-Off-Auto switch and hard and soft stop start functions. In the Hand mode, the equipment shall be called to operate. In the Auto mode, the piece of equipment shall be called to operate as described herein. In the Off mode, the equipment shall not be called to operate regardless of the controlling value status. If the equipment should be called to operate based on the controlling logic described, but the equipment is in the Off or Hand mode, generate an associated "Not in Auto" alarm.

2. Provide an HMI screen to show the status of the software stop start switch for the equipment.
- I. Software Run Time Meters
 1. Each piece of equipment with a "Running" contact monitored by the PLC shall have software Elapsed Time Meters (ETM).
 2. Software ETM shall monitor the "running" contact and the HMI shall display totalized, non-resettable run time in hours and tenths, and runtime for the last 24 hours in hours and tenths.
 - J. Variable Frequency Drives (VFD)
 1. Each variable frequency drive (VFD) shall be controlled by the PLC and shall allow the operator to set maximum and minimum motor speeds. Alarm if a closed-loop set point is not maintainable within the motor maximum and minimum speeds. Coordinate with the motor supplier the minimum allowable speed.
 2. Monitor VFD alarm contacts. Generate associate alarm.
 3. Monitor and indicate motor speed. Alarm if motor speed running does not agree with the motor speed called while drive is in any "Auto" mode.
 4. When the software HOA is put in the Hand position requires the operator shall be able to locally or remotely control the motor speed.
 - K. Valves
 1. Upon sending an OPEN or CLOSE command to the valves, the PLC shall monitor the limit switches to verify proper operation. If after 30 seconds (adjustable) the valve has not properly responded, generate an alarm.
 2. Upon sending a position signal for modulating valves, the PLC shall monitor the feedback signal to verify proper operation. If after 30 seconds (adjustable) the valve has not properly responded within an adjustable deadband, generate an alarm. Display valve position.

2.02 EQUIPMENT CONTROL STRATEGIES

- A. Each of the Proposed High Service Pumps P-HS-1 & P-HS-2 shall receive their "Call to Start" from the remote master SCADA panel through Control panel CP-12 PLC system when the pressures in the water system for either the city's Zone 7 or Zone 8 pressure zones begin to drop below user adjustable pressure set points, sequentially starting each high service pump to maintain water pressure levels. Note that each pump has a time delay on start so they all cannot start simultaneously. See the Control Diagram for additional information on the time delay starts for sequencing.
 1. SCADA Control Panel CP-12 shall monitor and control the two (2) high service pumps. Each of the pumps shall be controlled based on water pressures in the City's Zone 7 and Zone 8 pressure zones.
 2. If the SCADA communications signal is lost after three (3) attempts, or if the PLC watchdog relay is turned off due to a PLC failure, the high service pumps shall be controlled by respective Pressure Transmitters PIT-1-1 & PIT-2-1. The control loop logic shall be determined during installation to configure the pressure settings in Control Panel CP-12. Field coordinate with the Engineer.
 3. The Control strategy shall allow the operator to establish ascending set points for the operation of each high service pump based on system pressure level signals.
 4. SCADA Control Panel CP-12 shall contain a proportional control loop that will vary the pump speeds in proportion to water pressure level signals between the "Minimum Pumping Speed" and "Maximum Pumping Speed" set points. As pressure level rises to a "Start" set

- point, call for the associated pumping stage, and continue calling for that stage until level falls below the respective "Stop" set point. All pumps shall operate at the same speed.
5. Provide a software time-of-day alternator to equalize wear on the two high service pumps by switching the operating order every 24 hours. Allow the operator to:
 - a. Set the time of day when the alternator advances.
 - b. Select from any fixed pump sequence, or automatic alternation.
 - c. Remove a pump(s) from the sequence for servicing. This shall also be coordinated with the Owner's existing summer/winter control schemes, if necessary.
 6. When called to stop, the high service pumps shall continue operating for a preset, adjustable time (0-300 seconds).
- B. Chlorine Gas Injection and Fluoride Operation:
1. Connect and terminate wiring for the scales required for the Fluoride tank. Confirm measurement ranges during construction.
 2. The well pump flow meter shall provide "running" contacts shall provide the necessary permissive signals for the chlorine injector solenoid valve and fluoride pumps to operate.
 3. Level transmitters shall be a two-wire, loop-powered units, and shall produce 4-20 mdc signals that are linearly proportional with level over the specified ranges.
 4. Allow the operator to establish HIGH LEVEL and LOW LEVEL alarm set points on each level signal. Provide adjustable time delays on set points.
 5. Provide wall-mounting, NEMA 4X, loop-powered liquid-crystal displays for local indication of each level signal. Loop-powered displays shall be calibrated 000.0-100.0%. Red Lion or approved equal as shown on the plans.
 6. Control of the chlorine cylinders shall be provided by the Chlorine solenoid valve SV-1-1 from the PLC based on flow. The opening of the chlorine injector solenoid shall occur when the well pump VFD run signal and the confirmation of flow from the flow meter occurs.
 7. Allow the operator to select either "FLOW-PROPORTIONAL", "WEIGHTED" or "OFF" operation for each of the chlorine and fluoride systems. When a system is in "OFF" mode, de-energize associated PLC outputs, and force associated pacing signals to 4.0 mdc.
 8. When the chlorine and fluoride systems are in "FLOW-PROPORTIONAL" mode, call for the system to operate when the associated analog flow signal(s) exceeds an adjustable minimum set point. For each control loop, allow the operator to set up a proportional controller by picking a "minimum" rate point and a "maximum" rate point at any two points on the associated flow input signal(s). Generate a 4-20 mdc output to the chlorine and fluoride systems system that is linear over the selected control range.
 9. When a chemical feed system is in "WEIGHTED" mode, call for the system to operate when the associated flow signal(s) exceeds an adjustable minimum set point. For each control loop, chemical addition shall be proportion to the flow rate and scaled by the level of residual chlorine in the filter effluent water based upon a signal from the filter effluent chlorine analyzer in order to achieve a total chlorine dosage set point (operator adjustable)
 10. Initial flow signals for control of each system:
 - a. Chlorine Flow.
 - b. Fluoride Flow.
 11. PLC shall send 4-20mA signals to control speed of the fluoride monitor feedback signals for each as indicated on the Drawings and digital control of the fluoride systems. Adjust the control of speed output signal to the fluoride pump controller to meet Engineers requirements as determined during start-up.
- C. The well pump VFD shall receive a "pump call" signal from remote SCADA during normal operation. Once the well pump VFD receives the call to start, the VFD shall start the well pump

and ramp up to 40 HZ within approximately 3-5 seconds to stabilize the system. This ramp time and current setting shall be adjusted in the field to fine tune the system. Then the VFD shall begin to ramp up to a preset, adjustable operating speed (40 HZ to 60 HZ) after a preset time. Once the VFD is at full operating speed, it shall continue to operate at that speed until the call to stop is initiated. When the "call" signal is extinguished the VFD shall begin to ramp down (60 HZ to 40 HZ), then after a preset time, ramp down to 0 HZ within 3-4 seconds.

The VFD speed shall be based on the respective water reservoir level(s) and the VFD speed shall vary between 40-60 HZ based on that level.

When the "call" signal is received by the VFD, the back-spin timer shall begin to time and the water solenoid valve open, after time out, the water solenoid valve shall turn off via an adjustable timer and the VFD shall start as shown on the control diagram. If the flow from the well pump does not meet or exceed the minimum flow requirements, the failure timer shall provide a timed out signal and send it to SCADA Control Panel CP-12 indicating a well pump system failure. The flow signal shall be provided by the flow meter signal routed to the SCADA Control Panel CP-12 and the PLC providing a digital output and an interposing relay to provide the proper signals to the VFD starter circuit. Monitor each well analog control circuit as shown on the plans.

The SCADA Control Panel CP-12 shall include a well water (drawdown) level measurement system that shall display water level on the HMI. The System Integrator shall provide a PID loop that monitors the well water level and if water drawdown level reaches an operator adjustable LOW LEVEL set point, transfer control of the well over to PID loop control by adjusting down the speed of the VFD to maintain well water level above the set point. Indicate VFD IN PID LEVEL MODE at each HMI. Once the VFD has returned to full speed and a normal level set point has been sustained in the well for an adjustable time period, take the VFD off of PID LEVEL MODE and return the well to NORMAL MODE. Display what mode the well is operating in at each HMI. Provide operator adjustable time delays on all set points. Coordinate exact set point ranges on the PID level control feature with the Owner and Engineer during shop drawing review and again during construction, based on actual well pumping results.

SCADA Control panel CP-12 shall continuously monitor the instantaneous output of each flow meter and shall display both instantaneous and totalized flow at each HMI. The SCADA Control Panel CP-12 shall use the flow signal in conjunction with the "run" contact from the pump VFD to prove that the well is operating and to provide chemical control. If confirmation of these signals is not confirmed at the SCADA Control Panel CP-12 after an adjustable time delay, alarm and display each well "failure" at each HMI. Allow the operator to remove the "proof" of flow feature from the magnetic flow meter signal for meter maintenance, etc.

D. LOOP DESCRIPTIONS

1. General:
 - a. The loop performance is described on the P&ID drawings and via the component specifications described later in this specification.
 - b. The loop performance of certain specific or complex operations shall be defined in the pre-submittal meetings.
 - c. Component Identification Code: The alpha-numeric code is used to identify the applicable component Specification included hereinafter.

2.03 COMPONENT SPECIFICATIONS

- A. SCADA Control Panel CP-12 Panel Requirements:
1. The System Integrator shall furnish the control panel completely factory wired and tested.
This work shall include receiving, storage and installation of equipment and instruments. The control panel work shall include all engineering, labor, and material necessary for a working unit. Upon completion of a factory acceptance test, the System Integrator shall reconcile the punch list, package, and deliver the panel, documentation, and accessories. The delivery shall be made to the building sites, except for the documentation, which shall be delivered to the Engineer.
 2. The System Integrator shall provide all the necessary incidental hardware required to complete the panel.
 3. SCADA Control Panel CP-12 shall be located in the deep well pump room as shown on the plans. The unit shall be floor mounted for this project and shall be made from steel with NEMA 1 gasketed construction same as the MCC structure. This is SCADA Control Panel CP-12 tagged hereafter as described using the same MCC type structure.
- B. SCADA Control Panel CP-12 Mechanical Requirements:
1. The Control Panel shall be completely fabricated, instruments installed, plumbed, and wired in the contractor's factory. All wiring shall be completed and tested before shipment. All external connections shall be by way of numbered and color-coded terminal blocks.
 2. The panel shall be constructed with external dimensions as shown on the Drawings. Instrument arrangement shall be as shown, with minor modifications as required by the particular equipment furnished. Construction shall be subject to the approval of the Engineer.
 3. The panel shall be NEMA-1 gasketed construction and dimensioned and arranged as shown on the Drawings.
 4. The panel shall be fabricated by the MCC manufacturer.
 5. The panel shall be able to withstand, without damage, all stresses incidental to shipping, installation, and operation for which the equipment is specified.
 6. The steel for the top, bottom, sides, and front shall be made with the same materials as those specified for the MCC specified in Specification Section 26 24 19.
 7. Steel shall be of prime stock, without tool, clamp marks, or other imperfections.
 8. The enclosure shall be square and plumb with all dimensions to the following tolerances, as measured by straight edge over the noted straight line length across the console; 1/16" in 3 ft., 1/8" in 3 ft. to 6 ft. and 3/16" over 6 ft. length.
 9. The panel front face shall be stiffened and reinforced to prevent distortion due to the cantilever forces of any installed devices and other internal materials. The device weight, dimensions and spacing shall be accounted for.
 10. Supports shall be provided inside the enclosure for the support of instruments, wiring, incoming cables, or other internal materials. These supports shall leave adequate clearance available for equipment servicing or removal without the interruption of service to other devices.
 11. The entire steel surface shall result in a neat and workmanlike appearance, with no welds, rivets, or bolt heads visible. All seams shall be continuous-welded, and ground smooth. The outside panel corners shall be rounded. All scratches, bulges, exterior joints, recesses, etc. shall be ground smooth and/or filled with metal putty to render them invisible after the panel has been painted. The edges of cutouts shall be ground smooth.
 12. The panel may be fitted with removable lifting rings (if required) and mounted on a suitable skid to facilitate handling during shipment and installation. The panel shall be wrapped in plastic and crated for site storage and/or installation.

13. Panel cutouts and openings shall be provided that are sized per the respective electrical equipment manufacturer's specifications. All cutout edges shall be ground smooth and made without the warping of panel surfaces.
14. SCADA Control Panel CP-12 and the NEMA 4X Chemical Room Control Panels shall be provided with front access only and shall be mounted on the wall as shown on the plans. Back panel shall be used for the mounting of internal devices such as terminal, blocks, power supplies, PLC, relays, radio and other devices. The panel shall also include space for the required UPS. The back panel shall be factory fabricated from sheet steel with a minimum of 11-gauge. The back panel shall be factory painted white. Access to the panel interiors shall be through the front mounted doors. The doors shall be full length, with continuous hinges. The doors shall be fully-neoprene gasketed secured by oil-resistant adhesive. The door shall be capable greater than 180 degree (fully opened). The doors shall be constructed so as to permit ease in opening without sticking or binding. The doors shall be constructed of #14 gauge steel. Internal devices shall maintain a 2-inch minimum separation from the nearest door part.
15. Each control panel surface shall have a smooth finish, scratch free, and chip-proof with chemical and abrasion resistance. All surfaces shall be completely cleaned, degreased, smoothed and given a phosphatizing treatment prior to painting. One (1) coat of primer and two (2) coats minimum, of finish paint shall be used. The second coat applied after the initial has dried. The panel interior color, including all sub-panels shall be gloss white enamel. Exterior finish paint shall be gray.
16. One (1) pint of finish paint shall be provided from the same batch as applied, and delivered with the panel for touch-up use.
17. The panels may have devices mounted on the front door as shown on the drawings. The layouts are given as elevation and center- line dimensions. The supplier shall use the specifications of the respective instruments manufacturers for exact dimensions and position the device at the center-line of that shown on the drawing to maintain equipment lines for panel symmetry as shown on the drawings.
18. The front of panel HMI(s) and other devices shall be properly aligned to present a workmanlike appearance. Devices on any particular center or elevation line shall not deviate from that line.
19. The interior devices shall be mounted on sub-panels. No interior mounting hardware shall penetrate the panel exterior surfaces.
20. The Contractor/System Integrator shall provide all necessary mounting screws and fastening devices, which shall be stainless steel.
21. All devices shall be located such that the servicing or removal can be accomplished without the interruption of operation of any other device and without the need for special tools.

C. Control Panel(s) Electrical Requirements:

1. The control panel shall have cable entry from either side, however care shall be exercised so not to group or route analog wiring with power wiring. The Contractor shall provide ample space for bringing these cables directly to the terminal blocks, through dedicated conduits, junction boxes and etc.
2. There will be two (2) classes of power wiring within the panels: Low-voltage (24VDC) (For signals-analog) and 120 VAC Class 1 600V (Line power and logic control). Signal and A.C. wiring shall be separated whether in wireway, loose, or bundled. The minimum separation shall be 4" in parallel paths. Where wires must cross, they shall be at a 90-degree angle.
3. The HMI and PLC Ethernet wiring in the panels and radio/PLC wiring shall not be routed with the A.C. wiring.

4. The panels shall have a main circuit breaker and branch circuit breakers for the following; DC power supplies, relay logic circuits if required, PLC, and any auxiliary instruments if required, with two spare power supplies installed for the future.
5. All wiring shall be run in plastic removable covered wireway such as Panduit, maximum fill shall be 50%. Wireway shall include ducting, covers, fasteners, wire retainers, and corner strips, as required.
6. Where not practical to run in wireway, wires shall be spiral wirewrap that are secured to the panel with tie wraps and adhesive backed mountings. Wire ties shall be locking such as Panduit "PLT", or equal.
7. Wire or bundled wire bends shall be neat and carefully made without damage to the wire insulation. Wiring shall be grouped in parallel runs, in either the vertical or horizontal plane and shall be installed in a uniform and workmanlike manner.
8. Wiring shall be continuous, without splices, between terminal points.
9. Individual wires or cables passing through or entering panel steel, boxes, or instrument cases shall be furnished and installed with plastic grommets to insulate and protect them.
10. The maximum length of un-insulated or unshielded stripped wire or cable to a termination shall be 1 inch.
11. Control wiring shall be terminated to the screw-type terminals.
12. Control wiring to the hand-switches and power wiring shall be carefully checked that each termination will not "pull-out" from the connection.
13. Wiring shall be protected with plastic bundle wrap where in contact with structural or equipment edges; for example bundles to door mounted equipment.
14. All wire ends shall be identified with shrink tube type labels, to indicate the wire or cable number. Cable shields do not need to be tagged. Identifying numbers shall include the loop number.
15. The maximum number of wires per device terminal is two.
16. Signal wires shall be instrument cable; 2 conductor twisted pair with overall shield and drain wire, #18 AWG-7 strand copper wire.
17. A.C. wiring shall primarily be No. 14 AWG, 19-strand copper, Type MTW, 600V insulation. Other AWG sizes shall be as shown on the Drawings (such as power and ground circuits).
18. Signal Common, Power Supply Common, Power Supply Positive, and other low-level D.C. wiring shall be No. 16 AWG, 19 strand copper, Type MTW, 600V insulation.
19. Individual wire color code shall be as follows:

Red - A.C. line power.

White - A.C. Neutral - Current carrying grounded conductor.

Blue - PLC input wiring.

Red - A.C. control circuits

Yellow - Externally powered wire, such as from interlock control circuits and PLC output wiring. These wires may be energized even if the panel disconnects are opened.

Black - Low-level D.C. such as Signal Common, Power Supply positive, power supply common, switched-D.C.

20. Terminal blocks shall be provided for all external panel wiring connections. The bottom side on horizontal, or the side on vertical mounted terminal blocks shall be dedicated to the

external wire terminations. The terminal blocks shall be color-coded as shown on the plans and shall be color coordinated with wiring colors noted above.

21. There shall be separate terminal block groups for each type of panel wiring. Terminal block color shall match wiring.
22. Each type of terminal block group shall be clearly labeled.
23. Terminal blocks shall be separated to allow for wireway and wire bends, as noted on the drawings. The arrangement shall afford maximum accessibility of terminals for ease in wiring, testing, and visibility for recognizing wire and terminal numbers.
24. Terminal blocks shall be 600 Volt box lug type and shall include mounting strips, solid jumpers (as needed), marker strips, end barriers and end clamps.
25. Each terminal block point shall be identified on the marker strip with permanent, non-smear black ink. Identifying numbers shall be as shown on the shop drawings.
26. Terminal blocks shall be separated to allow for wireway and wire bends, as noted on the shop drawings.
27. Terminal block groups shall each have 20 percent spare terminals.
28. Terminal block points shall be vertically and/or horizontally mounted and arranged in numerical order, according to the shop drawings.
29. The "safety and shield" ground buses shall be provided to terminate ground wires from instrument chassis, panel frame, the purchasers' ground cable and other device grounds. The safety ground bus shall be bonded to the panel sub-panel at each end.
30. The panel structural steel, including all sub-panels and mounting brackets shall be bonded such that all elements are grounded when connected to the "safety" bus.
31. External and internal panel signal cable shields shall be terminated only at the field/panel terminal blocks, as shown on the shop drawings. The shields at the non-terminated ends, such as at the field sensor or receiving instrument, shall be insulated with tape or heat shrink tubing to insure no physical contact with any conductor. The drain wire at the cable shield termination side shall also be insulated.
32. The ends of all unused spare wires or pairs in multi-cable bundles shall be coiled, crimped, exposed ends insulated, and tagged as "spares" in the panels.
33. Each instrument or device case shall be safety grounded by an individual wire from the case to the ground bus.
34. The branch circuit shall be 120 VAC/60 HZ/1 phase/3 wire including ground. The circuit for the control panel will be provided by the respective lighting panels as shown on the plans.
35. The wiring to hand switches and instruments shall have sufficient slack (6" minimum) at the device to permit removal without disconnecting any wire and door opening provisions.

D. Identification and Labeling:

1. Identification shall be provided for all equipment.
2. Nameplates shall be provided for all front of panel instruments, and other devices as shown on the Drawings.
 - a. Nameplates shall be 1/8" thick laminated plastic, such as Gravoply, with white surface and black core unless otherwise indicated on the Drawings.
 - b. Nameplate front surface edges shall be beveled to frame the nameplate with a border.
 - c. Nameplates shall be mounted immediately below the component it identifies, or as shown on the Drawings.
 - d. Nameplates shall be fastened to the control panel with adhesive double-backed tape.
 - e. The overall size of the nameplates shall be as indicated on the Drawings.
 - f. The lettering shall be by machine-engraving through the facing to the core. Lettering shall be block type and square cut.
 - g. The height of the nameplate lettering shall be 3/16 inch. Legends shall be as shown on the drawings.

3. Equipment labels shall also be provided for all internally mounted devices front of panel mounted items.
 - a. The labels shall be Kalograph mylar film photosensitive tape or equal.
 - b. The labels shall identify instruments by instrument tag number and other devices by device number or if none by name.
 - c. Devices labeled shall include as a minimum; relays, hand switches, visual message displays, and terminal blocks.
 - d. The label shall not be affixed to the device itself. The label shall be easily seen and not located beneath wire bundles.
 - e. Each front of panel device will have a label affixed to the interior of the front panel face.
4. Pushbuttons and selector switches escutcheons shall be the manufacturer's standard, with legends, as specified on the Drawings.
5. Wires and terminal block points shall be identified as described elsewhere in the specification.
6. Adhesive-backed mylar typed lists shall be provided and applied to internal space as directed by the Engineer. The lists shall include a circuit breaker/function list, relay list, aux. instrument list. Each shall contain the tag number, service, and arrangement per the physical installation.

E. Preparation for Shipment:

1. Following the completion of the Factory Test and Punch List work, replace all instrument and device covers to prevent damage and the entrance of debris.
2. The panel shall be thoroughly cleaned inside and out. Exterior surfaces shall be cleaned to remove all dirt and grease. The interior shall be vacuumed to remove all debris incidental to the assembly.
3. Secure the device and equipment to prevent damage during shipment and handling. Original equipment such as shipping stops and ties, shall be reinstalled. Glass shall be protected from breakage.
4. Box all accessories, such as special tools, spare parts, and deliver with the panel.
5. Protection shall be provided against damage due to handling, shipment, storage, inclement weather, and field installation.
6. Label each separate shipping unit (panel section or boxes). The label shall be weatherproof and securely attached. Multiple shipping units shall indicate the unit number and number of total units on each label. In addition to other customary information the label shall show the Contractor No., the name of the item, and Owner.

2.04 STANDARD COLOR INSCRIPTIONS, FOR HMI SCREENS

- A. Unless otherwise noted in the individual Loop Specifications, the following color code and inscriptions shall be followed for the HMI alarm screens.

<u>Tag</u>	<u>Inscription(s)</u>	<u>Color</u>
ON	ON	Green
OFF	OFF	Red
AUTO	AUTO	Blue
MANUAL	MANUAL	White
REMOTE	REMOTE	Yellow
REQUIRED	REQUIRED	Yellow
PRIMARY ALARM	ALARM	Red
SECONDARY ALARM	ALARM	Yellow

2.05 STANDARD HANDSWITCH COLORS AND INSCRIPTIONS

- A. Unless otherwise noted in the individual Loop Specifications, the following color code and inscriptions shall be followed for all pushbuttons/ selector switches:

<u>Tag</u>	<u>Inscription(s)</u>	<u>Color</u>
00A	OFF/ON/AUTO	Black
00	ON	Black
	OFF	Black
RESET	RESET	Red

2.06 SELECTOR SWITCHES AND INDICATING LIGHTS

- A. Units shall be heavy-duty, oil-tight, industrial type selector switches with contacts rated for 120V ac service at 10 amperes continuous. Units shall have standard size aluminum legend plates with black engraved markings, as indicated. Operators shall be black knob type. Units shall have the number of positions and contact arrangements and spring return function (if any) as required. Units shall be single-hole mounting, accommodating panel thickness from 1/16-inch minimum to 1/4-inch maximum. Selector switch bodies shall be made from corrosion resistant thermo-plastic polyester material.
- B. Indicating lights shall be Push-To-Test LED transformer type with colors as shown on the plans and specified within.
- C. Units shall be Allen Bradley 800T Series, 30.5MM type.

2.07 PUSHBUTTON, MOMENTARY (IF USED)

- A. Units shall be heavy-duty, oil tight, industrial type pushbuttons with momentary contacts rated for 10 amperes continuous at 120V ac. Button color shall be black. Units shall have standard size aluminum legend plates with black engraved marking as indicated. Contact arrangements shall be as shown. Pushbutton bodies shall be made from corrosion resistant thermo-plastic polyester material. See plans for required keyed selector switches for both interior and exterior use.
- B. Units shall be Allen Bradley 800T Series, 30.5MM type.

2.08 INTERNALLY MOUNTED DEVICES

- A. Internal Panel Component Tag Number Reference List
1. This listing is for the major components of the loop. Miscellaneous auxiliary components shall also be provided as required by the general requirements of the plans and specifications for signal processing (e.g., interlocks, other logic).

<u>COMPONENT</u>	<u>ITEM</u>	<u>TAG NO.</u>	<u>CODE</u>
	1. PLC system (local and remote)	PLC-XX	PLC
	2. Power supply	PS-1	---
	3. Power supply	PS-2	---

4. Control relay CR-xxx ---

2.09 PROGRAMMABLE LOGIC CONTROLLER

- A. Description of System: The PLC shall be installed in the control panel and shall perform logic and communications operations.
- B. The PLC shall include an interface, both hardware and software to communicate with the human-machine interface specified. This shall include the production of driver software if required to communicate the required functions.
- C. The PLC shall receive all signals for control and monitoring and future communications.
- D. The PLC shall perform the logic and sequencing requirements of the required control. This shall include signals from panel mounted selector switches and all logic and sequencing requirements as shown on the plans.
- E. The PLC shall operate on 120vac power and shall include a UPS for backup power as shown on the plans.
- F. Provide a rack enclosure to house the power supplies, processor/memory card, analog and discrete I/O cards and communication module.
- G. Provide programming software as required.
- H. The PLC system shall be remote I/O capable, including communication adapter modules as required.
- I. The PLC shall be Allen Bradley Compact Logix as specified on the plans and as specified within.
- J. The System shall consist of:
- K. Processor with memory;
 - 1. I/O hardware for all points, analog and discrete.
 - 2. Power supplies.
 - 3. Provide the following: One spare output board of each type used.
 - 4. Discrete outputs shall be relay type.
 - 5. Provide required interconnecting cables.
 - 6. Size memory with minimum reserve capacity of 30%.
 - 7. Internal diagnostics shall be available to user for troubleshooting.
 - 8. Processor shall have battery backup to prevent program loss on power failure.
 - 9. Each PLC shall utilize the same instruction set as the existing PLC's
 - 10. Each PLC shall have indicator lights at major diagnostic points to simplify troubleshooting.
 - 11. Each PLC shall be capable of detecting internal communications faults and turning off all outputs in the event of a fault. The fault causing the shutdown shall be identified and available as indication of which major components caused the shutdown.
 - 12. Each PLC shall be designed so that all input signals are read on the first scan of logic before any outputs are triggered, thus preventing the controller from triggering the I/O in an unpredictable fashion.

13. To ensure safe operation of the control system, the controller shall perform power-up and run time checks on the internal operating system, the health and status of the major system components and user developed application software. In the event of a failure the controller shall follow a predictable, pre-defined course of events to bring the system to a known state.
- L. Instruction Set: The ladder logic instruction set of the PLC shall include the following functions as a minimum.
 1. Contacts & coils.
 - a. Normally open contact.
 - b. Normally closed contact.
 - c. Positive transitional contact (rising edge one-shot).
 - d. Negative transitional contact (falling edge one-shot).
 - e. Standard coil.
 - f. Memory retentive coil (retaining state in the event of loss of power to the CPU).
 2. Counters & timers.
 - a. Up counter.
 - b. Down Counter.
 - c. Timers (retentive and non-retentive) with the following time bases:
 - 1) 1 second
 - 2) 0.1 second
 - 3) 0.01 second
 3. Basic positive integer mathematics
 - a. Addition
 - b. Subtraction
 - c. Multiplication
 - d. Division
 - e. Enhanced mathematics
 - 1) Double precision (32 bit mathematics)
 - a) Addition
 - b) Subtraction
 - c) Multiplication
 - d) Division
 - e) Square root
 - f) Process square root
 - 2) Floating point operations (IEEE floating point standard).
 - a) Base 10 Logarithm
 - b) Base 10 Antilogarithm
 - c) Integer to floating point conversion
 - d) Integer plus floating point
 - e) Integer minus floating point
 - f) Integer times floating point
 - g) Integer divided by floating point
 - h) Floating point minus integer
 - i) Floating point divided by integer
 - j) Integer to floating point comparison
 - k) Floating point to integer conversion
 - l) Addition
 - m) Subtraction
 - n) Multiplication
 - o) Division

- p) Comparison
- q) Change sign
- r) Floating point trigonometric instructions
 - (1) Load value of Pi
 - (2) Sine & arcsine
 - (3) Cosine & arc cosine
 - (4) Tangent & arc tangent
 - (5) Convert radians to degrees & degrees to radians.
- s) Exponential
- t) Natural & common logarithm
- 3) Data move instructions
 - a) Place a register or block of registers into a table
 - b) Read a register or block of registers from a table
 - c) FIFO
 - d) Copy a register or block of registers
- 4) Other instructions
 - a) Subroutines
 - b) PID
 - c) Skip sections of ladder logic
 - d) Analog input scaling
 - e) Analog output scaling
 - f) Totalizer
 - g) Ration controller
- f. Communications
 - 1) The PLC shall have (2) two communication ports. The PLC shall be able to communicate with the radio modem.
 - 2) The PLC shall communicate using an industry standard, open architecture protocol (data highway). No programming shall be required in the PLC to make it communicate using this communication protocol.
 - 3) The PLC shall be capable of "high speed", peer to peer communications using an industry standard protocol.
- 4. Expansion capabilities: Each PLC shall be capable of additional I/O. This expansion shall be capable using any combination of the following methods:
 - a. Each PLC shall support the addition of manufacturer standard family I/O modules in its local rack.
 - b. Each PLC shall support a network of similar PLC's via the high-speed network port.
 - c. Each PLC shall support a network of intelligent drops of I/O via the high-speed network port.

2.10 PLC POWER SUPPLIES

- A. Provide DC power supply(s) as required to power instruments requiring external DC power. Power supplies shall convert 120V ac, 60-Hz power to DC power of the appropriate voltage(s) with sufficient voltage regulation and ripple control to assure that the instruments being supplied can operate within their required tolerances. Output over-voltage and over-current protective devices shall be provided with the power supply to protect the instruments from damage due to power supply failure and to protect the power supply from damage due to external failure.

2.11 RADIO MODEM

- A. The required radio for the project shall be unit specified on the drawings.

2.12 HMI UNIT

- A. Display (HMI)
1. Provide each HMI as specified on the plans. Submit sample displays to Engineer and Owner during shop drawing review.

2.13 SPARE PARTS

- A. Spares, Expendables, and Test Equipment:
1. Provide the following installed spares:
a. Fuses: 20 percent of each size and type used, but no less than five of each size and type.
b. Circuit Breakers: 20 percent of each size and type used, but no less than two of each size and type.
c. Relays: 2 of each type used.
2. Provide 1 (one) spare power supply.

2.14 INSTRUMENTS

- A. See Specification 28 16 01 (Electrical and Instrumentation Equipment” for additional information.

PART 3 EXECUTION

3.01 STANDARDIZATION

- A. All instruments shall be of the latest and most modern design and shall have the overall accuracy specified herein or equal to that of the specified components.
B. Install all equipment per the manufacturer’s recommendation’s, this includes furnishing all components indicated in the manufacturer’s documentation, as directed by the Engineer.
C. All key codes, licenses, software shall be turned over to the Owner including software literature, and other materials supplied by the manufacturer’s. Hard copy and electronic copies of all I/O and PLC programming shall be included with subscripts for each input in the ladder logic print-outs.

3.02 INPUT/OUTPUT (I/O) LIST

- A. The following I/O is monitored and/or controlled from the PLC located from the SCADA Control Panel CP-12:
B. Digital Inputs:
Equipment Location: Device or Equipment: Condition:
Above Ground Storage Tank Hatch Switch ZX-1-1 Intrusion
Above Ground Storage Tank Float Switch LSHH-1-1 High-High Level
Above Ground Storage Tank Float Switch LSH-1-1 High Level

Above Ground Storage Tank	Float Switch LSL-1-1	Low Level
Well Unit Building	Door Switch ZX-2-1	Intrusion
Well Unit Building	Door Switch ZX-3-1	Intrusion
Existing Security Panel	Internal Relay(s)	Intrusion (All Doors)
MCC-1A	Surge Arrestor	Failure
SCADA Control Panel CP-12	UPS	Failure (Internal)
SCADA Control Panel CP-12	PLC	Failure (Internal)
Fire Alarm Control Panel	Control Panel	Alarm
Fire Alarm Control Panel	Control Panel	Trouble
Pump/Electrical Room	Flood Alarm Switch XA-1-1	Flood
Deep Well Room	Flood Alarm Switch XA-2-1	Flood
Fluoride Room	Low Temperature Switch TEL-1-1	Low Temperature
Chlorine Room	Low Temperature Switch TEL-2-1	Low Temperature
Deep Well Room	Low Temperature Switch TEL-3-1	Low Temperature
Chlorine Room	Chlorine Shut Down Panel	Alarm Condition
Chlorine Room	Vacuum Loss Panel VS-1-1	Alarm Condition
Motorized Valve V-HS-2	Valve Limit Switch ZX-2-1	Valve Fully Open
Motorized Valve V-HS-2	Valve Limit Switch ZX-2-1	Valve Fully Closed
Motorized Valve V-HS-3	Valve Limit Switch ZX-3-1	Valve Fully Open
Motorized Valve V-HS-3	Valve Limit Switch ZX-3-1	Valve Fully Closed
Motorized Valve V-FW-1	Valve Limit Switch ZX-1-1	Valve Fully Open
Motorized Valve V-FW-1	Valve Limit Switch ZX-1-1	Valve Fully Closed
MCC-1B	Well Pump VFD	Not In Auto
MCC-1B	Well Pump VFD	Running
MCC-1B	Well Pump VFD	Failure
MCC-1B	Well Pump VFD	Motor High Temp.
MCC-1B	Well Pump VFD	Vibration
MCC-1B	High Service Pump No.1 VFD	Not In Auto
MCC-1B	High Service Pump No.1 VFD	Running
MCC-1B	High Service Pump No.1 VFD	Failure
MCC-1B	High Service Pump No.1 VFD	Motor High Temp.
MCC-1B	High Service Pump No.2 VFD	Not In Auto
MCC-1B	High Service Pump No.2 VFD	Running
MCC-1B	High Service Pump No.2 VFD	Failure
MCC-1B	High Service Pump No.2 VFD	Motor High Temp.
MCC-1B	Spare Starter No.1	Not In Auto
MCC-1B	Spare Starter No.1	Running
MCC-1B	Spare Starter No.1	Failure
Spare		
Spare		
Spare		
Spare		
Spare		
Spare		
Spare		
Spare		
Spare		
Spare		
Spare		
Spare		
Spare		

C. Digital Outputs:		
Equipment Location:	Device or Equipment:	Condition:
MCC-1B	Well Pump VFD	Call to Start
MCC-1B	Well Pump VFD SV-5-1	Call to Run
MCC-1B	High Service Pump No.1 VFD	Call to Start
MCC-1B	High Service Pump No.2 VFD	Call to Start
MCC-1B	Spare Starter No.1	Call to Start
Pump/Electrical Room	Chlorine Solenoid Valve SV-3-1	Energize
Pump/Electrical Room	Chlorine Solenoid Valve SV-4-1	Energize
Chlorine Room	Chlorine Injector Valve SV1-1	Energize
Fluoride Room	Fluoride Pump	Receptacle Power
Chlorine Room	Chlorine Pump	Receptacle Power
Chlorine Room	Chlorine Gas Detector	High Level
Chlorine Room	Chlorine Gas Detector	Fault Condition
Spare		
Spare		
Spare		
Spare		
Spare		
Spare		
D. Analog/Pulse Inputs:		
Equipment Location:	Device or Equipment:	Condition:
Above ground storage tank	Level Transducer LE-1-1	Variable Level
Well Pump Casing	Level Transducer LE-2-1	Variable Level
MCC-1B	Well Pump VFD	Speed Verified
MCC-1B	High Service Pump No.1 VFD	Speed Verified
MCC-1B	High Service Pump No.1 VFD	Speed Verified
Entry Room	Flow Meter FIT-1-1	Instantaneous Flow
Entry Room	Flow Meter FIT-1-1	Totalized Flow
Pump/Electrical Room	Flow Meter FIT-2-1	Instantaneous Flow
Pump/Electrical Room	Flow Meter FIT-2-1	Totalized Flow
Pump/Electrical Room	Flow Meter FIT-3-1	Instantaneous Flow
Pump/Electrical Room	Flow Meter FIT-3-1	Totalized Flow
Motorized Valve V-HS-2	Valve Position XS-2-1	Valve Position
Motorized Valve V-HS-3	Valve Position XS-3-1	Valve Position
Motorized Valve V-FW-1	Valve Position XS-1-1	Valve Position
Pump/Electrical Room	Pressure Transmitter PIT-1-1	System Pressure
Pump/Electrical Room	Pressure Transmitter PIT-2-1	System Pressure
Pump/Electrical Room	Chlorine Analyzer-QIT-1-1	Chlorine Levels
Pump/Electrical Room	Chlorine Analyzer-QIT-2-1	Chlorine Levels
Chlorine Room	Weight Scale WIT-1-1	Weight Scale WE-1-1
Chlorine Room	Weight Scale WIT-1-1	Weight Scale WE-1-2
Fluoride Room	Weight Scale WIT-2-1	Weight Scale WE-2-1
Fluoride Room	Fluoride Pump	Speed Verified
Chlorine Room	Chlorine Gas Detection Panel	Chlorine Levels
Spare		
Spare		
Spare		
Spare		
Spare		
Spare		

E. Analog Outputs:		
Equipment Location:	Device or Equipment:	Condition:
MCC-1B	Well Pump VFD	Speed Control
MCC-1B	High Service Pump No.1 VFD	Speed Control
MCC-1B	High Service Pump No.1 VFD	Speed Control
Motorized Valve V-HS-2	Valve Position ZS-2-1	Valve Positioner
Motorized Valve V-HS-3	Valve Position ZS-3-1	Valve Positioner
Motorized Valve V-FW-1	Valve Position ZS-1-1	Valve Positioner
Fluoride Room	Fluoride Pump	Speed Control
Spare		
Spare		
Spare		
Spare		

Notes:

1. The System Integrator shall include in his/her bid ten (10) additional I/O output programming, additions to screens and terminations as required.

3.03 SYSTEM INTEGRATORS FIELD SERVICES REQUIREMENTS

- A. The System Integrator shall be able to provide on-site services including required maintenance, programming, debugging, system start-up, and have the ability to access replacement parts for each of the installed components. The System Integrator shall have the ability to be "on call" twenty four (24) hours per day for service. The System Integrator shall have at least three (3) full time service personnel with the proper equipment for servicing the equipment.
- B. All equipment shall be secured locally and assembled at the System Integrator facilities. For contract purposes, locally means relative to System Integrator home office, where service will be conducted from. This will allow for site certification of all equipment by the engineer and owner.

3.04 MANUFACTURER'S SERVICES

- A. The System Integrator shall calibrate and commission the instrumentation and control system and shall provide services as needed to support the activity. The Engineer will direct the System Integrator to provide additional services at the System Integrator's costs if the Engineer determines that the components have not met their performance requirement.
- B. Provide installation supervision assistance to the electrical contractor for various issues as they arise; verification of wiring & interconnections, instrumentation & switch device support and calibration, etc.
- C. Minimum Service Requirements
 1. Installation: As required for proper installation.
 2. Start-up and field-testing: As required.
 3. Operator Training: Two (2) days on site for basic system operation.

Provide certificate of proper installation and one day of field support service after 3 months of operation after system acceptance. Service shall be provided at no cost to the owner. Support

shall include such items as; modification to PLC control strategies, changes to graphic displays, additions of field instrumentation, calibration, or similar services as directed by the owner or their engineer.

- D. Service to repair defective work: Provide during warranty period under the provisions of the Procurement General Conditions.

END OF SECTION

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SECTION 26 16 01

INSTRUMENTATION EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. The System Integrator shall furnish the following equipment and the Electrical Contractor shall install the equipment including the level elements, pressure transmitters, intrusion switches, float switches, flow meters/flow elements and low temperature switches. Note the magnetic intrusion switches are not specified within, the System Integrator shall furnish and the Electrical Contractor shall install and wire the switches to meet the Owner's requirements.
- B. The following equipment is included as specified below.
 - 1. Level Transducers.
 - 2. Pressure Transmitters.
 - 3. Intrusion Switches.
 - 4. Float Switches.
 - 5. Magnetic Flow Meters.
 - 6. Low Temperature Switches.
 - 7. Flood Alarm Switches.

1.02 REFERENCES

- A. All equipment specified within shall be UL Listed or have an equivalent listing.

PART 2 PRODUCTS

2.01 LEVEL TRANSDUCERS LE-1-1- AND LE-2-1

- A. The well level transducer LE-2-1 shall be KPSI Series 330 with 316 stainless steel wetted parts and the lightning protection option or Engineer approved equal. The transducer shall output a 4-20 MADC signal using a piezo-resistive pressure sensing element with an all welded design, traceable calibration card and temperature compensation. The diameter shall be 3/4 inch maximum. The transducer shall include a polyurethane jacketed shielded cable to the junction box shown on the plans.
- B. The transducer shall include a vent tube for atmospheric compensation and aneroid bellows to prevent moisture from penetrating into the electronics through the vent tube. The static accuracy shall be +/- 10% of span. The transducer shall include a lightning protection surge arrestor. If a substitution is made it shall meet the same or be better than the data that is currently available on the manufacturer and model specified.
- C. The transducer shall be installed into the well casing and wired by the Electrical Contractor at the location provided by the Well Contractor. The transducer shall be located at a depth of 320 feet and supported and installed as shown on the plans.
- D. The transducer shall be supplied with 330 feet of cable. The cable shall be routed from the well pipe to the junction box with 4-20MADC cable from the junction box to the SCADA Control Panel without any splices along its length except at the junction box near the point of entry to the well head. Verify exact cables with the manufacturer.
- E. The existing Water Storage Tank Level Transducer LE-1-1 shall be KPSI Series 735 made with welded 316 stainless steel and the lightning protection option or Engineer approved equal. The transducer shall include a polyurethane jacketed shielded cable to the junction box shown on the plans. If a substitution is made it shall meet the same or be better than the data that is currently available on the manufacturer and model specified.

- F. The transducer shall include a vent tube for atmospheric compensation and aneroid bellows to prevent moisture from penetrating into the electronics through the vent tube. The static accuracy shall be +/- 0.1 of span. The transducer shall include a lightning protection surge arrester.
- G. The transducer shall be installed into the stilling well and wired by the Electrical Contractor at the location shown on the plans. The transducer shall be located at a depth of 16 feet and supported and installed as shown on the plans.
- H. The transducer shall be supplied with 75 feet of cable. The cable shall be routed from the transducer to the junction box with 4-20ma cable from the junction box to the SCADA Control Panel without any splices along its length except at the junction box near the point of entry to the existing Water Storage Tank. Verify exact cables with the manufacturer.

2.02 PRESSURE TRANSMITTERS/ELEMENTS PIT-1-1/PE-1-1 AND PIT-2-1/PE-2-1

- A. The Pressure transmitter/transducers shall be Foxboro or Engineer approved equal manufacturer, size and style. The units shall be made from AISI 316L stainless steel and diaphragm made from Hastelloy C276 materials. The transmitter/ transducer shall mount to the pipe using 1/2-14 NPT thread. A Valve shall be supplied ahead of each transducer to isolate it per the process specifications.
- B. The transmitter/transducers shall be installed onto the existing process piping at the locations shown on the plans.
- C. The transmitter/transducers shall provide a 4-20ma output signal. The power supply to the transmitter/transducer shall require separate 24VDC power supplied from Remote SCADA Control Panels as specified. Each transmitter/transducer shall include ½ inch conduit adaptors for the electrical connections.
- D. The operating temperature of -29 degrees C to +82 degrees C. The housings shall meet NEMA 4X ratings. The transmitters/transducers shall meet FM certificates for the application and shall be provided with a stainless steel mounting bracket.
- E. The transmitters/transducers shall be rated to 6000 PSI upper range limit with a silicon sensor fluid and a ½ inch NPT process fitting.
- F. The transmitters/transducers shall be calibrated for 0-30 PSI for this application. These transmitter/transducers shall provide 0.07% accuracy. The sensor limits shall be from -14.7 psi & 30 psi.
- G. The transmitters/transducers shall be catalog number IGP20-I-22-C-2-F-M2-A1-Z1-W, or Engineer approved equal. Verify final catalog numbers with manufacturer.
- H. Each transmitter/transducer shall be furnished with sufficient 4-20ma cable from the transducer to the SCADA Control Panel.

2.03 INTRUSION SWITCHES ZX-1-1, ZX-2-1 AND ZX-3-1 AS SHOWN ON THE PLANS

- A. The door intrusion alarm switches for the Chemical Rooms shall be Cutler Hammer catalog number E50SB6P body with E50DS3 operating head and E50KL548 limit switch operator or Engineer approved equal submitted in compliance with section 01 25 13. Verify current model and furnish same at no additional cost to the project.
- B. The intrusion switches shall be heavy duty type, with 2 N/O and 2 N/C contact blocks 600 volt rated. The current rating for the contacts shall be 60 amps make and 6 amps break at 120 volts AC. The contact material shall be silver. The switch body shall be manufactured using Viton seals and boots for sealing the device. The unit shall be NEMA 1, 3, 3S, 4, 4X, 6, 6P, 13 and IP67 rated.

- C. The intrusion switches shall be provided with an 8 foot cable.
- D. The required magnetic door switches shown on the plans shall be provided but are not specified.

2.04 FLOAT SWITCHES LSHH-1-1, HSH-1-1 AND LSL-1-1

- A. The floats shall be JSE SignalMaster Control Switch made from high impact corrosion resistant polypropylene or approved equal manufacturer.
- B. The floats shall pass NSF Standard 61 protocol by an approved water quality association laboratory.
- C. The floats shall be at least 2.75 inch in diameter and at least 4.85 inches in length.
- D. The floats shall be provided with 5 amp rated contacts at 120 volts and shall be normally open, activated closed on level increase. The float shall have a control differential of 1.5 inches above or below horizontal.
- E. The floats shall include 18-2 Type SJOW water resistant cable.
- F. The floats shall be supported with a ¼ stainless steel cable and a 20lb weight. The stainless steel cable shall be hung from a stainless steel hook cast in the tank walls where shown on the plans.

2.05 FLOW METERS MAGNETIC FLOW METER FIT-1-1/FE-1-1, FIT-2-1/FE-2-1 & FIT-3-1/FE-3-1

- A. The three (3) Magnetic flow meters shall be sized for twelve (12) inch diameter pipe and shall be Toshiba Model LF622 FAC 221 convertor (flow transmitter) and LF654 NM1BNCAAF flow element (detector) with Toshiba magmeter signal and excitation cables, types 2A-XX and 3A-XX where XX is the cable length as determined in the field, no approved equal. Verify final numbers with Manufacturer.
- B. The body shall be stainless steel, epoxy painted with a polyurethane flow tube lining. Each Mag meter shall include stainless steel ground rings.
- C. The remote transmitter shall be 120 volt AC powered and shall provide separate 4-20ma signal into less than 0-750 ohm impedance for flow and scaled pulse signal, maximum 10kHz for totalized flow. The detector shall include two cable entrances for the signal and coil. Each shall be potted to prevent water from entering the flow element. The meter enclosure shall be NEMA 4 rated and suitable for mounting in the SCADA Control Panel. The housing shall be stainless steel.
- D. The convertor shall be powered from 120 volt power source and the pulse and analog signals wired into the SCADA Control Panel. The transmitter shall be Microprocessor based with a 4 line display X 128 X 128 dot matrix character back-lit LCD display. The unit shall provide bidirectional flow sensing and totalization. It shall provide automatic zero point stability and a 0.1% repeatability rate with empty pipe detection. The transmitter shall display in gallons but have the ability to display ounces, pounds, MGD, liters, Cubic Meters, Cubic feet and Acre feet.
- E. The System Integrator shall furnish the specified flow transmitter and flow element to the Electrical Contractor for installation. The wiring shall be provided by the Electrical Contractor.

2.06 FLOOD ALARM SWITCHES

- A. The flood alarm switch shall be Waterbug WB-200 system, part number 1040 surface sensor for monitoring flooding. The sensor shall operate on 24VDC, and provide a 1 amp form C contact as an input to the PLC. The unit shall be powered from the SCADA control panel using 24 VDC.

- B. The sensor shall be mounted to the floor using silicon caulk dapped on the corners to hold the unit in place.

2.07 LOW TEMPERATURE SWITCHES

- A. The low temperature thermostat for the well pump room shall be Dayton model No. 2E206 or approved equal. The thermostat shall include a single pole, double throw contact with an adjustable set point of 30 degrees F to 110 degrees F. The thermostat shall be set at 45 degrees F and shall signal low temperature at that set point. The hydraulic capillary tube shall be manufactured from stainless steel. The contact rating shall be 16 amps at 120 volt inductive load and 22 amps resistive load. Verify current model and furnish same at no additional cost to the project.
- B. The low temperature thermostat shall be mounted near the SCADA Control Panel.
- C. The low temperature alarm switches for the Chemical Rooms shall be PECO model number TRF115-005 or Engineer approved equal. The thermostat shall include a single pole, double throw contact with an adjustable set point of 0 degrees F to 120 degrees F to open or close on rise. The low temperature thermostat shall be set at 45 degrees F and shall signal low temperature at that set point.
- D. The thermostat enclosures shall be NEMA 4X rated.
- E. The thermostats shall have a temperature differential of approximately 3 degrees F.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install all equipment per the manufacturer's recommendations and as shown on plans.
- B. Install all equipment for ease of maintenance and operation.

3.02 ADJUSTING

- A. Adjust equipment and test for proper operation.

END OF SECTION

SECTION 26 22 01

LOW-VOLTAGE TRANSFORMERS GENERAL PURPOSE, DRY AND NON-LINEAR LOAD TYPE

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Dry type two winding transformers.
- B. Electrical Component Standard: Components and installation shall comply with NFPA 70 "National Electrical Code."
- C. ANSI/IEEE Compliance: Comply with applicable requirements of ANSI/IEEE Standards including C2, "National Electrical Safety Code," and C57.12.80, "Terminology for Power and Distribution Transformer."
- D. UL Listing and Labeling: Items provided under this section shall be listed and labeled by UL.

1.02 SUBMITTALS

- A. Submit under provisions of Division 1.
- B. Product Data: Provide outline and support point dimensions of enclosures and accessories, unit weight, voltage, KVA, and impedance ratings and characteristics tap configurations, insulation system type, K factor rating and rated temperature rise.
- C. Test Reports: Indicate loss data, efficiency at 25, 50, 75 and 100 percent rated load, and sound level.
- D. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of Product.
- E. Manufacturer's Certificate: Certify that Products comply with the specified requirements.

1.03 QUALITY ASSURANCE

- A. Perform Work in accordance with NECA Standard of installation.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Store, protect, and handle products to site under provisions of Division 1.
- B. Deliver transformers individually wrapped for protection and mounted on shipping skids.
- C. Accept transformers on site. Inspect for damage.
- D. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- E. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to transformer internal components, enclosure, and finish.

PART 2 PRODUCTS

2.01 TWO-WINDING TRANSFORMERS

- A. Manufacturers:
 - 1. Cutler Hammer. See Motor Control Center Specifications for additional information.
 - 2. Allen Bradley (If MCC mounted).
 - 3. No approved equal.

- B. Transformers, General: Factory assembled and tested, air cooled units of types specified, having characteristics and ratings as indicated. Units shall be designed for 60-HZ service.
 - 1. Cores: Continuous windings without splices except for taps.
 - 2. Internal Coil Connections: Brazed or pressure type.
 - 3. Internal Coil Connections: Brazed or pressure type.
 - 4. All 3 phase transformers are 480 VAC, 3 phase, 3 wire, delta primary with 120/208 3 phase, 4 wire wye secondary with adjustable taps.
 - 5. All 1 phase transformers are 480 VAC 1 phase, 2 wire primary with 120/240 1 phase 3 wire secondary with adjustable taps.

- C. General purpose, Dry-Type Transformers: Comply with NEMA Standards ST 20 "Dry-Type Transformers for General Applications."
 - 1. Windings: 2-winding type. Three phase transformers shall use one coil per phase in primary and secondary.
 - 2. Sound Level: Minimum of 3 dB less than NEMA ST 20 standard sound levels for transformer type and size indicated when factory tested in accordance with that standard.
 - 3. Transformers shall have the following features and ratings:
 - a. Enclosure: Indoor, ventilated area.
 - b. Enclosure: Totally enclosed, nonventilated weather proof.
 - c. Insulation Class: 185 deg C or 220 deg C class for transformers 15 kVA or smaller; 220 deg C class for transformers larger than 15 kVA.
 - d. Insulation Temperature Rise: 150 deg C maximum rise above 40 deg C, for 220 deg C class insulation; 115 deg C maximum rise for 185 deg C class insulation.
 - e. Taps: For transformers 3 kVA and larger, full capacity taps in high-voltage winding as follows:
 - 1) 15 kVA through 500 kVA: Six 2-1/2 percent taps, 2 above and 4 below rated high-voltage.
 - 4. Accessories: As follows:
 - a. Wall mounting brackets: Manufacturers standard brackets for transformers sized up to 75 kVA where wall mounting is indicated or if located in MCC section as shown on the plans.

- D. Control and Signal Transformers: Comply with NEMA Standard ST 1 "Specialty Transformers", and UL Standard 506, "Specialty Transformers."
 - 1. Ratings: As indicated and for continuous duty. Where ratings are not indicated, provide capacity in excess of load.
 - 2. Type: Self-cooled, two-winding dry type.
 - 3. Enclosure: Indoor, except as indicated.

2.02 NON-LINEAR LOAD TYPE (IF SHOWN ON PLANS)

- A. In addition to the requirements of paragraph 2.1 of this section, transformers for non-linear loads shall have the following features:
 - 1. Full width electrostatic shield to provide a maximum effective coupling capacitance between primary and secondary of 33 picofarads. Full load attenuation of line noise and transients shall be:
 - a. Common Mode: 0 to 1.5 KHZ - 120 db; 1.5 KHZ to 10 KHZ - 90 db, 10 KHZ to 1000 KHZ - 65 db; 100 KHZ to 1 MHZ - 40 db.
 - b. Transverse Mode: 1.5 KHZ to 10 KHZ - 5 db; 10 KHZ to 100 KHZ - 30 db; 100 KHZ to 1 MHZ, - 30 db.

- B. Core flux density at full load shall be below the saturation point to minimize overheating caused by harmonic voltage distortion.
- C. Common core concentration. Transformers utilizing more than one core, or Scott-T connection, shall not be acceptable.
- D. Transformer secondary neutral terminal shall be sized for 200% of the rated secondary phase current.
- E. Provide a Underwriters Laboratories approved K-factor rating of 4.

2.03 SOURCE QUALITY CONTROL

- A. Provide testing of transformers under provisions of Division 1 and 26.
- B. Provide production testing of each unit in accordance with NEMA ST20.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Where transformers are installed in a MCC section, installation shall be required with Specification Section 26 24 19.
- B. Arrange equipment to provide adequate spacing for cooling air circulation.
- C. Identify transformers in accordance with Section 26 05 53.
- D. Tighten electrical connectors and terminals in accordance with manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
- E. Ground transformers and tighten connections to comply with tightening torques specified in UL Standard 486A.
- F. Tests shall conform to International Electrical Testing Association (INETA) Standard ATS, "Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems," to assure transformer installation is operational within industry and manufacturer's tolerances, is installed in accordance with Contract Documents, and is suitable for energizing.
 - 1. Testing for transformers shall include insulation resistance test, taps verification and excitation test.
 - 2. Test Failures: Correct deficiencies identified by tests and make ready for retest. Verify that equipment meets the specified requirements.
- G. Upon completion of installation, inspect interiors and exteriors of accessible components. Remove paint splatters and other spots, dirt, and construction debris. Touch up scratches and mars of finish to match original finish.
- H. Adjust transformer taps to provide optimum voltage conditions at utilization equipment.
- I. Temporary Heating: Apply temporary heat in accordance with manufacturer's recommendations within enclosure of each transformer throughout periods during which equipment is not in a space that is continuously under normal control of temperature and humidity.
- J. Provide liquid tight flexible metal conduit with grounding conductors on transformer primary and secondary connections. Mount on vibration isolation pads.
- K. Enclosure: NEMA ST 20; Type 3R ventilated. Provide lifting eyes or brackets.

- L. Isolate core and coil from enclosure using vibration-absorbing mounts.
- M. Nameplate: Include transformer connection data and overload capacity based on rated allowable temperature rise.

3.02 FIELD QUALITY CONTROL

- A. Check for damage and tight connections prior to energizing transformer.
- B. Measure primary and secondary voltages and make appropriate tap adjustments.

END OF SECTION

SECTION 26 24 16

PANELBOARDS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. New Distribution panelboards.
- B. New Branch circuit panelboards.

1.02 REFERENCES

- A. NECA (National Electrical Contractors Association) "Standard of Installation."
- B. NEMA AB 1 - Molded Case Circuit Breakers.
- C. NEMA ICS 2 - Industrial Control Devices, Controllers, and Assemblies.
- D. NEMA KS 1 - Enclosed Switches.
- E. NEMA PB 1 - Panelboards.
- F. NEMA PB 1.1 - Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less.
- G. NFPA 70 - National Electrical Code.

1.03 SUBMITTALS

- A. Submit under provisions of Division 1.
- B. Shop Drawings: Indicate outline and support point dimensions, voltage, main bus ampacity, integrated short circuit ampere rating, circuit breaker and fusible switch arrangement and sizes.

1.04 PROJECT RECORD DOCUMENTS

- A. Submit under provisions of Division 1.
- B. Record actual locations of Products; indicate actual branch circuit arrangement.

1.05 OPERATION AND MAINTENANCE DATA

- A. Submit under provisions of Division 1.
- B. Maintenance Data: Include spare parts data listing; source and current prices of replacement parts and supplies; and recommended maintenance procedures and intervals.

1.06 FIELD MEASUREMENTS

- A. Verify that field measurements are as indicated on shop drawings.

1.07 MAINTENANCE MATERIALS

- A. Provide four (4) panelboard keys for each of the panelboards. All panelboards shall be keyed alike.

1.08 EXTRA MATERIALS

- A. Furnish as shown on drawings.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Cutler Hammer PLR1a (100 amp, 120/240, 1 phase and 120/208 3PH 4W), Cutler Hammer PLR2a (225 amp, 277/480 3PH 4W).
- B. Allen Bradley equivalent.
- C. No approved equal.

2.02 NEW DISTRIBUTION PANELBOARDS

- A. Panelboards: NEMA PB 1; circuit breaker type.
- B. Panelboard Bus: Tin plated copper, ratings as indicated. Provide tin plated copper ground bus in each panelboard.
- C. Minimum Integrated Short Circuit Rating: See drawings.
- D. Molded Case Circuit Breakers: NEMA AB 1. Provide circuit breakers with integral thermal and instantaneous magnetic trip in each pole. Provide circuit breakers UL listed as Type HACR for air conditioning equipment branch circuits. Provide HID rated circuit breakers for High discharge lighting systems. Where SWD circuit breakers are required furnish same.
- E. Enclosure: NEMA PB 1; Type 1 in interior locations and MCC locations or NEMA 4X stainless steel in exterior locations.
- F. Cabinet Front: Surface type, fastened with concealed trim clamps, hinged and latch. Provide hinged door with flush lock. Finish in manufacturer's standard gray enamel. The Electrical Contractor or MCC System Integrator shall notice special requirements for double or triple fronts for panelboards. The contractor may furnish these panelboard fronts as separate components, however they must fit together so that they can be properly aligned to provide a neat and level appearance on the walls.

2.03 NEW BRANCH CIRCUIT PANELBOARDS

- A. Lighting and Appliance Branch Circuit Panelboards: NEMA PB1, circuit breaker type.
- B. Panelboard Bus: Tin plated Copper, ratings as indicated. Provide tin plated copper ground bus in each panelboards.
- C. Minimum Integrated Short Circuit Rating: Unless otherwise indicated on plans provide 10,000 amperes RMS symmetrical for 208 volt and 240 volt panelboards; 65,000 amperes RMS symmetrical for 277/480 volt panelboards unless otherwise noted on the plans.
- D. Molded Case Circuit Breakers: NEMA AB 1, bolt-on type thermal magnetic trip circuit breakers, with common trip handle for all poles. Provide circuit breakers UL listed as Type SWD for lighting circuits. Provide UL Class A ground fault interrupter circuit breakers where scheduled. Do not use tandem circuit breakers
- E. Where heat trace systems are shown on the plans provide 30ma ground fault circuit breakers.
- F. Where ground fault circuit interrupter circuit breakers are required on the plans they shall have maximum ground fault detection of 4-6ma.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install panelboards in accordance with NEMA PB 1.1.
- B. Install panelboards plumb. Install recessed panelboards flush with wall finishes where shown on drawings. Provide supports in accordance with Section 26 05 29.
- C. Where panelboards are installed into a MCC section, also see Section 26 24 19.
- D. Provide filler plates for unused spaces in panelboards.
- E. Provide typed circuit directory for each new and existing branch circuit panelboard. Revise directory to reflect circuiting changes required to balance phase loads.
- F. Provide engraved plastic nameplates under the provisions of Section 26 05 53.
- G. Provide spare conduits out of each recessed panelboard to an accessible location above ceiling. Minimum spare conduits: 5 empty 1 inch. Identify each as SPARE.

3.02 FIELD QUALITY CONTROL

- A. Measure steady state load currents at each panelboard feeder; rearrange circuits in the panelboard to balance the phase loads to within 20 percent of each other. Maintain proper phasing for multi-wire branch circuits.
- B. Visual and Mechanical Inspection: Inspect for physical damage, proper alignment, anchorage, and grounding. Check proper installation and tightness of connections for circuit breakers, fusible switches, and fuses.

END OF SECTION

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SECTION 26 24 19

MOTOR CONTROL CENTERS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. The System Integrator shall furnish Motor control Centers (MCC-1A, MCC-1B and MCC-2) to the Electrical Contractor. The Electrical Contractor shall install and wire the field devices and equipment to the Motor Control Centers (MCC-1A, MCC-1B and MCC-2) as shown on the plans and as specified within. Each MCC will be provided with the quantity and size circuit breaker/ disconnects and VFD units shown on the plans.
- B. The service voltage at this facility is 277/480 volt, 3 phase, 4 wire.
- C. The required control devices will be provided as described within, and as shown on the plans.
- D. Shipping splits will be provided as required for the installation.

1.02 RELATED SECTIONS

- A. Section 26 09 24 - Motor and Lighting Controllers
- B. Section 26 22 01 - Low voltage Transformers
- C. Section 26 24 16 - Panelboards
- D. Section 26 28 13 - Fuses
- E. Section 26 28 16.02 - Enclosed Circuit Breakers
- F. Section 26 29 24 - Variable Frequency Drives
- G. Section 26 43 13 -Surge Suppression Systems

1.03 REFERENCES

- A. NFPA 70 - National Electrical Code.
- B. NEMA AB 1 - Molded Case Circuit Breakers.
- C. NEMA ICS 2 - Industrial Control Devices, Controllers and Assemblies.
- D. NEMA ICS 2.3 - Instructions for the Handling, Installation, Operation and Maintenance of Motor Control Centers.
- E. UL-845 & UL-508.
- F. Each MCC shall be ISO 9001 and 9002 certified.

1.04 MOTOR CONTROL SUPPLIER

- A. The Motor Control Centers with VFD units and other MCC equipment shown on the plans and specified within shall be furnished, programmed and internally wired by the MCC System Integrator.
- B. The System Integrator shall include all on-site start-up services including MCC, VFD and PLC/HMI start-up, testing, programming and debugging.

- C. The Electrical Contractor shall route all the interconnect wiring, circuit wiring, analog and digital control wiring and Ethernet cabling as required for the System Integrator to terminate. The feeders and branch circuits shall be terminated by the Electrical Contractor.

1.05 SUBMITTALS

- A. Submit under provisions of Division 1.
- B. Shop Drawings: Include front and side views of enclosures with overall dimensions shown; conduit entrance locations and requirements; nameplate legends; size and number of bus bars per phase, and ground; electrical characteristics including voltage, frame size and trip ratings, withstand ratings, and time/current curves of all equipment and components.
- C. Test Reports: Indicate field test and inspection procedures and test results.
- D. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of Product.

1.06 OPERATION AND MAINTENANCE DATA

- A. Submit under provisions of Division 1.
- B. Maintenance Data: Include spare parts data listing; source and current prices of replacement parts and supplies; and recommended maintenance procedures and intervals.

1.07 QUALITY ASSURANCE

- A. Perform Work in accordance with NEMA ICS 2.3.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Store, protect, and handle products to site under provisions of Division 1.
- B. Deliver in 60 inch maximum width shipping splits, individually wrapped for protection and mounted on shipping skids. Verify that 60" width will fit into building. If not, supply in shorter splits. Also, see 1.01 (C) above.
- C. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- D. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to transformer internal components, enclosure, and finish.

1.09 ENVIRONMENTAL REQUIREMENTS

- A. Conform to NEMA ICS 2 service conditions during and after installation of motor control centers.

1.10 FIELD MEASUREMENTS

- A. Verify that field measurements are as indicated on shop drawings.

1.11 EXTRA MATERIALS

- A. See specifications and drawings for required fuses, switches and other miscellaneous materials.

PART 2 PRODUCTS

2.01 MANUFACTURER

- A. Allen Bradley (See plans for maximum allowable space per base design, as all equipment shall fit within the space provided).
- B. Where motors, starters, control relays, timers, push buttons, selector switches, indicating lights, ETM's and other devices are required; they shall be manufactured by the MCC manufacturer that is being supplied when possible.
- C. No approved equal.

2.02 MOTOR CONTROL CENTER

- A. Motor Control Centers: NEMA ICS 2, Class II, Type B wiring for MCC-1A and MCC-1B. This classification requires the MCC System Integrator to provide all internal MCC wiring to interconnect each motor starter, VFD and other require devices, internal MCC power wiring, all control wiring for each device, providing terminal blocks at each unit starter, VFD units, and all other front mounted or internal wiring devices. All external wiring to the MCC units and sections from the field devices and equipment shall be furnished, installed and terminated by the Electrical Contractor.
- B. Cubicles shall be approximately 90" high, 21" wide and 21" deep or the dimensions shown on the plans for other MCC equipment requiring larger sections including soft starters and/or variable frequency drives. Each MCC shall be dead front, totally enclosed, open bottom with rigid channel frame for free standing installation. Manufacturer's published standard steel construction, shall be used except the minimum gage shall be 14. Entire control center shall be primed and painted with two coats of ANSI-61 light gray enamel.
- C. All unpainted metal parts shall be plated for corrosion resistance.
- D. Vertical hinged door wiring compartments with access to each starter unit for power and control wiring.
- E. Accessible pullbox compartments at top and bottom of each cubicle, for horizontal wiring between cubicles.
- F. Conduit entrance space in top and bottom of each cubicle.
- G. Matching blank panels shall be used for unused space.
- H. See the service entrance specification for electrical utility metering requirements.
- I. The Electrical Contractor shall coordinate entire installation, including verification of all motor sizes, voltages, control devices required, etc. Control devices shall be provided as specified.
- J. Each Motor control center shall be mounted on the floor as shown on the drawings.
- K. Horizontal phase bussing shall be 1200 amp tinned copper for MCC-1A and MCC -1B and 600 amp for MCC-2. Vertical bussing shall be rated for at least 600 amps.
- L. Neutral Bussing is not required, provide neutral plate for landing neutral conductors shown on the plans.
- M. Each VFD unit shall be installed and wired as shown on the plans.
- N. Voltage Rating: 480 volts, 3 phases, 4 wire, 60 Hertz with ground.
- O. Circuit disconnects shall be braced for 65,000 RMS amperes symmetrical fault current at highest service voltage. The AIC ratings are shown on the plans.

- P. The manufacturer shall provide 1/4" X 2" Tin-plated copper ground bus to extend the full length of control center and it shall be bolted to each cubicle.
- Q. Enclosure: NEMA ICS6, type 1A, gasketed.
- R. Where instrumentation devices are installed into the Motor Control Center, adequate space shall be provided for the equipment. Special consideration shall be provided for ventilation of equipment that is sensitive to temperature.
- S. Special consideration shall be provided for ventilation of equipment that is sensitive to temperature.
- T. MCC-1A shall be provided with a 1200 amp main service entrance rated circuit breaker as specified in the Enclosed Circuit Breaker specifications and MCC-1B shall be provided with main lugs only as shown on the plans.

2.03 ETHERNET COMMUNICATIONS REQUIREMENTS

- A. Each MCC shall be equipped and wired for Ethernet/IP communications for integration into VFD units, owner metering and other equipment as shown on the plans. The Ethernet system shall comply with the following:
 - B. Ethernet/IP cable shall be routed through each MCC lineup from the top or bottom wireway as shown on the plans.
 - C. Eight Ethernet/IP device ports shall be provided in the rear of each full height vertical wireway. The switch shall be a managed unit and shall be accessible from the front of the MCC behind a door.
 - D. The Ethernet/IP device within each plug-in unit shall be factory connected to one of the Ethernet/IP ports in the vertical wireway with 600 volt, type PLTC rated cable.
 - E. The Ethernet/IP cable shall meet National Electrical Code (NEC) Article 300-3 © (1) and the Canadian Electrical Code Rule 12-904. The Ethernet/IP cable shall have an insulating rating equal to or better than the maximum circuit voltage present in any of the MCC units such that no special wireway or barriers or internal conduit is required to meet NEC Article 300-3 as noted above.
 - F. The Ethernet/IP cable shall be UL listed.
 - G. The addition or removal of a unit from the Ethernet/IP system shall not interrupt the operation of other units located on the Ethernet/IP system.
 - H. The Ethernet/IP system located in MCC-1B shall be provided with 120 volt power from Panelboard L1.
 - I. Each unit shall be provided with an individual IP address. All addressing shall be determined by the MCC System Integrator and shall be shown on the shop drawings and O&M Manuals with a disk copy of the electronic data sheet (EDS) files for the Ethernet/IP devices. Each unit shall have a label indicating its IP address within.
 - J. Each unit shall be factory tested to verify the addressing is correct and is operating properly.
 - K. The MCC System Integrator shall install an N-Tron managed copper Ethernet switch in MCC-1B unit and provide power to the device. The Ethernet switch shall be N-Tron model number 708TX or Engineer approved equal that shall be fully compatible with all other required switches shown on the plans. The Electrical Contractor shall install a conduit from MCC-1A to MCC-1B overhead for routing the cable from MCC-1B to MCC-1A.

2.04 FEEDER TAP UNITS: MOLDED CASE THERMAL-MAGNETIC CIRCUIT BREAKERS

- A. Branch circuit and sub-feeder over-current protection shall be provided by molded case, thermal-magnetic, quick-make, quick-break, trip free on faults, thermal-inverse time delay element and magnetic instantaneous trip coil in each ungrounded phase conductor, or approved equivalent solid state trip unit. Also see Section 26 28 16.02 "Enclosed Circuit Breakers" for requirements.
- B. Breaker ampere rating shall be engraved on handle or trip unit.
- C. Multi-pole breakers with internal common trip shall be furnished.

2.05 MAIN SERVICE ENTRANCE RATED CIRCUIT BREAKERS

- A. See Section 26 28 16.02 "Enclosed Circuit Breakers" for requirements.

2.06 COMBINATION STARTER-MOTOR CIRCUIT PROTECTORS

- A. Protector shall be plug-in type with 100 AMP and 240 AMP stubs which increase contact pressure when subjected to short circuit currents.
- B. Starter units shall be constructed to allow withdrawal of unit from cubicle without removing door.
- C. Starter units shall be magnetic, full voltage; non-reversing, to conform to NEMA Industrial Control standards for horsepower served, and shall have NEMA size 1 minimum, with electronic overload protection based on actual full load current of motor installed.
- D. The starter units shall be provided complete with the following features:
 - 1. Reset button in front MCC or starter cover to reset overload relays.
 - 2. 120 volt control transformer except as indicated otherwise with two primary and one secondary fuse for each (Class H fuses).
 - 3. Legend plate, use white plastic with 1/4" high black letters describing motor being served.
 - 4. Terminal block with permanent identification.
 - 5. 120 VAC 60 Hz operating coils.
 - 6. Motor branch circuit over-current protection - motor circuit protector, MCP, in conjunction with the motor starter overload elements.
 - 7. Provide individual Hand-Off-Auto selector switches, push-to-test run and failure lights, digital liquid crystal elapsed time meters front panel mounted equipment as shown on the wiring diagrams. See plans for additional equipment required for the project(s).
 - 8. Use only Allen Bradley equipment and components.
 - 9. Provide electronic overloads, NEMA ICS class 20 electronic type overload relay.
 - 10. Provide adjustable current sensing coil in each phase to trip the protector on fault or over-current conditions.

2.07 VARIABLE FREQUENCY DRIVE (VFD) REQUIREMENTS

- A. See Specification Section 26 29 24.

2.08 SOFT STARTER REQUIREMENTS

- A. Not used.

2.09 SURGE SUPPRESSION SYSTEMS

- A. See Specification Section 26 43 13.

2.10 PRODUCT OPTIONS AND FEATURES

- A. Auxiliary Contacts: NEMA ICS 2, Auxiliary contacts (convertible) shall be provided as required for control scheme. A minimum of 3-N/O (normally open) auxiliary contacts shall be furnished for each motor starter and 2-N/O (normally open) auxiliary contacts shall be furnished for each contactor.
- B. Provide N/O (normally open) alarm contact on overload relay for each motor starter.
- C. Remote Mounted Pilot Devices shall be NEMA ICS 2, heavy duty LED transformer type and oil-tight type. All devices shall be 30.5 mm in size.
 - 1. Hand-Off-Auto selector switches, three position type, where shown.
 - 2. Hand-Off-Remote-Auto or similar selector switches, two, three, four or five position type, where shown on the plans.
 - 3. Front panel mounted elapsed non-resettable mechanical time meters (ETM), where shown on the wiring diagrams.
- D. Pilot Device Contacts: NEMA ICS 2, Form Z.
- E. Pushbuttons: Unguarded, shrouded type.
- F. Selector Switches: Provide 2, 3, 4 or 5 position switches, 30.5 mm heavy duty type, contacts rated for 10 amps as required by the plans and specifications.
- G. Control Power Transformers: 120 volt secondary unless indicated otherwise, in each motor starter. Provide fused primary and secondary, and bond unfused leg of secondary to enclosure. Provide 150% of spare capacity.
- H. Provide for each relay and starter coil a transient surge suppression device.
- I. Provide time delay relays and standard relays as shown on the wiring diagrams. All time delay relays shall be of the solid-state type, fully adjustable (0-30 seconds), plug-in type. Standard relays shall be NEMA class with convertible 10 amp contacts. The coils shall be rated and wired for 120VAC operation.
- J. Provide one additional spare relay and time delay relay in each motor starter unit.
- K. Phase Loss Relay: Not Required.

2.11 FIELD WIRING TERMINATION COMPARTMENT (TYPE C CONSTRUCTION)

Not Used.

2.12 DISCONNECTS

- A. Combination Controllers: Combine motor controllers with motor circuit protector disconnect in common enclosure. Provide means for locking disconnect handle, and means for defeating cover interlock.
- B. Motor Circuit Protector: NEMA AB 1, circuit breakers with integral instantaneous magnetic trip in each pole.

2.12 OWNER METERING

- A. Provide Owner metering in Motor Control Center MCC-1A as follows: Allen Bradley catalog number **Xxxxxxx**.
- B. The meter shall monitor and display the following:
 - 1. Volts L-L, L-N, Average L-L and average L-N.
 - 2. Phase and neutral currents.
 - 3. Power, real, reactive and apparent.

4. Frequency.
 5. Energy in real, forward, reverse and sum.
 6. Demand, peak with date and time.
 7. Percent THD.
 8. Harmonics and individual harmonics.
 9. Demand comparisons.
- C. The meter shall be installed on the front of the MCC-1A.
- D. The meter shall be accurate within 0.1% reading of voltage and current and within 0.2% or energy and demand in accordance with ANSI C12.20. The meter shall scan at a 400 cycle sampling rate.
- E. The meter shall be provided with a RJ-45 10/100 Base-T Ethernet network port with the TCP/IP Protocols for communications to the SCADA Ethernet network. The System Integrator shall connect the meter to the Ethernet switch located in at the SCADA control panel.
- F. The meter shall include a 256MB memory for data logging.
- G. The meter shall be powered from a separate 120 volt power source from Panelboard L1.

2.13 OWNER TRAINING

- A. Provide the Owner with two (2) hours of training on the MCC equipment including MCC-1A and MCC-1B.
- B. Provide the Owner with two (2) hours of training on the VFD units, Owner metering, surge arrestors and other MCC related equipment.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that surface is suitable for motor control center installation.

3.02 INSTALLATION

- A. Install motor control centers in accordance with manufacturer's instructions.
- B. Tighten accessible bus connections and mechanical fasteners after placing motor control center.
- C. Install fuses in fusible switches.
- D. Set overloads to match installed motor characteristics.
- E. Provide engraved plastic nameplates under the provisions of Section 26 05 53.
- F. Motor Data: Provide neatly typed label inside each motor starter door identifying motor served, nameplate horsepower, full load amperes, code letter, service factor, motor rpm and voltage/phase rating.

3.03 FIELD QUALITY CONTROL

- A. Inspect and test each enclosed controller to NEMA ICS 2.
- B. Install motor control center level and plumb. Do not install where access cannot meet NEC requirements.

END OF SECTION

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SECTION 26 27 01
SERVICE ENTRANCE

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.
- B. Division-26 Basic Electrical Materials and Methods sections apply to work specified in this section.

1.02 SUMMARY

- A. Extent of service-entrance work is indicated by drawings and schedules.
- B. Types of service-entrance equipment in this section include the following:
 - 1. Meter socket (Furnished and installed by the Electrical Contractor).
 - 2. The utility meter will be furnished and installed by the Utility Company.
 - 3. CT's to be furnished by the Electrical Utility Company and installed in the MCC by the System Integrator. The Electrical Contractor shall mount the meter socket and terminate the CT wiring.
 - 4. The Service Entrance Enclosure with shorting blocks shall be furnished and installed by the Electrical Contractor.
- C. Wires/cables, raceways, and electrical boxes and fittings are specified in Division-26 Basic Electrical Materials and Methods sections, "Low-Voltage Electrical Power Conductors and Cables", "Conduit and Raceways", and "Boxes and hand holes."
- D. Refer to other Division-26 sections for wires/cables, raceways, and electrical boxes and fittings work required in connection with service-entrance equipment.
- E. The electrical service installation shall meet the Electrical Utility Company requirements. Coordinate any and grounding requirements necessary for proper installation with the Electrical Utility Company.
- F. The Electrical Utility Company will be furnishing and installing the concrete transformer pad as shown on the plans and routing the secondary conduits and conductors from the service entrance enclosure to the transformer. The Electrical Contractor is responsible for furnishing the service entrance enclosure and the conduit and wiring from it to MCC-1A.
- G. The Electrical Utility Company is: Madison Gas & Electric
Mr. Christopher Erickson
Office Phone Number is (608) 252-5670
Cellular Number is (608) 516-7940
Email is CErickson@mge.com

1.03 UTILITY COMPANY FEES

- A. No fees are required by MG&E.

1.04 SUBMITTALS

- A. Provide submittal on service entrance enclosure and meter socket.

1.05 QUALITY ASSURANCE

- A. Meet utility requirements and specifications.

1.06 DELIVERY, STORAGE AND HANDLING

- A. Not Required.

1.07 SEQUENCING AND SCHEDULING

- A. Not Required.

PART 2 PRODUCTS

2.01 SERVICE-ENTRANCE EQUIPMENT

- A. Cables/Wires:
 - 1. General: Provide cables/wires complying with Division-26 Basic Electrical Materials and Methods section "Wires and Cables", in accordance with the following listing:
 - a. Type XHHW copper conductors for underground installation.
 - b. Type XHHW for above ground installations.
- B. Raceways:
 - 1. General: Provide raceways complying with Division-26 Basic Electrical Materials and Methods section "Conduit and Raceways", in accordance with the following listing:
 - a. PVC conduit and fittings.
 - b. Rigid steel galvanized conduit.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine areas and conditions under which service-entrance equipment and components are to be installed. Coordinate the electrical services work with MG&E.

3.02 INSTALLATION OF SERVICE- ENTRANCE EQUIPMENT

- A. Install service-entrance equipment as indicated, in accordance with equipment manufacturer's written instructions, and with recognized industry practices, to ensure that service-entrance equipment fulfills requirements. Comply with applicable installation requirements of NEC and NEMA standards and each of the utility company requirements.
- B. Tighten electrical connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Stds 486A and B, and the National Electrical Code.

3.03 FIELD QUALITY CONTROL

- A. Prior to energization of service-entrance equipment, check accessible connections for compliance to manufacturer's torque tightening specifications.
- B. Prior to energization of service-entrance equipment, check with ground resistance tester, phase-to-phase and phase-to-ground insulation resistance levels to ensure requirements are fulfilled.
- C. Prior to energization, test circuitry for electrical continuity, free of shorts.

3.04 GROUNDING

- A. Provide equipment grounding connections for service-entrance equipment as indicated. Tighten connections to comply with tightening torques specified in UL Std 486A to assure permanent and effective grounding.

3.05 ADJUSTING AND CLEANING

- A. Adjust operating mechanisms for free mechanical movement.
- B. Touch-up scratched or marred enclosure surfaces to match original finishes.

3.06 DEMONSTRATION

- A. Upon completion of installation of service-entrance equipment and electrical circuitry, energized 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 to demonstrate compliance.

END OF SECTION

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SECTION 26 27 16

ELECTRICAL CABINETS AND ENCLOSURES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Hinged cover enclosures, where shown on plans.
- B. Cabinets.
- C. Accessories.

1.02 REFERENCES

- A. UL 508.
- B. JIC Standard EGP-1-1967.
- C. ANSI/NFPA 70 - National Electrical Code.

PART 2 PRODUCTS

2.01 HINGED COVER ENCLOSURES (INTERIOR NON-CORROSIVE INSTALLATIONS ONLY)

- A. Construction: NEMA, Type 12, painted steel enclosures or as shown in the plans.
- B. Covers: Continuous hinge, held closed by hasp and staple for padlock.
- C. Provide interior metal panel for mounting terminal blocks and electrical components; finish with white enamel.

2.02 HINGED COVER ENCLOSURES (EXTERIOR AND CORROSIVE INSTALLATIONS)

- A. Construction: NEMA, Type 4X, 316 Stainless steel enclosures as shown in the plans.
- B. Covers: Continuous hinge, held closed by hasp and staple for padlock.
- C. Provide interior metal panel for mounting terminal blocks and electrical components; finish with white enamel.

2.03 TERMINAL BLOCKS

- A. Manufacturers:
 - 1. Allen Bradley, 1492 Series, finger safe.
 - 2. Phoenix Contact, finger safe.
- B. Provide ground bus terminal block, with each connector bonded to enclosure.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify conditions.
- B. Verify that surfaces are ready to receive work.

3.02 INSTALLATION

- A. Install Products in accordance with manufacturer's instructions.
- B. Install enclosures and boxes plumb. Anchor securely to wall and structural supports at each corner.
- C. Install cabinet fronts plumb.

END OF SECTION

SECTION 26 27 26

WIRING DEVICES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Wall switches.
- B. Receptacles.
- C. Telephone outlets.
- D. Device plates and decorative box covers.

1.02 REFERENCES

- A. NEMA WD 1 - General Purpose Wiring Devices.
- B. NEMA WD 6 - Wiring Device Configurations.

1.03 SUBMITTALS

- A. Submit under provisions of Division 1.
- B. Product Data: Provide manufacturer's catalog information showing dimmers, colors, and configuration.
- C. Submit one sample of each type of device that will be provided for the project except for explosion proof area devices. Each sample will be retained by the Engineer.
- D. Some equipment may be called out on the plans, if so provide that catalog number or most current catalog number. It is the Electrical Contractor's responsibility to verify all catalog numbers and provide the most current device specified at no additional cost to the contract.

1.04 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years of experience.

1.05 REGULATORY REQUIREMENTS

- A. Conform to requirements of ANSI/NFPA 70.
- B. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and shown.

PART 2 PRODUCTS

2.01 WALL SWITCHES

- A. Single Pole Switch:
 - 1. Hubbell Model HBL1221. (Brown)
 - 2. Hubbell Model HBL1221I. (Ivory)
 - 3. Lighted 1 Way Hubbell Model HBL12211L

4. Or Engineer approved equal.
- B. Double Pole Switch:
1. Hubbell Model HBL1222. (Brown)
 2. Hubbell Model HBL1222I. (Ivory)
 3. Or Engineer approved equal.
- C. Three-way Switch:
1. Hubbell Model HBL1223. (Brown)
 2. Hubbell Model HBL1223I. (Ivory)
 3. Lighted 3 Way Hubbell Model HBL12231L
 4. Or Engineer approved equal.
- D. Four-way Switch:
1. Hubbell Model 1224. (Brown)
 2. Hubbell Model HBL1224-I (Ivory)
 3. Or Engineer approved equal.
- E. Indicator Switch:
1. Hubbell Model HBL1221-IL. (Ivory)
 2. Or Engineer approved equal.
- F. Locator Switch:
1. Hubbell Model HBL18221CN. (Brown)
 2. Hubbell Model HBL18221ICN. (Ivory)
 3. Or Engineer approved equal.
- G. Weather Proof Switch:
1. Hubbell Model HBL1221/HBL1795 Cover.
 2. Or Engineer approved equal.
- H. Explosion Proof Switches:
1. Appleton. Model EFS Series.
 2. Crouse-Hinds. Model EDS Series.
 3. Or Engineer approved equal.

2.02 RECEPTACLES

- A. Duplex Convenience Receptacle:
1. Hubbell. Model HBL5362. (Brown)
 2. Hubbell Model HBL5362I. (Ivory)
 3. Or Engineer approved equal.
- B. GFCI Receptacle:
1. Hubbell. Model GF5362. (Brown)
 2. Hubbell Model GF5262I. (Ivory)
 3. Or Engineer approved equal.
- C. Corrosion Resistant Receptacle: (Where Specified).
1. Hubbell. Model HBL52CM62I. (Ivory)
 2. No Substitutes.
- D. Explosion Proof Receptacle:
1. Crouse-Hinds. Model ENR 21201.
 2. Or Engineer approved equal.
- E. Single Receptacle:
1. Hubbell. Model HBL5251. (Brown)

2. Hubbell Model HBL5251I. (Ivory)
3. Or Engineer approved equal.

2.03 WALL PLATES

- A. Weatherproof Cover Plate: In-use Gasketed cast metal with hinged gasketed device cover. Required on building exterior.
 1. Hubbell WP8MH for receptacle.
 2. Hubbell WP26MH for GFI receptacle.
 3. Or Engineer Approved equal.

2.04 TELEPHONE SYSTEM SERVICE

- A. Provide RJ11 and RJ 45 jacks for telephone and Ethernet communications as manufactured by Hubbell or Engineer approved equal.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify conditions.
- B. Verify outlet boxes are installed at proper height.
- C. Verify wall openings are neatly cut and will be completely covered by wall plates.
- D. Verify floor boxes are adjusted properly.
- E. Verify branch circuit wiring installation is completed, tested, and ready for connection to wiring devices. GFCI's shall be wired as feed-thru devices.
- F. Verify openings in access floor are in proper locations.

3.02 PREPARATION

- A. Provide extension rings to bring outlet boxes flush with finished surface.
- B. Clean debris from outlet boxes.

3.03 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install devices plumb and level.
- C. Install switches with OFF position down.
- D. Install receptacles with grounding pole on top.
- E. Connect wiring device grounding terminal to branch circuit equipment grounding conductor.
- F. Install decorative plates on switch, receptacle, and blank outlets in finished areas.
- G. Connect wiring devices by wrapping conductor around screw terminal.
- H. Use jumbo size plates for outlets installed in masonry walls.

- I. Install galvanized steel plates on outlet boxes and junction boxes in unfinished areas, above accessible ceilings, and on surface mounted outlets.

3.04 INTERFACE WITH OTHER PRODUCTS

- A. Coordinate locations of outlet boxes provided under Section 26 05 33.02 to obtain mounting heights specified and indicated on Drawings.
- B. Install wall switches 48 inches above finished floor, measured from top of box to finished floor.
- C. Install convenience receptacles 24 inches, measured from top of box to finished floor, unless otherwise noted on the plans.
- D. Install convenience receptacle 6 inches above counters and in laboratories backsplash if shown on plans.

3.05 FIELD QUALITY CONTROL

- A. Inspect each wiring device for defects.
- B. Operate each wall switch with circuit energized and verify proper operation.
- C. Verify that each receptacle device is energized.
- D. Test each receptacle device for proper polarity.
- E. Test each GFCI receptacle device for proper operation.
- F. Verify that each telephone jack is properly connected and circuit is operational.

3.06 ADJUSTING

- A. Adjust devices and wall plates to be flush and level.

END OF SECTION

SECTION 26 28 13

FUSES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Specification Section 26 28 15.01 - Enclosed Switches.
- C. Specification Section 26 09 24 - Motor and Lighting Controllers.
- D. Specification Section 26 24 19 - Motor Control Centers.

1.02 SUMMARY

- A. This Section includes the following:
 - 1. Fuses.
 - a. Power
 - b. Control

1.03 SUBMITTALS

- A. General: Submit the following according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Product data for each fuse type. Include the following:
 - 1. Descriptive data and time-current curves.
 - 2. Fuse size for elevator feeder and disconnect applications.
- C. Field test reports indicating and interpreting test results.
- D. Maintenance data for tripping devices to include in the "Operating and Maintenance Manual" specified in Division 1.

1.04 QUALITY ASSURANCE

- A. Comply with NFPA 70 "National Electrical Code" for components and installation.
- B. Listing and Labeling: Provide products specified in this Section that are listed and labeled.
 - 1. The Terms "Listed" and "Labeled": As defined in the "National Electrical Code," Article 100.
- C. Single-Source Responsibility: all fuses shall be the product of a single manufacturer.

1.05 EXTRA MATERIALS

- A. Furnish the following extra materials that match products installed, packaged with protective covering for storage, and with identification labels clearly describing contents.
- B. Spare Fuses: Furnish quantity equal to 20 percent of each fuse type and size installed, but not less than 1 set of 3 of each type and size.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide fuses by one of the following:
 1. Buss Fuses, Inc.
 2. Bussmann Div., Cooper Industries, Inc.
 3. Circuit Protection Div.,; Gould, Inc.
 4. Littelfuse, Inc.

2.02 CARTRIDGE FUSES

- A. Characteristics: NEMA FU 1 nonrenewable cartridge fuse, class as specified or indicated, current rating as indicated, voltage rating consistent with circuit voltage.
- B. Motor Branch Circuits: Class RK1 time delay.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install fuses in fusible devices as indicated. Arrange fuses so that fuse ratings are readable without removing fuse.

3.02 IDENTIFICATION

- A. Install typewritten labels on the inside on the inside door of each fused switch to indicate fuse replacement information.

END OF SECTION

SECTION 26 28 16.01

ENCLOSED SWITCHES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Enclosed, heavy duty fusible switches.
- B. Enclosed, heavy duty non-fusible switches.
- C. Manual bypass switches, if shown on plans.
- D. See Specification Section 26 28 13 for "FUSES".

1.02 REGULATORY REQUIREMENTS

- A. National Electrical Manufacturers Association (NEMA): Provide switches conforming to NEMA KS 1, "Enclosed Switches."
- B. NEMA: Construct enclosures conforming to NEMA 250, "Enclosures for Electrical Equipment (1000 Volts Maximum)."
- C. National Fire Protection Association (NFPA): Conform to NFPA 70, "National Electrical Code," for installation and minimum fusing requirements.
- D. Underwriters Laboratories, Inc. (UL): Manufacture switches conforming to the requirements of UL 98, "Enclosed and Dead-Front Switches."
 - 1. Provide switches listed and labeled by UL.
 - 2. Provide fuse holders conforming to UL 512, "Fuseholders."
 - 3. Provide cabinets conforming to UL 50, "Cabinets and Boxes."

1.03 EXTRA MATERIALS

- A. Furnish under provisions of Division 1.
- B. Provide three of each size and type fuse installed.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Cutler Hammer, (250 volt and 600 volt).
- B. General Electric.
- C. No Approved Equal.

2.02 ENCLOSED SWITCHES

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

- B. General: Provide individually enclosed air-break switches as indicated on the drawings, with all current-carrying parts enclosed and manually operable by means of external handles. Switches shall be heavy duty (HD) type, ampere and horsepower rated.
 - 1. Provide cartridge enclosed fuses and rejection fuse holders when fuse switches are indicated.
 - 2. Provide electrically tripped switches where indicated.
 - 3. Provide NEMA 1 enclosures for indoors in non-corrosive areas and NEMA 4X stainless steel enclosures for outdoors and corrosive areas, or as indicated on the drawings.
 - 4. Provide auxiliary break before break contacts where specified on the plans.
 - 5. Provide NEMA 7/9 explosion-proof disconnect switches as shown on the plans.
- C. Switching Action: Provide quick-make, quick-break type switch action.
- D. Construction: All current carrying parts shall be high conductivity copper, with heating ratings conforming to UL 98.
 - 1. Provide silver tungsten or silver-plated copper contacts.
 - 2. Provide fuse holders of the rejection type, sized for fuses scheduled.
 - 3. Provide interrupting ratings minimum 10 times locked rotor current of NEMA maximum motor horsepower rating.
 - 4. Arrange for padlocking with two locks in both "off" and "on" positions.
- E. Fuses: Provide fuses of class, type and rating indicated on the drawings and schedules.
- F. Enclosures: NEMA KS 1.
 - 1. Interior Dry Locations: Type 1.
 - 2. Exterior Locations: Type 4X.
 - 3. Class I Division I and II Locations: Type UL listed.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install disconnect switches where indicated.
- B. Install fuses in fusible disconnect switches.
- C. Provide engraved nameplate on outside door of each switch indicating UL fuse class and size for replacement.

END OF SECTION

SECTION 26 28 16.02

ENCLOSED CIRCUIT BREAKERS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Enclosed circuit breakers for new equipment as specified on the plans.

1.02 RELATED WORK

- A. Section 26 24 16 – Panelboards
- B. Section 26 09 24 - Motor and Lighting Controllers
- C. Section 26 24 19 – Motor Control Centers
- D. Section 26 22 01 - Low Voltage Transformers, General Purpose, Dry Type and Non-Linear Load Type

1.03 SUBMITTALS

- A. Submit product data under provisions of Division 1.
- B. Product Data: Provide catalog sheets showing ratings, trip units, time current curves, dimensions, and enclosure details.
- C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, installation and starting of Product.

1.04 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing Products specified in this Section with minimum three years of experience.

1.05 REGULATORY REQUIREMENTS

- A. Conform to requirements of NFPA 70.
- B. Furnish products listed and classified by Underwriter's Laboratories, Inc., as suitable for purpose specified and indicated.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Cutler Hammer: HLD type for 400-600 amp/600 amp frame with LSI Digitrip RMS310 electronics for 277/480 volt service entrance rated at 65KAIC.
- B. Cutler Hammer type ED thermal magnetic for 10-225 amp frame circuit breakers at 120/240 and 240 volts with non-interchangeable trip units at up to 65KAIC.

Cutler Hammer type HFD thermal magnetic for 10-225 amp frame circuit breakers for 277/480 Volt loads with non-interchangeable trip units at up to 65KAIC.

- C. Cutler Hammer type HMCP magnetic only for 100 amp frame circuit breakers for motor loads with non-interchangeable trip units at up to 65KAIC.
- D. Cutler Hammer type CHLD 100% rated thermal magnetic from 125 amp to 600 amp frame circuit breakers at 480 volt and 277/480 Volt major feeders with LSI Digitrip RMS550 electronics.
- E. Main circuit breaker located in MCC-1A shall be service entrance rated, Cutler Hammer type HMDL with LSI Digitrip RMS550 electronics.
- F. The main circuit breaker shall be installed in the panelboards with top or bottom feed as determined by the project conditions.
- G. Provide thermal/magnetic and magnetic circuit breakers for other equipment installed in panelboards as shown on the plans. Where circuit breakers are shown for current and future horsepower ranges, provide circuit breakers with selectable trip settings or plugs.
- H. Allen Bradley equivalent.
- I. No approved equal.

2.02 MOLDED CASE CIRCUIT BREAKER

- A. Circuit Breaker: NEMA AB 1.

2.03 ENCLOSURE

- A. Enclosure: NEMA AB 1; 12.
- B. Fabricate enclosure from steel.
- C. Finish using manufacturer's standard enamel finish.
- D. See One-Line Diagram for additional information.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install enclosed circuit breakers where indicated, in accordance with manufacturer's instructions.
- B. Install enclosed circuit breakers plumb. Provide supports in accordance with Section 26 05 29.
- C. Height: 5 ft. (1.6 M) to operating handle.
- D. Provide engraved plastic nameplates under the provisions of Section 26 05 53.

3.02 FIELD QUALITY CONTROL

- A. Field inspection and testing will be performed under provisions of Division 1.
- B. Inspect and test each circuit breaker to NEMA AB 1.
- C. Inspect each circuit breaker visually.
- D. Perform several mechanical ON-OFF operations on each circuit breaker.

- E. Verify circuit continuity on each pole in closed position.
- F. Determine that circuit breaker will trip on over-current condition, with tripping time to NEMA AB 1 requirements.
- G. Include description of testing and results in test report.

3.03 ADJUSTING

- A. Adjust work under provisions of Division 1.

END OF SECTION

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SECTION 26 29 24

VARIABLE FREQUENCY DRIVES (VFD)

PART 1 GENERAL

1.01 SUMMARY

- A. The Variable Frequency Drives shall be furnished in the Motor Control Centers as shown on the plans. The System Integrator shall furnish MCC mounted six (6) pulse variable frequency drive (VFD) motor controller(s) shown on the One-line Diagram.

The project includes four (4) constant torque VFD units based on Cutler Hammer ratings located in MCC-1B structure measuring 90 inches tall X 20 inches deep with the widths shown on the plans for the well pump and high services pumps as shown on the plans. See the respective control diagrams for additional control requirements.

- B. Type: Pulse-width modulated type using IGBT or newer Technology. Coordinate the drives with the motor rpm ranges required for the project.
- C. Locations: diagrammatic; coordinate with motor and space condition.
- D. Nameplates: indicate horsepower, voltage, rpm and equipment controlled including system, equipment number and area served.
- E. Related Sections: Also refer to other sections for the following:
 - 1. Electrical identification.
 - 2. Instrumentation and controls.
 - 3. Sequence of operation.
 - 4. Testing, adjusting and balancing.

1.02 QUALITY ASSURANCE

- A. Manufacturing firms regularly engaged in manufacture of this material with characteristics and capacities required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Provide equipment whose performance, under specified conditions, is certified by the manufacturer.
- C. Conform to the requirements of National Electrical Manufacturers Association (NEMA). The units shall be UL listed as a complete assembly and shall be built in compliance with the latest standards of ANSI, IEEE and the National Electrical Code.

1.03 SUBMITTALS

- A. Division 1: Refer to Division 1, "Submittals" for basic information relating to submittal requirements.
- B. Product Data: Submit manufacturer's standard technical product data indicating conformance to the stipulated reference specifications, construction material, construction details, and test procedures.
- C. Submittal data shall also contain the following:
 - 1. Catalog cuts showing dimension and rating.
 - 2. Single line diagrams.
 - 3. Elementary control diagrams.
 - 4. In accordance with IEEE 519.

1.04 DELIVERY, STORAGE AND HANDLING

- A. Delivery: Handle variable frequency drives (VFD) carefully to prevent damage, denting and scoring. Do not install damaged VFD or components; replace with new.
- B. Storage: Store VFD and components in a clean, dry place. Protect from weather, dirt, water, construction debris, and physical damage.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Allen Bradley Powerflex 753.
- B. No Approved Equal.

2.02 MATERIALS

- A. Type: All controllers full voltage non-reversing type unless otherwise noted.
- B. Standard Protection Features:
 - 1. Phase-loss protection.
 - 2. Instantaneous overcurrent.
 - 3. Input line undervoltage trip.
 - 4. Overtemperature.
 - 5. Overcurrent.
 - 6. Continuous ground fault.
 - 7. Short circuit protection.
 - 8. Motor overload protection.
 - 9. Fuses: Similar to Bussman, Lo-Peak and/or Hi-Cap.
- C. Basic Description:
 - 1. The one (1) 10 HP Air Handler motor shall include VFD shall be variable torque rated for 22 continuous amps.
 - 2. The one (1) 250 HP well pump motors shall include VFD shall be constant torque rated for 302 continuous amps.
 - 3. The two (2) 200 HP high service pump motors shall include VFD's shall be constant torque rated for 367 continuous amps.
 - 4. The VFD units shall produce an adjustable AC voltage/frequency output. It shall have an output voltage regulator to maintain correct output V/Hz. despite incoming voltage variations. The VFD units shall be supplied with an integral input AC line reactor of minimum 5 percent impedance. Line reactor shall be designed to address performance issues of NEMA MG1-20.55 and provide proper transient protection of the VFD input power devices. Input line reactors shall be integrated within the VFD to meet the most current IEEE-519 (current) specifications.
 - 5. The feeder is length is shown on the plans.
 - 6. The VFD units shall have a continuous output current rating of 100 percent of motor nameplate current up to 122 degrees F.
 - 7. The VFD units shall be of the Pulse-Width Modulated type and shall consist of a full-wave diode bridge converter to convert incoming fixed voltage/frequency to a fixed DC voltage. The Pulse Width Modulation strategy shall be of the space vector type implemented in a microprocessor which generates a sine-code output voltage.
 - 8. The inverter output shall be generated by power transistors which shall be controlled by six identical base driver circuits. The VFD units shall not induce excessive power losses in the motor. The worst case RMS motor line current measured at rated speed, torque and voltage shall not exceed 1.05 times the rated RMS motor current for pure sine wave operation.
- D. Variable speed drives: Where shown on the drawings the motor shall be rated at 480 volts, 3 phase, variable voltage. The VFD units shall incorporate the following:
 - 1. Adjustable to provide soft starting and stopping of the motor.

2. Linear acceleration and deceleration rates independently adjustable from 2 to 360 seconds.
 3. Circuitry to initiate an orderly shutdown of the VFD controller for protection against input phase failure and over temperature.
- E. The VFD units shall include the following protective features:
1. Single phase fault or 3-phase short circuit on VFD output terminals without damage to any power component.
 2. Static instantaneous overcurrent and overvoltage trip with inverse overcurrent protection.
 - a. Static overspeed (overfrequency) protection.
 - b. Line or fuse loss and undervoltage protection.
 - c. Power unit overtemperature protection.
 - d. Electronic motor overload protection.
 - e. Responsive action to motor winding temperature detectors or thermostatic switches.
 - f. Isolated operator controls.
 - g. Input line fuses.
 - h. Be insensitive to incoming power phase sequence.
 - i. Have desaturation circuit to drive inverter section transistor base current to zero in event of controller fault.
 - j. Have DC bus discharge circuit for protection of operator and service personnel with an indicator lamp.
 - k. Input line noise suppression with line reactor.
 - l. Individual transistor overcurrent protection.
- F. Integral input line reactors shall be provided to reduce both voltage and current harmonic distortion introduction on the line supply to within IEEE-519-1992 current Standards.
- G. Enclosure:
1. The VFD's shall be mounted into an MCC section of the size shown on the plans and shall be supplied by the VFD manufacturer. The VFD units shall be front accessible and shall also include the required circuit breaker and line side contactor with overload protection as shown on the plans. Overload protection shall be electronic type.
- H. The following system configuring settings shall be provided, field adjustable through the keypad/display unit or via the serial communication port only. The VFD display shall be mounted on the front of the VFD/MCC unit construction.
1. Motor Nameplate Data: Motor frequency, number of poles, full load speed, motor volts, motor full load amps, motor KW, current min., and current max.
 2. VFD Limits: Independent accel/decel rates, no load boost, Vmin, Vmax, V/Hz., full load boost, overload trip curve select (Inverse or Constant), Min/Max speed (frequency), auto reset for load or voltage trip select, slip compensation, catch-A Spinning-Load select, and Overload trip time set.
 3. VFD Parameters: Voltage loop gain, voltage loop stability, and current loop stability.
 4. Controller Adjustments: PID control enable/disable, setpoint select, proportional band select, reset time select, input signal scaling, input signal select (4-20 mA/0-5 Volts), auto start functions: on/off, Delay On/Off, Level Select On/Off, speed profile: entry, exit, point select, min, max speed select, inverse profile select (allows VFD speed to vary directly or inversely with input signal.)
 5. The fault log record shall be accessible via a RS232C/RS422 serial link as well as line by line on the keypad display.
 6. The drive is to be provided with isolated 4-20 mA DC output signals proportional to speed, current or voltage (select maximum of two signals) for remote monitoring of the VFD.
 7. The VFD shall be furnished with an Ethernet communications card for networking into the plants Ethernet backbone. This link shall provide visual indication of all VFD parameters and future remote programming and access.
 8. All System Integrator furnished VFD units shall be programmed for "flying Start" to ride through short duration power loss.
 9. The System Integrator shall set the ground fault setting such that the VFD will trip before the main circuit breaker in MCC-1A will trip, coordinate during shop drawing review.

- I. System Operation:
 1. With the manual start pushbutton selected, the drive shall be controlled by the increase/decrease pushbuttons on the drive keypad. The VFD manual speed shall be controlled by the keypad on the front panel.
 2. With the automatic pushbutton selected, the VFD shall start when the timer values provide the start signal if not in alarm. The exhaust fan starter shall not be an alarm or the VFD shall not start.
 3. The controller shall be subject to, but not limited to, the following quality assurance controls, procedures and tests:
 - a. Power transistors, SCRs and diodes shall be tested to ensure correct function and highest reliability.
 - b. Every controller shall be functionally tested with the motor to ensure that if the drive is started up according to the instruction manual provided, the unit will run properly.
 - c. The VFD units shall be fabricated into the Motor Control Centers by the System Integrator and not the manufacturer.
 4. The VFD units and installation shall be U.L. listed and shall be compatible with the motors and supplied as shown on the plans and shall be rated for Horsepower, amperage and other requirements for complete compatibility.

PART 3 EXECUTION

3.01 INSTALLATION OF VARIABLE FREQUENCY DRIVE

- A. Factory installed in the NEMA 1 gasketed MCC enclosure. Also see Specification Section 26 24 19 for additional information.

3.02 SYSTEM PROGRAMMING

- A. The VFD shall be programmed to start when the start signal is provided by the Hand-Off-Auto selector switch when in the "Auto" position and the control relay CR1 is energized to energize the line side contactor.
- B. The VFD units shall start and run at full speed to operate the pumps as shown on the plans and described in the Process and Instrumentation specifications.

3.03 TESTS

- A. Measure insulation resistance of each phase to phase and phase to ground with the starter contacts closed and the protective device open.
- B. Measure insulation resistance of each control circuit with respect to ground.
- C. Test motor overload units by injecting primary current through overload unit and monitoring trip time.
- D. Perform operational test by initiating devices to effect proper operation.

3.04 SERVICE CONDITIONS

- A. The controller shall be designed and constructed to operate within the following service conditions:
elevation: To 3300 Feet Ambient Temperature, Range: 0°C to 40°C Atmosphere: Non-Condensing relative humidity to 95 percent AC Line Voltage Variation: -5 percent to + 10 percent AC Line, Frequency Variation: ± 3 Hertz.

END OF SECTION

SECTION 26 31 00

FIRE DETECTION AND ALARM

PART 1 – GENERAL

1.1 DESCRIPTION

- A. This section of the specification includes the furnishing, installation, connection and testing of the microprocessor controlled, intelligent reporting fire alarm equipment required to form a complete, operative, coordinated system. It shall include, but not be limited to, alarm initiating devices, alarm notification appliances, Fire Alarm Control Panel (FACP), auxiliary control devices, annunciators and wiring as shown on the drawings and specified herein.
- B. The fire alarm system shall comply with requirements of 2010 NFPA Standard 72 for Protected Premises Signaling Systems except as modified and supplemented by this specification. The system shall be electrically supervised and monitor the integrity of all conductors.
- C. The fire alarm system shall be manufactured by an ISO 9001 certified company and meet the requirements of BS EN9001: ANSI/ASQC Q9001-1994.
- D. The FACP and peripheral devices shall be manufactured 100% by a single U.S. manufacturer (or division thereof).
- E. The system and its components shall be Underwriters Laboratories, Inc. listed as a complete system under the appropriate UL testing standard as listed herein for fire alarm applications and the installation shall be in compliance with the UL listing.
- F. The installing company shall employ NICET (minimum Level II Fire Alarm Technology) technicians on site to guide the final check-out and to ensure the systems integrity.
- G. The fire alarm control panel shall be connected to the phone system with dual telephone lines to call out to the locations required by the Fire Marshall. The Electrical Contractor shall coordinate with the City of Madison.

1.2 SCOPE

- A. A new intelligent reporting, microprocessor controlled fire detection system shall be installed in accordance to the project specifications and drawings.
- B. Basic Performance:
 - 1. Alarm, trouble and supervisory signals from all intelligent reporting devices shall be encoded on NFPA Style 4 (Class B) Signaling Line Circuits (SLC).
 - 2. Initiation Device Circuits (IDC) shall be wired Class B (NFPA Style B) as part of an addressable device connected by the SLC Circuit.
 - 3. Notification Appliance Circuits (NAC) shall be wired Class A (NFPA Style Y) as part of an addressable device connected by the SLC Circuit.
 - 4. Digitized electronic signals shall employ check digits or multiple polling.
 - 5. A single ground fault or open circuit on the system Signaling Line Circuit shall not cause system malfunction, loss of operating power or the ability to report an alarm.
 - 6. Alarm signals arriving at the main FACP shall not be lost following a primary power failure (or outage) until the alarm signal is processed and recorded.

C. BASIC SYSTEM FUNCTIONAL OPERATION

When a fire alarm condition is detected and reported by one of the system initiating devices, the following functions shall immediately occur.

1. The system alarm LED on the FACP shall flash.
2. A local piezo electric signal in the control panel shall sound.
3. A backlit 80-character LCD display on the FACP shall indicate all information associated with the fire alarm condition, including the type of alarm point and its location within the protected premises.
4. Printing on the remote printer and history storage equipment shall log the information associated each new fire alarm control panel condition, along with time and date of occurrence.
5. All system output programs assigned via control-by-event interlock programming to be activated by the particular point in alarm shall be executed and the associated system outputs (alarm notification appliances and/or relays) shall be activated.
6. The FACP shall include interface output relays with 24VDC coils with Form C relay contacts rated for 10 amps @ 120 volts for remote "Fault" and "Alarm" for connection to the SCADA Control Panel.

D. Fire alarm plan submission:

1. The contractor and fire alarm system supplier shall prepare necessary sets of plans and forms of the fire alarm system for approval by the Wisconsin Department of Safety and Professional Services (DSPS) and Authority Having Jurisdiction (AHJ) prior to construction. Submittal requirements include:
 - a. Battery calculations.
 - b. Voltage drop calculations for all circuit runs.
 - c. Device information including coverage area of detectors, visual and audio ratings, etc.
 - d. Locations of all devices. Additional devices as needed to meet all code requirements shall be included in bid to meet all applicable codes (additional devices beyond those shown on the plans that are identified by Engineer during shop drawing review and/or as determined by the AHJ/DSPS approval process will not be paid as a change order).
 - e. Complete list of detection, evacuation signaling and annunciator zones and/or addresses.
 - f. Complete list of fire control functions (i.e. fan shut down, etc.).
 - g. Complete sequence of operations, detailing all inputs and outputs.
 - h. All other information required for review and approval.
 - i. Floor plans.
2. Plans and forms will be stamped and signed by the Engineer prior to submittal if necessary.
3. The contractor and/or fire alarm supplier shall submit all stamped plans and forms, and payment to the appropriate authorities.
4. The contractor shall apply for the permit from the appropriate AHJ and include all work related and necessary in the bid.

1.3 SUBMITTALS

A. General:

1. Six copies of all submittals shall be submitted to the Architect/Engineer for review.

2. All references to manufacturer's model numbers and other pertinent information herein is intended to establish minimum standards of performance, function and quality. Equivalent compatible UL-listed equipment from other manufacturers may be substituted for the specified equipment as long as the minimum standards are met.
3. For equipment other than that specified, the contractor shall supply proof that such substitute equipment equals or exceeds the features, functions, performance and quality of the specified equipment.

B. Shop Drawings:

1. Sufficient information, clearly presented, shall be included to determine compliance with drawings and specifications.
2. Include manufacturer's name(s), model numbers, ratings, power requirements, equipment layout, device arrangement, complete wiring point-to-point diagrams and conduit layouts.
3. Show annunciator layout, configurations and terminations.

C. Manuals:

1. Submit simultaneously with the shop drawings, complete operating and maintenance manuals listing the manufacturer's name(s), including technical data sheets.
2. Wiring diagrams shall indicate internal wiring for each device and the interconnections between the items of equipment.
3. Provide a clear and concise description of operation that gives, in detail, the information required to properly operate the equipment and system.

D. Software Modifications:

1. Provide the services of a factory trained and authorized technician to perform all system software modifications, upgrades or changes. Response time of the technician to the site shall not exceed 4 hours.
2. Provide all hardware, software, programming tools and documentation necessary to modify the fire alarm system on site. Modification includes addition and deletion of devices, circuits, zones and changes to system operation and custom label changes for devices or zones. The system structure and software shall place no limit on the type or extent of software modifications on-site. Modification of software shall not require power-down of the system or loss of system fire protection while modifications are being made.

E. Certifications:

1. Together with the shop drawing submittal, submit a certification from the major equipment manufacturer indicating that the proposed supervisor of the installation and the proposed performer of contract maintenance is an authorized representative of the major equipment manufacturer. Include names and addresses in the certification.

1.4 GUARANTY

- A. All work performed and all material and equipment furnished under this contract shall be free from defects and shall remain so for a period of at least one (1) year from the date of acceptance. The full cost of maintenance, labor and materials required to correct any defect during this one year period shall be included in the submittal bid.

1.5 APPLICABLE STANDARDS AND SPECIFICATIONS

The specifications and standards listed below form a part of this specification. The system shall fully comply with the latest issue of these standards, if applicable.

A. National Fire Protection Association (NFPA) - USA:

- No. 12 CO2 Extinguishing Systems (low and high)
- No. 12B Halon 1211 Extinguishing Systems
- No. 13 Sprinkler Systems
- No. 13A Halon 1301 Extinguishing Systems
- No. 15 Water Spray Systems
- No. 16 Foam/Water Deluge and Spray Systems
- No. 17 Dry Chemical Extinguishing Systems
- No. 17A Wet Chemical Extinguishing Systems
- Clean Agent Extinguishing Systems
- No. 72-2010 National Fire Alarm and Signaling Code
- No. 101 Life Safety Code

B. Underwriters Laboratories, Inc. (UL) - USA:

- No. 268 Smoke Detectors for Fire Protective Signaling Systems
- No. 864 Control Units for Fire Protective Signaling Systems
- No. 268A Smoke Detectors for Duct Applications
- No. 521 Heat Detectors for Fire Protective Signaling Systems
- No. 464 Audible Signaling Appliances
- No. 38 Manually Actuated Signaling Boxes
- No. 346 Water flow Indicators for Fire Protective Signaling Systems
- No. 1076 Control Units for Burglar Alarm Proprietary Protective Signaling Systems
- No. 1971 Visual Notification Appliances

C. Local and State Building Codes.

D. All requirements of the Authority Having Jurisdiction (AHJ).

1.6 APPROVALS

A. The system shall have proper listing and/or approval from the following nationally recognized agencies:

UL Underwriters Laboratories, Inc.

FM Factory Mutual

B. The fire alarm control panel shall meet UL Standard 864 (Control Units) and UL Standard 1076 (Proprietary Burglar Alarm Systems).

C. The system shall be listed by the national agencies as suitable for extinguishing release applications. The system shall support release of high and low pressure CO2.

1.7 ACCEPTABLE MANUFACTURERS

A. Notifier

B. Simplex

- C. Edwards
- D. No Approved equal.

PART 2 – PRODUCTS

2.1 EQUIPMENT AND MATERIAL, GENERAL

- A. All equipment and components shall be new, and the manufacturer's current model. The materials, appliances, equipment and devices shall be tested and listed by a nationally recognized approvals agency for use as part of a protective signaling system, meeting the National Fire Alarm Code.
- B. All equipment and components shall be installed in strict compliance with manufacturer's recommendations. Consult the manufacturer's installation manuals for all wiring diagrams, schematics, physical equipment sizes, etc., before beginning system installation.
- C. All equipment back boxes shall be attached to walls and ceiling/floor assemblies and shall be held firmly in place (e.g. detectors shall not be supported solely by suspended ceilings). Fasteners and supports shall be adequate to support the required load.

2.2 CONDUIT AND WIRE

- A. Conduit:
 - 1. Conduit shall be in accordance with The National Electrical Code (NEC), local and state requirements.
 - 2. All wiring shall be installed in conduit or raceway. Conduit fill shall not exceed 40 percent or interior cross sectional area where three or more cables are contained within a single conduit.
 - 3. Cable must be separated from any open conductors of power, or Class 1 circuits and shall not be placed in any conduit, junction box or raceway containing these conductors, per NEC Article 760-29.
 - 4. Wiring for 24 volt DC control, alarm notification, emergency communication and similar power-limited auxiliary functions may be run in the same conduit as initiating and signaling line circuits. All circuits shall be provided with transient suppression devices and the system shall be designed to permit simultaneous operation of all circuits without interference or loss of signals.
 - 5. Conduit shall not enter the fire alarm control panel or any other remotely mounted control panel equipment or back boxes, except where conduit entry is specified by the FACP manufacturer.
- B. Wire:
 - 1. All fire alarm system wiring shall be new.
 - 2. Wiring shall be in accordance with local, state and national codes (e.g., NEC Article 760) and as recommended by the manufacturer of the fire alarm system manufacturer, but not less than 18 AWG (1.02 mm) for Initiating Device Circuits and Signaling Line Circuits, and 14 AWG (1.63 mm) for Notification Appliance Circuits.
 - 3. All wire and cable shall be listed and/or approved by a recognized testing agency for use with a protective signaling system.
 - 4. Wire and cable shall have a fire resistance rating suitable for the installation as indicated in NFPA 70.

5. Wiring used for the multiplex communication circuit (SLC) shall be twisted and shielded and support a minimum wiring distance of 10,000 feet. In certain applications, the system shall support up to two (2) SLC's with up to 1,000 feet of untwisted, unshielded wire. The design of the system shall permit use of IDC and NAC wiring in the same conduit with the SLC communication circuit.
 6. All field wiring shall be electrically supervised for open circuit and ground fault.
 7. The fire alarm control panel shall be capable of t-tapping Class B (NFPA Style 4) Signaling Line Circuits (SLC's). Systems which do not allow or have restrictions in, for example, the amount of t-taps, length of t-taps etc., are not acceptable.
- C. Terminal Boxes, Junction Boxes and Cabinets:
1. All boxes and cabinets shall be UL listed for their use and purpose.
- D. Initiating circuits shall be arranged to serve like categories (manual, smoke, waterflow). Mixed category circuitry shall not be permitted except on signaling line circuits connected to intelligent reporting devices.
- E. The fire alarm control panel shall be connected to a separate dedicated branch circuit, maximum 20 amperes. This circuit shall be labeled at the main power distribution panel as FIRE ALARM. Fire alarm control panel primary power shall be 12 AWG. The control panel cabinet shall be grounded to the buildings grounding system.

2.3 MAIN FIRE ALARM CONTROL PANEL

- A. The FACP shall contain a microprocessor based Central Processing Unit (CPU). The CPU shall communicate with and control the following types of equipment used to make up the system; intelligent addressable smoke and thermal (heat) detectors, addressable modules, printer, annunciators and other system controlled devices.
- B. Operator Control
1. Acknowledge Switch:
 - a. Activation of the control panel acknowledge switch in response to new alarms and/or troubles shall silence the local panel piezo electric signal and change the alarm and trouble LEDs from flashing mode to steady-ON mode. If multiple alarm or trouble conditions exist, depression of this switch shall advance the 80-character LCD display to the next alarm or trouble condition.
 - b. Depression of the Acknowledge switch shall also silence all remote annunciator piezo sounders.
 2. Alarm Silence Switch:
 - a. Activation of the alarm silence switch shall cause all programmed alarm notification appliances and relays to return to the normal condition after an alarm condition. The selection of notification circuits and relays that are silenceable by this switch shall be fully field programmable within the confines of all applicable standards. The FACP software shall include silence inhibit and auto-silence timers.
 3. Alarm Activate (Drill) Switch:
 - a. The Alarm Activate switch shall activate all notification appliance circuits. The drill function shall latch until the panel is silenced or reset.

4. System Rest Switch:
 - a. Activation of the System Reset switch shall cause all electronically-latched initiating devices, appliances or software zones, as well as all associated output devices and circuits, to return to their normal condition.
5. Lamp Test:
 - a. The Lamp Test switch shall activate all system LEDs and light each segment of the liquid crystal display.

C. System Capacity and General Operation

1. The control panel shall provide a minimum of 20% spare capacity for intelligent/addressable devices.
2. The control panel shall include Form-C alarm, trouble, supervisory and security interface relays rated at a minimum of 10 amps @ 120 VAC with 24VDC coils. It shall also include four Class B (NFPA Style Y) or Class A (NFPA Style Z) programmable Notification Appliance Circuits.
3. The system shall support up to 8 additional output modules (signal, speaker, telephone or relay), each with 8 circuits for an additional 64 circuits. These shall be either Class A (NFPA Style D) or Class B (NFPA Style Y) per the project drawings.
4. The fire alarm control panel shall include a full-featured operator interface control and annunciation panel that shall include a backlit Liquid Crystal Display (LCD), individual color-coded system status LEDs, and an alphanumeric keypad for the field programming and control of the fire alarm system.
5. All programming or editing of the existing program in the system shall be achieved without special equipment and without interrupting the alarm monitoring functions of the fire alarm control panel. The system shall be fully programmable, configurable and expandable in the field without the need for special tools, PROM programmers or PC based programmers. It shall not require replacement of memory ICs to facilitate programming changes.
6. The system shall allow the programming of any input to activate any output or group of outputs. Systems which have limited programming (such as general alarm), have complicated programming (such as a diode matrix).
7. The FACP shall provide the following features:
 - a. Drift compensation to extend detector accuracy over life. Drift compensation shall also include a smoothing feature, allowing transient noise signals to be filtered out.
 - b. Detector sensitivity test, meeting requirements of NFPA 72, Chapter 7.
 - c. Maintenance alert, with two levels (maintenance alert/maintenance urgent), to warn of excessive smoke detector dirt or dust accumulation.
 - d. Nine sensitivity levels for alarm, selected by detector. The alarm level range shall be 1 to 2.35 percent per foot for photoelectric detectors and 0.5 to 2.5 percent per foot for ionization detectors. The system shall also include up to nine levels of pre-alarm, selected by detector, to indicate to maintenance personnel of impending alarms.
 - e. The ability to display or print system reports.

- f. Alarm verification, with counters and a trouble indication to alert maintenance personnel when a detector enters verification 20 times.
 - g. PAS pre-signal, meeting NFPA 72 3-8.3 requirements.
 - h. Rapid manual station reporting (under 3 seconds).
 - i. Non-alarm points for general (non-fire) control.
 - j. Periodic detector test, conducted automatically by the software.
 - k. Self optimizing pre-alarm for advanced fire warning, which allows each detector to learn its particular environment and set its pre-alarm level to just above normal peaks.
 - l. Cross zoning with the capability of counting: two detectors in alarm, two software zones in alarm, or one smoke detector and one thermal detector.
 - m. Walk test, with a check for two detectors set to same address.
 - n. Control-by-time for non-fire operations, with holiday schedules.
 - o. Day/night automatic adjustment of detector sensitivity.
 - p. Device blink control for sleeping areas.
 - q. UL-1076 security monitor points.
 - r. Releasing options including: 10 independent hazards, a sophisticated cross zone, delay and discharge timers, and an abort function. The system shall also include the ability to control low pressure CO2 valves with the ability to set time in/time out values in one second increments including a soak time of up to 9999 seconds.
8. The FACP shall be capable of coding notification circuits in march time (120 PPM), and temporal (NFPA 72 A-2-2.2.2). Main panel notification circuits (NAC 1, 2, 3 and 4) shall also support special two and three stage operations. The two stage feature allows 20 Pulses Per Minute (PPM) on alarm and 120 PPM after 5 minutes or when a second device activates. The three stage option provides 20 PPM with one detector in alarm, 120 PPM with two detectors in alarm and steady on with release.

D. Central Microprocessor

- 1. The microprocessor shall be a state-of-the-art, high speed, and it shall communicate with, monitor and control all external interfaces. It shall include an EPROM for system program storage, non-volatile memory for building-specific program storage and a "watch dog" timer circuit to detect and report microprocessor failure.
- 2. The microprocessor shall contain and execute all control-by-event programs for specific action to be taken if an alarm condition is detected by the system. Control-by-event equations shall be held in non-volatile programmable memory and shall not be lost even if system primary and secondary power failure occurs.
- 3. The microprocessor shall also provide a real-time clock for time annotation of system displays, printer and history file. The time-of-day and date shall not be lost if system

primary and secondary power supplies fail. The real time clock may also be used to control non-fire functions at programmed time-of-day, day-of-week and day-of-year.

4. A special program check function shall be provided to detect common operator errors.
5. An auto-program (self-learn) function shall be provided to quickly install initial functions and make the system operational.
6. For flexibility and to ensure program validity, an optional Windows™ based program utility shall be available. This program shall be used to off-line program the system with batch upload/download. This program shall also have a verification utility which scans the program files, identifying possible errors. It shall also have the ability to compare old program files to new ones, identifying differences in the two files to allow complete testing of any system operating changes. This shall be in compliance with the NFPA 72 requirements for testing after system modification.

E. Display

1. The display shall provide all the controls and indicators used by the system operator and may also be used to program all system operational parameters.
2. The display shall include status information and custom alphanumeric labels for all intelligent detectors, addressable modules, internal panel circuits and software zones.
3. The display shall include an 80-character back-lit alphanumeric Liquid Crystal Display (LCD). It shall also provide 8 Light-Emitting-Diodes (LEDs), that indicate the status of the following system parameters: AC POWER, FIRE ALARM, PRE-ALARM WARNING, SECURITY ALARM, SUPERVISORY SIGNAL, SYSTEM TROUBLE, DISABLED POINTS, and ALARM SILENCED.
4. The display shall be an easy to use QWERTY type keypad, similar to a PC keyboard. This shall be part of the standard system and have the capability to command all system functions, entry of any alphabetic or numeric information, and field programming. Two different password levels shall be provided to prevent unauthorized system control or programming.
5. The display shall include the following operator control switches: ACKNOWLEDGE, ALARM SILENCE, ALARM ACTIVATE (drill), SYSTEM RESET and LAMP TEST.
6. The system shall support an optional battery ammeter/voltmeter display.

F. Signaling Line Circuits (SLC)

1. The system shall include a minimum of 20% spare capacity in the SLCs. Provide quantity as needed. Each SLC interface shall provide power to and communicate with up to 127 addressable devices. Each SLC shall be capable of NFPA 72 Style 4, (Class B) wiring.
2. The Loop Interface Board (LIB) shall receive analog information from all intelligent detectors to be processed to determine whether normal, alarm, pre-alarm or trouble conditions exist for each detector. The software shall automatically maintain the detector's desired sensitivity level by adjusting for the effects of environmental factors, including the accumulation of dust in each detector. The analog information shall also be used for automatic detector testing and for the automatic determination of detector maintenance requirements.
3. The detector software shall meet NFPA 72, Chapter 7 requirements and be certified by UL as a calibrated sensitivity test instrument.
4. The detector software shall allow manual or automatic sensitivity adjustment.

G. Serial Interfaces

1. The system shall include two serial EIA-323 interfaces. Each interface shall be a means of connecting UL Listed Electronic Data Processing (EDP) peripherals.

2. One EIA-232 interface shall be used to connect an UL-Listed 80 column printer. Printers which are not UL-Listed are not considered acceptable substitutes.
3. The second EIA-232 interface shall be used to connect an UL-listed CRT terminal. This ancillary capability shall allow remote readout of all status information, including analog values, and shall not interfere with or degrade FACP operations when used. It shall allow remote FACP Acknowledge, Reset or Signal Silence in this mode. It shall also allow adjustment of detector sensitivity and readout of the history file.
4. The system shall include an EIA-485 port for the serial connection of optional annunciators and remote LCD displays.
5. The EIA-485 interface may be used for network connection to a proprietary receiving unit.

H. Notification Appliance Circuit (NAC) Module

1. The Notification Appliance Circuit module shall provide fully supervised Class B (NPFA Style Y) notification circuits. An expansion circuit board shall allow expansion to eight circuits per module.
2. The notification circuit capacity shall be 2.0 amperes maximum per circuit and 8.0 amperes maximum per module.
3. The module shall not affect other module circuits in any way during a short circuit condition.
4. Each notification circuit shall include a custom label inserted to identify each circuit's location.
5. The notification circuit module shall be provided with removable wiring terminal blocks for ease of installation and service. The terminal strips shall be UL listed for use with up to 12 AWG wire.
6. Each circuit shall be capable of, through system programming, deactivating upon depression of the signal silence switch.

I. Control Relay Module

1. The control relay module shall provide four Form-C auxiliary relay circuits rated at 5 amperes, 28 VDC. An expansion circuit board shall allow expansion to eight Form-C relays per module.
2. Each relay circuit shall be capable of being activated (change in state) by any initiating device or form any combination of initiating devices.
3. Each relay circuit shall include a custom label inserted to identify its location.
4. The control relay module shall be provided with removable wiring terminal blocks for ease of installation and service. The terminal blocks shall be UL listed for use with up to 12 AWG wire.

J. Enclosures:

1. The control panel shall be housed in an UL-listed cabinet suitable for surface or semi-flush mounting. The cabinet and front shall be corrosion protected, given a rust-resistant prime coat and manufacturer's standard finish.
2. The back box and door shall be constructed of 0.060 steel with provisions for electrical conduit connections into the sides and top.
3. The door shall provide a key lock and shall include a glass or other transparent opening for viewing of all indicators. For convenience, the door may be selected for either right or left hand hinging.

K. Power Supply:

1. The main power supply for the fire alarm control panel shall provide 6.0 amps of available power for the control panel and peripheral devices.
 2. Provisions will be made to allow the audio-visual power to be increased as required by adding modular expansion audio-visual power supplies.
 3. Positive-Temperature-Coefficient (PTC) thermistors, circuit breakers or other over-current protection shall be provided on all power outputs. The power supply shall provide an integral battery charger for use with batteries up to 50 AH or may be used with an external battery and charger systems. Battery arrangement may be configured in the field.
 4. The main power supply shall continuously monitor all field wires for earth ground conditions and shall have the following LED indicators:
 - a. Ground Fault LED
 - b. Battery Fail LED
 - c. AC Power Fail LED
 5. The main power supply shall operate on 120 VAC, 60 Hz, and shall provide all necessary power for the FACP.
 6. The main power supply shall provide a battery charger for 24 hours of standby using dual-rate charging techniques for fast battery recharge.
 7. The main power supply shall provide a very low frequency sweep earth detect circuit, capable of detecting earth faults.
 8. All circuits shall be power-limited, per 1995 UL864 requirements.
- L. Field Charging Power Supply: The FCPS is a device designed for use as either a remote 24 volt power supply or used to power Notification Appliances.
1. The FCPS shall offer up to 8.0 amps (4.0 amps continuous) of regulated 24-volt power. It shall include an integral charger designed to charge 12.0 amp hour batteries and to support 24-hour standby.
 2. The Field Charging Power Supply shall have two input triggers. The input trigger shall be a Notification Appliance Circuit (from the fire alarm control panel) or a relay. Four outputs (Style Y) shall be available for connection to the Notification devices.
 3. The FCPS shall include an attractive surface mount backbox.
 4. The Field Charging Power Supply shall include the ability to delay the AC fail delay per 1993 NFPA requirements.
 5. The FCPS include power limited circuitry, per 1995 UL standards.
 6. EC to provide 120 volt circuits as determined from supplier.
- M. Specific System Operations
1. Smoke Detector Sensitivity Adjust: A means shall be provided for adjusting sensitivity of any or all addressable intelligent detectors in the system from the system keypad. Sensitivity range shall be within the allowed UL window and have a minimum of 9 levels.
 2. Alarm Verification: Each of the intelligent addressable smoke detectors in the system may be independently selected and enable to be an alarm verified detector. The alarm verification delay shall be programmable from 5 to 30 seconds and each detector shall be able to be selected for verification. The FACP shall keep a count of the number of times that each detector has entered the verification cycle. These counters may be displayed and reset by the proper operator commands.
 3. Point Disable: Any addressable device or conventional circuit in the system may be enabled or disabled through the system keypad.
 4. Point Read: The system shall be able to display or print the following point status diagnostic functions:

- a. Device status
 - b. Device type
 - c. Custom device label
 - d. View analog detector values
 - e. Device zone assignments
 - f. All program parameters
5. System Status Reports: Upon command from an operator of the system, a status report will be generated and printed, listing all system status.
 6. System History Recording and Reporting: The fire alarm control panel shall contain a history buffer that will be capable of storing up to 600 events. Up to 300 events shall be dedicated to alarm and the remaining events are supervisory. Each of these activations will be stored and time and date stamped with the actual time of the activation. The contents of the history buffer may be manually reviewed, one event at a time or printed in its entirety.

The history buffer shall use non-volatile memory. Systems that use volatile memory for history storage are not acceptable substitutes.

7. Automatic Detector Maintenance Alert: The fire alarm control panel shall automatically interrogate each intelligent detector and shall analyze the detector responses over a period of time. If any intelligent detector in the system responds with a reading that is above or below normal limits, then the system will enter the trouble mode, and the particular detector will be annunciated on the system display, and printed on the optional printer. This feature shall in no way inhibit the receipt of alarm conditions in the system, nor shall it require any special hardware, special tools or computer expertise to perform.
8. Pre-Alarm Function: The system shall provide two levels of pre-alarm warning to give advance notice of a possible fire situation. Both pre-alarm levels shall be fully field adjustable. The first level shall give an audible indication at the panel. The second level shall give an audible indication and may also activate control relays. The system shall also have the ability to activate local detector sounder bases at the pre-alarm level, to assist in avoiding nuisance alarms.
9. Software Zones: The FACP shall provide 99 software zones and 10 additional special function zones.
10. The fire alarm control panel shall include a walk test feature. It shall include the ability to test initiating device circuits and notification appliance circuits from the field without returning to the panel to reset the system. Operation shall be as follows:
 - a. Alarm an initiating device shall activate programmed outputs, which are selected to participate in walk test, for 3 seconds.
 - b. Introducing a trouble into the initiating device shall activate the programmed outputs for 8 seconds.
 - c. Walk test shall be selectable on a per device/circuit basis. All devices and circuits which are not selected for walk test shall continue to provide fire protection and if an alarm is detected, will exit walk test and activate all programmed alarm functions.
 - d. All devices tested in walk test shall be recorded in the history buffer.
11. Water flow Operation

An alarm from the water flow detection devices shall activate the appropriate alarm message on the 80-character display to turn on all programmed notification appliance circuits and shall not be affected by the signal silence switch.

12. Supervisory Operation

An alarm from a supervisory device shall cause the appropriate indication on the 80-character display, light a common supervisory LED, but will not cause the system to enter the trouble mode.

13. Signal Silence Operation

The FACP shall have the ability to program each output circuit (notification, relay, speaker, etc.) to deactivate upon depression of the signal silence switch.

14. Non-Alarm Input Operation

Any addressable initiating device in the system may be used as a non-alarm input to monitor normally-open contact type devices. Non-alarm functions are a lower priority than fire alarm initiating devices.

15. Combo Zone

A special type code shall be available to allow water flow and supervisory devices to share a common addressable module. Water flow devices shall be wired in parallel, supervisory devices in series.

2.4 SYSTEMS COMPONENTS

A. Horns and/or Strobes:

1. Shall be low profile and operate on 24 VDC nominal.
2. Horns shall have multi-selectable settings. Horns shall provide slow whoop, continuous or interrupted tones with an output sound level of at least 82 dBA measured at 10 feet from the device per ANSI/UL 464.
3. Strobes shall have a maximum pulse duration of 2/10 of one second. The flash rate and strobe intensity shall meet the requirements of UL 1971 and be synchronized.
4. Indoor wall mounted strobes shall have multi-selectable candela settings of 15, 30, 60, 75, and 110. Indoor ceiling mounted strobes shall have multi-selectable candela settings of 15, 30, 75, 95, 115 and 150. Exterior strobes shall have a candela rating of 75.
5. Shall be flush mounted in public areas.
6. Indoor wall mounted units shall be equal to Gentex Commander3 Series and indoor ceiling mounted units shall be equal to Gentex Commander4 Series.
7. Outdoor wall mounted units shall be equal to Gentex WGE series.
8. Verify color with Architect and AHJ.

B. Water flow Indicator:

1. Water flow Switches shall be an integral, mechanical, non-coded, non-accumulative retard type.
2. Water flow Switches shall have an alarm transmission delay.
3. All water flow switches shall come from a single manufacturer and series.
4. Water flow switches shall be furnished and installed by the sprinkler contractor and wired by the electrical contractor.

C. Sprinkler and Standpipe Valve Supervisory Switches:

1. Each sprinkler system water supply control valve riser, zone control valve, and standpipe system riser control valve shall be equipped with a supervisory switch. Standpipe hose valves, and test and drain valves shall not be equipped with supervisory switches.
2. PIV (post indicator valve) or main gate valves shall be equipped with a supervisory switch.
3. The switch shall be mounted so as not to interfere with the normal operation of the valve and adjusted to operate within two revolutions toward the closed position of the valve control, or when the stem has moved no more than one-fifth of the distance from its normal position.
4. The supervisory switch shall be contained in a weatherproof aluminum housing, which shall provide a 3/4 inch (19 mm) conduit entrance and incorporate the necessary facilities for attachment to the valves.
5. The switch housing shall be finished in red baked enamel.
6. The entire installed assembly shall be tamper proof and arranged to cause a switch operation if the housing cover is removed, or if the unit is removed from its mounting.
7. Valve supervisory switches shall be furnished and installed by the sprinkler contractor and wired by the electrical contractor.

D. Alphanumeric LCD Type Annunciator:

1. The alphanumeric display annunciator shall be a supervised, remotely located back-lit LCD display containing a minimum of eighty (80) characters for alarm annunciation in clear English text.
2. The LCD annunciator shall display alarm and trouble conditions in the system.
3. An audible indication of alarm shall be integral to the alphanumeric display.
4. The display shall be UL listed for fire alarm application.
5. It shall be possible to connect up to 31 LCD displays and be capable of wiring distances up to 6,000 feet from the control panel.
6. The annunciator shall connect to a separate, dedicated "terminal mode" EIA-485 interface. This is a two-wire loop connection. Each terminal mode LCD display shall mimic the main control panel.
7. Annunciators shall be capable of the following system functions: Acknowledge, Signal Silence and Reset which shall be protected from unauthorized use by a keyed switch or password.

E. All interfaces and associated equipment are to be protected so that they will not be affected by voltage surges or line transients consistent with UL standard 864.

F. Universal Digital Alarm Communicator Transmitter (UDACT). The UDACT is an interface for communicating digital information between a fire alarm control panel and an UL-Listed central station.

1. The UDACT shall be compact in size, mounting in a standard module position of the fire alarm control cabinet. Optionally, the UDACT shall have the ability for remote mounting, up to 6,000 feet from the fire alarm control panel. The wire connections between the UDACT and the control panel shall be supervised with one pair for power and one pair for multiplexed communication of overall system status. Systems that utilize relay contact closures are not acceptable.
2. The UDACT shall include connections for dual telephone lines (with voltage detect), per UL/NFPA/FCC requirements. It shall include the ability for split reporting of panel events up to three different telephone numbers.

3. The UDACT shall be completely field programmable from a built-in keypad and 4 character red, seven segment display.
4. The UDACT shall be capable of transmitting events in at least 15 different formats. This ensures compatibility with existing and future transmission formats.
5. Communication shall include vital system status such as:
 - a. Independent Zone (Alarm, trouble, non-alarm, supervisory)
 - b. Independent Addressable Device Status
 - c. AC (Mains) Power Loss
 - d. Low Battery and Earth Fault
 - e. System Off Normal
 - f. 12 and 24 Hour Test Signal
 - g. Abnormal Test Signal (per UL requirements)
 - h. EIA-485 Communications Failure
 - i. Phone Line Failure
6. The UDACT shall support independent zone/point reporting when used in the Contract ID format. In this format the UDACT shall support transmission of up to 2, 040 points. This enables the central station to have exact details concerning the origin of the fire or response emergency.

G. Field Wiring Terminal Blocks

For ease of service all panel I/O wiring terminal blocks shall be removable, plug-in types and have sufficient capacity for #18 to #12 AWG wire. Terminal blocks which are permanently fixed are not acceptable.

2.5 SYSTEM COMPONENTS - ADDRESSABLE DEVICES

A. Addressable Devices - General

1. Addressable devices shall used simple to install and maintain decade (numbered 0 to 9) type address switches.
2. Addressable devices will use a binary-coded address setting method, such as a DIP switch.
3. Detectors shall be intelligent (analog) and addressable and shall connect with two wires to the fire alarm control panel signaling line circuits.
4. Addressable smoke and thermal detectors shall provide dual alarm and power/polling LEDs. Both LEDs shall flash under normal conditions, indicating that the detector is operational and in regular communication with the control panel, indicating that an alarm condition has been detected. If required, the LED flash shall have the ability to be removed from the system program. An output connection shall also be provided in the base to connect an external remote alarm LED.
5. The fire alarm control panel shall permit detector sensitivity adjustment through field programming of the system. Sensitivity shall be automatically adjusted by the panel on a time-of-day basis.
6. Using software in the FACP, detectors shall automatically compensate for dust accumulation and other slow environmental changes that may affect their performance. The detectors shall be listed by UL as meeting the calibrated sensitivity test requirements of NFPA Standard 72, Chapter 7.
7. The detectors shall be ceiling-mount and shall include a separate twist-lock base with tamper proof feature. Base shall include a sounder base with a built-in (local) sounder rated at 85 DBA minimum, a relay base and an isolator base designed for Style 7 applications.

8. The detectors shall provide a test means whereby they will simulate an alarm condition and report that condition to the control panel. Such a test may be initiated at the detector itself (by activating a magnetic switch) or initiated remotely on command from the control panel.
9. Detectors shall also store an internal identifying type code that the control panel shall use to identify the type of device (ION, PHOTO, THERMAL).
10. Detectors will operate in an analog fashion, where the detector simply measures its designed environment variable and transmits an analog value to the FACP based on real-time measured values. The FACP software, not the detector, shall make the alarm/normal decision, thereby allowing the sensitivity of each detector to be set in the FACP program and allowing the system operator to view the current analog value of each detector.
11. Detectors shall provide address-setting means using decimal switches and shall also store an internal identifying code that the control panel shall use to identify the type of device. LEDs shall be provided that shall flash under normal conditions, indicating that the device is operational and is in regular communication with the control panel.
12. Addressable devices shall provide address-setting means using decimal switches and shall also store an internal identifying code that the control panel shall use to identify the type of device. LED(s) shall be provided that shall flash under normal conditions, indicating that the device is operational and is in regular communication with the control panel.
13. A magnetic test switch shall be provided to test detectors and modules. Detectors shall report an indication of an analog value reaching 100% of the alarm threshold.

B. Addressable Pull Box (manual station)

1. Addressable pull boxes shall, on command from the control panel, send data to the panel representing the state of the manual switch and the addressable communication module status. They shall use a key operated test-reset lock, and shall be designed so that after actual emergency operation, they cannot be restored to normal use except by the use of a key.
2. All operated stations shall have a positive, visual indication of operation and utilize a key type reset.
3. Manual stations shall be double action, non-breakglass, constructed of Lexan with clearly visible operating instructions provided on the cover. The word FIRE shall appear on the front of the stations in raised letters, 1.75 inches (44mm) or larger. They shall be of modern design appearance.

C. Intelligent Photoelectric Smoke Detector

1. The detectors shall use the photoelectric (light-scattering) principal to measure smoke density and shall, on command from the control panel, send data to the panel representing the analog level of smoke density.

D. Intelligent Thermal Detectors

1. Thermal detectors shall be intelligent addressable devices rated at 135 degrees Fahrenheit (58 degrees Celsius) and have a rate-of-rise element rated at 15 degrees F (9.4 degrees C) per minute. It shall connect via two wires to the fire alarm control panel signaling line circuit.

E. Intelligent Duct Smoke Detector

1. The smoke detector housing shall accommodate an intelligent photoelectric detector, of that provides continuous analog monitoring and alarm verification from the panel.

2. When sufficient smoke is sensed, an alarm signal is initiated at the FACP, and appropriate action taken to change over air handling systems to help prevent the rapid distribution of toxic smoke and fire gases throughout the areas served by the duct system.
3. A remote indicator/test station shall be provided for each duct detector (regardless if shown or not on the plans). The location shall in a visible location in the room or ceiling and have an engraved plaque identifying the location of the detector (i.e. RTU-2 Return).

F. Addressable Dry Contact Monitor Module

1. Addressable monitor modules shall be provided to connect one supervised IDC zone of conventional alarm initiating devices (any N.O. dry contact device) to one of the fire alarm control panel SLCs.
2. The monitor module shall mount in a 4-inch square (101.6 mm square), 2-1/8 inch (54 mm) deep electrical box.
3. The IDC zone shall be suitable for Style D or Style B operation. A LED shall be provided that shall flash under normal conditions, indicating that the monitor module is operational and in regular communication with the control panel.
4. For difficult to reach areas, the monitor module shall be available in a miniature package and shall be no larger than 2-3/4 inch (70 mm) x 1-1/4 inch (31.7 mm) x 1/2 inch (12.7 mm). This version need not include Style D or an LED.

G. Two Wire Detector Monitor Module

1. Addressable monitor modules shall be provided to connect one supervised IDC zone of conventional two-wire smoke detectors or alarm initiating devices (any N.O. dry contact device).
2. The two-wire monitor module shall mount in a 4-inch square (101.6 mm square), 2-1/8 inch (54 mm) deep electrical box or with an optional surface backbox.
3. The IDC zone may be wired for Class A or B (Style D or Style B) operation. A LED shall be provided that shall flash under normal conditions, indicating that the monitor module is operational and in regular communication with the control panel.

H. Addressable Control Module

1. Addressable control modules shall be provided to supervise and control the operation of one conventional NACs of compatible, 24 VDC powered, polarized audio/visual notification appliances. For fan shutdown and other auxiliary control functions, the control module may be set to operate as a dry contract relay.
2. The control module shall mount in a standard 4-inch square, 2-1/8 inch deep electrical box, or to a surface mounted backbox.
3. The isolator module shall not require any address-setting, and its operations shall be totally automatic. It shall not be necessary to replace or reset an isolator module after its normal operation.
4. The isolator module shall mount in a standard 4-inch (101.6 mm) deep electrical box or in a surface mounted backbox. It shall provide a single LED that shall flash to indicate that the isolator is operational and shall illuminate steadily to indicate that a short circuit condition has been detected and isolated.

2.6 BATTERIES

- A. The batteries shall be sealed Gel Cell type, 12 volt nominal.

- B. The battery shall have sufficient capacity to power the fire alarm system for not less than twenty-four hours plus 15 minutes of alarm upon a normal AC power failure.
- C. The batteries are to be completely maintenance free. No liquids are required. Fluid level checks for refilling, spills and leakage shall not be required.
- D. If necessary to meet standby requirements, external battery and charger systems may be used.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Installation shall be in accordance with the NEC, NFPA 72, local and state codes, as shown on the drawings, and as recommended by the major equipment manufacturer.
- B. All conduit, junction boxes, conduit supports and hangers shall be concealed in finished areas and may be exposed in unfinished areas. Smoke detectors shall not be installed prior to the system programming and test period. If construction is ongoing during this period, measures shall be taken to protect smoke detectors from contamination and physical damage.
- C. All fire detection and alarm system devices, control panels and remote annunciators shall be flush mounted when located in finished areas and may be surface mounted when located in unfinished areas.
- D. Manual pull stations shall be suitable for surface mounting or semi-flush mounting as shown on the plans, and shall be installed not less than 42 inches (1067 mm), nor more than 48 inches (122 mm) above the finished floor.

3.2 TESTING

The service of competent, factory-trained engineer or technician authorized by the manufacturer of the fire alarm equipment shall be provided to technically supervise and participate during all of the adjustments and tests for the system. All testing shall be in accordance with NFPA 72, Chapter 7.

1. Before energizing the cables and wires, check for correct connections and test for short circuits, ground faults, continuity and insulation.
2. Water flow and tamper switches shall be tested along with the sprinkler contractor.
3. Open initiating device circuits and verify that the trouble signal actuates.
4. Open and sort signaling line circuits and verify that the trouble signal actuates.
5. Open and short notification appliance circuits and verify that trouble signal actuates.
6. Ground all circuits and verify response of trouble signals.
7. Check presence and audibility of tone at all alarm notification devices.
8. Check installation, supervision and operation of all intelligent smoke detectors using the walk test.
9. Each of the alarm conditions that the system is required to detect should be introduced on the system. Verify the proper receipt and the proper processing of the signal at the FACP and the correct activation of the control points.
10. When the system is equipped with optional features, the manufacturer's manual shall be consulted to determine the proper testing procedures. This is intended to address such items as verifying control performed by individually addressed or grouped devices, sensitivity monitoring, verification functionality and similar.

3.3 FINAL INSPECTION

- A. At the final inspection, a factory trained representative of the manufacturer of the major equipment shall demonstrate that the system functions properly in every respect.

3.4 INSTRUCTION

- A. Instruction shall be provided as required for operating the system. Hands-on demonstrations of the operation of all system components and the entire system including program changes and functions shall be provided.
- B. The contractor and/or the systems manufacturer's representatives shall provide a typewritten "Sequence of Operation."

END OF SECTION

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SECTION 26 43 13

SURGE SUPPRESSION FOR LOW-VOLTAGE ELECTRICAL POWER AND CONTROL CIRCUITS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of contract, including General and Supplementary Conditions and Division 1 specification sections, apply to this and the other sections of Division 26.
- B. Furnish and install surge protection devices (formally known as transient voltage surge suppressors) as shown on the Drawings and herein specified.
- C. Related Sections: The following Sections contain requirements that relate to this section:
 - 1. Section 26 05 19 - Low Voltage Electrical Power Conductors and Cables.
 - 2. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
 - 3. Section 26 28 16.01 - Enclosed Switches.
 - 4. Section 26 09 01 - Process Instrumentation and Control.
 - 5. Section 26 24 19 – Motor Control Centers.

1.02 STANDARDS

- A. Underwriters Laboratories - UL 1449 3rd Edition, current Standard for Safety for Surge Protective Devices).
- B. Underwriters Laboratories - UL 1283 listed as an electromagnetic interference filter that provides noise attenuation.
- C. Underwriters Laboratories - UL 96A 12th Edition, Standard for Installation Requirements for Lightning Protection Systems.
- D. Canadian Standards Association - CAN/CSA-C22 No. 8; cUL 1449 Ed.3.
- E. National Electrical Code - NEC 2008 Article 285 TVSS Installation Practice; NEC 2008 Article 250.56 Grounding.
- F. NFPA-78 and CSA - (National Fire Protection Association and Canadian Standards Associations).
- G. ISO 9001:2000 - Quality standard / Military Standards (MIL-STD 220A).
- H. American National Standards Institute and Institute of Electrical and Electronic Engineering - ANSI/IEEE - C62.41 and C62.45.
- I. The fusing elements must be capable of allowing the suppressor's maximum rated single impulse current to pass through the suppressor at least one time without failure.
- J. CBEMA (ITIC) and IEC - (Computer Business Equipment Manufacturers Association or Information Technology Industry Council and International Electrotechnical Commission define clamping voltage tolerance guidelines for sensitive equipment).
- K. All manufacturers must comply with above listed standards and any additions current revisions of industry standards. All products that do not comply with current industry standards will not be accepted. Canadian Standards Association (CSA).
- L. American National Standards Institute and Institute of Electrical and Electronic Engineers (ANSI/IEEE C62.11, C62.41, C62.45).

- M. National Electrical Manufacturer Association (NEMA LS-1 1992).
- N. National Electric Code (NEC).
- O. National Fire Protection Association (NFPA 20, 70, 75 and 780).
- P. Underwriters Laboratories (UL 1449 Second Edition and UL 1283.)
- Q. International Electro-technical Commission (IEC 1000).
- R. International Standards Organization (ISO) Company certified ISO 9001 for manufacturing, design and service.

1.03 SUBMITTALS

- A. Drawings: Electrical and mechanical drawings shall be provided by the manufacturer which show unit dimensions, weights, mounting provisions, connection notes, wire size and wiring diagram.
- B. Equipment Manual: The manufacturer shall furnish an installation manual with installation notes, start-up and operating instructions for the specified system. Installation instructions shall clearly state whether the system requires an external over current device to maintain the system's UL 1449 listing.
- C. Submit UL 1449 3rd Edition Listing/Classification page listing the Voltage Protection Ratings with corresponding model numbers.
- D. Independent Testing:
 1. High exposure with the 10 x 1,000us tests per IEEE C62.41.2 Section 7.2.
 2. Life Cycle/Repetitive Testing per C62.45-2002 section B.38 minimum of 1,000 to 2,000 times
- E. National Electrical Code (NEC) 285 - Installation requirements for SPD's Surge Protection Devices that utilize fuses must have repetitive surge capability that can survive its surge rating and meet UL 1449.
- F. Section 285.6, TVSS shall be marked with a short circuit current rating and shall not be installed at a point on the system (ex. service, distribution or branch panels) where the available fault current (AIC rating) is in excess of that rating.
- G. UL 1449 stipulation for SPD Type 2 product that requires over-current protection devices; the manufacturer's authorized representative is required to submit the following:
 1. Certify that the SPD system is UL 1449 listed (VZCA file documentation).
 2. Indicate the type of external over-current protection that shall be incorporated.
 3. With the SPD system; and, what impact the fusing has on the performance of the device with respect to surge capacity and clamping levels.
- H. Maintenance Data: Include maintenance instructions for cleaning methods; cleaning materials recommended; component replacement, testing and adjustment.
- I. Any deviation from the specification, modification of products, models, or alternative units must be submitted to the engineer as a letter signed by the owner reflecting the requested changes. The letter should in detail outline the changes and requested product details.
- J. Operation and maintenance data for materials specified in this section to include in the "Operating and Maintenance Manual" specified in Division 1.

1.04 SYSTEM DESCRIPTION

- A. Environmental Requirements:
 1. Storage Temperature: Storage temperature range shall be -40 to +80°C.

2. Operating Temperature: Operating temperature range shall be -40 to +80°C.
 3. Relative Humidity: Operation shall be reliable in an environment with 0% to 90% non-condensing relative humidity.
 4. Operating Altitude: The system shall be capable of operating up to an altitude of 12,000 feet above sea level.
- B. Electrical Installations:
1. System Operating Voltage: The nominal system operating voltage shall be 277/ 480 three phase, 4 wire plus ground as shown on the plans for MCC-1A.
- C. The equipment's minimum surge current capacity shall be 200 kA per phase (L-N plus L-G) and 100 kA per mode (L-N, L-G, L-L and N-G)
- D. The UL 1449 Edition 3 Nominal Discharge Current Rating shall be no less than 20 kA.
- E. The system protection modules shall contain a technology that utilizes a symmetrical array of balanced metal oxide varistors (MOV). Each MOV will be individually coordinated to pass UL 1449.
- F. All primary transient paths shall utilize copper wire, aluminum bus bar and lugs of equivalent capacity to provide equal impedance interconnection between phases.
- No plug- in module or components shall be used in surge carrying paths.
- G. Each protection module shall have a visual indicator that signifies that the protection circuitry is on line. The unit shall not be taken off line to verify integrity system. Redundant status indicators shall be mounted on the front of the door that monitors the system protection circuitry.
- H. The system shall be modular with field replaceable modules. Modular units shall contain a minimum of one module per phase.
- I. Filter Attenuation shall be equal to, or greater than -40 dB at 100 kHz.
- J. Protection modes: The SPD shall provide protection for all modes, L-G, L-N, N-G, L-L for WYE, L-L and L-G for Delta configurations.
- K. Service Conditions: ALL SPD shall operate under the following conditions, unless otherwise indicated:
1. MCOV: Maximum Continuous Operating Voltage of 125% or greater.
 2. Operating Temperature: 30 to 120 degrees F.
 3. Humidity: 0 to 85 percent, non-condensing.
 4. Altitude: Less than 20,000 feet above sea level.
- L. Equipment shall provide the following monitoring features: N.O./N.C. Relay.
- M. Contacts: Digital Surge Counter; Audible Alarm; LED Indication for each Phase.
- N. The SPD shall be rated for NEMA 4; or NEMA 4X in corrosive environments.

The UL 1449 Ed. 3 Voltage Protection Ratings (VPR) shall be equal to or less than the following voltage configurations:

<u>Voltage:</u>	<u>Mode:</u>	<u>UL 1449 Ed 3 VPR:</u>
120/240 (1 Phase)	L-G, N-G L-N	700V 1,200V
120/208 (3-Phase WYE)	L-G, N-G, L-N/L-L	700V/1200V
277/480 (3-Phase WYE)	L-G, N-G, L-N/L-L	1,200V/2,000V
240 (Delta)	L-L, L-G	1,200V
480 (Delta)	L-L, L-G	2,000V

- O. Provide an enclosure as follows:
 - 1. Fabrication shall be made with a heavy duty NEMA 4 enclosures or better for the installation. All monitor indicators shall be displayed without opening doors.
 - 2. The back panel shall be molded from a thermoplastic or metal.

1.05 WARRANTY

- A. The manufacturer shall provide not less than a full five year component warranty from date of shipment against any part failure when installed in compliance with manufacturer's written instructions, UL listing requirements, and any applicable national or local electrical codes. Manufacturer shall make available (local, national) field engineering service support. Where direct factory employed service engineers are not locally available, travel time from the factory or nearest dispatch center shall be stated.

1.06 QUALITY ASSURANCE

- A. The specified systems shall be thoroughly factory tested before shipment. Testing of each system shall include but shall not be limited to quality control checks, dielectric voltage withstand tests at twice rated voltage plus 1000 volts per UL requirements, IEEE C62.41 Category B surge tests, UL ground leakage test, and operational and calibration tests.

PART 2 PRODUCT

2.01 PRODUCT

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1. MCC-1A: Critec model number SES200, 277/480 or most current model submitted in compliance with section 01 25 13.
 - 2. SCADA Control Panel SCP-1: Critec model number TDS11002SR150 or most current model submitted in compliance with section 01 25 13 for 120 volt operation.
 - 3. Remote 4-20ma signals: Critec model number RTP 30 34 or most current model submitted in compliance with section 01 25 13.
 - 4. Ethernet Copper: Critec model number LAN RJ45 Series or most current model submitted in compliance with section 01 25 13.
- B. Accessories
 - 1. Unit Status Indicators: Solid state indicators with printed labels shall be provided on the front each surge suppression enclosure to repeatedly indicate unit module status.
 - 2. Provide electrically isolated Form C (one N.O. and one N.C.) summary alarm contact rated or at least 120 VAC and 1 ampere shall be provided for remote annunciation of unit status. The summary alarm contact shall change state if any one or more of the surge current modules has failed.

PART 3 INSTALLATION

3.01 INSTALLATION

- A. The System Integrator and/or Electrical Contractor shall install the parallel surge suppression units with short and straight conductors as practically as possible.
- B. The surge suppression units shall be installed in the equipment as shown on the plans.
- C. The System Integrator shall follow the surge suppression manufacturer's recommended installation practices and requirements.

- D. The System Integrator and/or Electrical Contractor shall provide Operation & Maintenance Manuals for the equipment.

END OF SECTION

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SECTION 26 51 13

INTERIOR LIGHTING FIXTURES, LAMPS, AND BALLASTS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Interior lighting.

1.02 RELATED WORK

- A. Section 26 56 00 - Exterior Lighting

1.03 SUBMITTALS

- A. Submit under provisions of Division 1.
- B. Shop Drawings: Indicate dimensions and components for each luminaire which is not a standard product of the manufacturer.
- C. Product Data: Provide dimensions, ratings, and performance data.
- D. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency specified under "Regulatory Requirements".
- E. Manufacturer's Instructions: Include instructions for storage, handling, protection, examination, preparation, installation, and starting of product.

1.04 PROJECT RECORD DOCUMENTS

- A. Submit under provisions of Division 1.
- B. Accurately record actual locations of each luminaire on as-built drawings.

1.05 OPERATION AND MAINTENANCE DATA

- A. Submit under provisions of Division 1.
- B. Maintenance Data: Include instructions for maintaining luminaires.

1.06 REGULATORY REQUIREMENTS

- A. Conform to requirements of ANSI/NFPA 70.
- B. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and shown.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect, and handle products to site under provisions of Division 1.
- B. Accept products on site. Inspect for damage.

1.08 COORDINATION

- A. Coordinate junction box, fixture supports and brackets with other trades.

1.09 EXTRA MATERIALS

- A. Furnish under provisions of Division 1.
- B. Provide two of each lamp type and wattage installed, unless otherwise noted on the plans.

1.10 MATERIALS SPECIFICATION

- A. This Section includes interior lighting fixtures, lamps, ballasts, emergency lighting units, and accessories.

1.11 DEFINITIONS

- A. Luminaire: Fixture.
- B. Average Life: The time after which 50 percent will have failed and 50 percent will have survived under normal conditions.

1.12 QUALITY ASSURANCE

- A. Comply with NFPA 70 "National Electrical Code" for components and installation.
- B. Listing and Labeling: Provide fixtures and emergency lighting units that are listed and labeled for their indicated use on the Project.
 - 1. Special Listing and Labeling: Provide fixtures for use in damp or wet locations, underwater, and recessed in combustible construction specifically listed and labeled for such use. Provide fixtures for use in hazardous (classified) locations that are listed and labeled for the specific hazard.
 - 2. The terms "Listed" and "Labeled": As defined in the National Electrical Code, Article 100.
- C. Coordination of Fixtures with Ceiling: Coordinate fixtures mounting hardware and trim with the ceiling system.

PART 2 PRODUCTS

2.01 FIXTURES, GENERAL

- A. Comply with the requirements specified in the Articles below, and lighting fixture schedule.

2.02 FIXTURE COMPONENTS, GENERAL

- A. Metal Parts: Free from burrs and sharp corners and edges.
- B. Sheet Metal Components: Steel, except as indicated. Components are formed and supported to prevent warping and sagging.
- C. Doors, Frames, and Other Internal Access: Smooth operating and free from light leakage under operating conditions. Arrange to permit relamping without use of tools. Arrange doors, frames, lenses, diffusers, and other pieces to prevent accidental falling during relamping and when secured in the operating position.
- D. Reflecting Surfaces: Minimum reflectances as follows, except as otherwise indicated:
 - 1. White Surfaces: 85 percent.
 - 2. Specular Surfaces: 83 percent.

3. Diffusing Specular Surfaces: 75 percent.
 4. Laminated Silver Metallized Film: 90 percent.
- E. Lenses, Diffusers, Covers, and Globes: 100 percent virgin acrylic plastic or water white, annealed crystal glass except as indicated.
1. Plastic: Highly resistance to yellowing and other changes due to aging, exposure to heat and UV radiation.
 2. Lens Thickness: 0.125 inches, minimum.

2.03 FLUORESCENT FIXTURES

- A. Fixtures: Conform to UL 1570, "Fluorescent Lighting Fixtures."
- B. Ballasts: Conform to UL 935, "Fluorescent-Lamp Ballasts."
1. Certification: By Electrical Testing Laboratory (ETL).
 2. Labeling: By Certified Ballast Manufacturers Association (CBM).
 3. Type: Class P, high-power-factor type except as indicated otherwise.
 4. Sound Rating: A rating, except as indicated otherwise.
 5. Voltage: Match connected circuits.
- C. Low Temperature Ballast Minimum Starting Temperature: Minus 20 deg C.
- D. Electronic Ballasts: Solid-state, full-light-output, energy-saving type compatible with energy-saving lamps. Conform to FCC Regulations Part 18 for electromagnetic interference. Conform to IEEE C62.41, "Guide for Surge Voltages in Low-Voltage AC Power Circuits," Category A, for resistance to voltage surges for normal and common modes.
1. Minimum Power Factor: 90 percent.
 2. Minimum Operating Frequency: 20,000 Hz.
 3. Maximum Total Harmonic Distortion (THD): 15 percent at 277V.
 4. Average Input: The following is the average required wattage when tested according to ANSI C82.2, "Fluorescent Lamp Ballasts, Methods of Measurement."
 - a. 62 or less watts when operating two F32T8 lamps.
 - b. 31 or less watts when operating one F32T8 lamp.
- E. Electromagnetic Interference Filters: Integral to the fixture assembly. Provide one filter for each ballast. Suppress electromagnetic interference as required by MIL-STD-461, "Electromagnetic Emission and Susceptibility Requirements for the Control of Electromagnetic Interference."
- F. For LED fixtures, they shall include a 5 year warranty as minimum. See the Light Fixture Schedule on the plans for additional information.

2.04 HIGH INTENSITY DISCHARGE (HID) FIXTURES

- A. Fixtures: Conform to UL 1572, "High-Intensity Discharge Lighting Fixtures."
- B. Ballasts: Conform to UL 1029, "High-Intensity-Discharge Lamp Ballasts" and ANSI C82.4, "Ballasts for High-Intensity-Discharge and Low-Pressure Sodium Lamps (Multiple-Supply Type)." Provide ballasts with the following features, except as otherwise indicated.
1. Constant wattage auto transformer (CWA) or regulator, high-power-factor type.
 2. Voltage rating matches system voltage.
 3. Single-Lamp Ballasts: Minimum starting temperature of minus 30 deg C.
 4. Normal ambient operating temperature is 40 deg C.
 5. Open circuit operation will not reduce the average life.
 6. High pressure sodium (HPS) ballasts incorporate a solid-state igniter/starter with an average life in the pulsing mode of 10,000 hours at an igniter/starter case temperature of 90 deg C.
 7. Noise Suppression: Manufacturer's standard epoxy encapsulated model designed to minimize audible fixture noise.

2.05 INCANDESCENT FIXTURES

- A. Conform to UL 1571, "Incandescent Lighting Fixtures."

2.06 FIXTURES FOR HAZARDOUS LOCATIONS

- A. Conform to UL 844, "Electric Lighting Fixtures for Use in Hazardous (classified) Locations," or provide units that have Factory Mutual Engineering and Research Corporation (FM) certification for the indicated class and division of hazard.

2.07 EXIT SIGNS

- A. Conform to UL 924, "Emergency Lighting and Power Equipment," and the following:
 1. Sign Colors: Conform to local code.
 2. Minimum Height of Letters: Conform to local code.
 3. Arrows: Include as indicated.

2.08 LAMPS

- A. Conform to light fixture schedule applicable to each type of lamp.

2.09 FINISH

- A. Steel Parts: Manufacturer's standard finish applied over corrosion-resistant primer, free of streaks, runs, holidays, stains, blisters, and defects. Remove fixtures showing evidence of corrosion during project warranty period and replace with new fixtures.
- B. Other Parts: Manufacturer's standard finish.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Setting and Securing: Set units plumb, square, and level with ceiling and walls, and secure according to manufacturer's printed instructions and approved shop drawings.
- B. Support For Recessed type Fixtures: Install units may be supported from suspended ceiling support system. Install ceiling system support rods or wires at a minimum of four rods or wires per fixture located not more than 6 inches from fixture corners.
 1. Fixtures Smaller Than Ceiling Grid: Install a minimum of four rods or wires for each fixture and locate at corner of the ceiling grid where the fixture is located. Do not support fixtures by ceiling acoustical panels.
 2. Fixtures of Sizes Less Than Ceiling Grid: Center in the acoustical panel. Support fixtures independently with at least two 3/4-inch metal channels spanning and secured to the ceiling tees.
 3. Install support clips for recessed fixtures, securely fastened to ceiling grid members, at or near each fixture corners.
- C. Support for Suspended Fixtures: Brace pendants and rods that are 4-feet long or longer to limit swinging. Support stem mounted single-unit suspended fluorescent fixtures with twin-stem hangers. For continuous rows, use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of chassis, including one at each end.
- D. Lamping: Lamp units according to manufacturer's instructions.

3.02 FIELD QUALITY CONTROL

- A. Inspect each installed fixture for damage. Replace damaged fixtures and components.

3.03 ADJUSTING AND CLEANING

- A. Clean fixtures upon completion of installation. Use methods and materials recommended by manufacturer.
- B. Adjust aimable fixtures to provide required light intensities.

END OF SECTION

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SECTION 26 56 00

EXTERIOR LIGHTING FIXTURES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Exterior lighting.

1.02 RELATED WORK

- A. Section 26 51 13 - Interior lighting Fixtures Lamps and Ballasts.

1.03 SUBMITTALS

- A. Submit under provisions of Division 1.
- B. Shop Drawings: Indicate dimensions and components for each luminaire that is not a standard product of the manufacturer.
- C. Product Data: Provide dimensions, ratings, and performance data.
- D. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency specified under Regulatory Requirements.
- E. Manufacturer's Instructions: Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.04 PROJECT RECORD DOCUMENTS

- A. Submit under provisions of Division 1.
- B. Accurately record actual locations of each luminaire on record drawings.

1.05 OPERATION AND MAINTENANCE DATA

- A. Submit under provisions of Division 1.
- B. Maintenance Data: Include replacement part list.

1.06 REGULATORY REQUIREMENTS

- A. Conform to requirements of ANSI/NFPA 70.
- B. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and shown.

1.07 DELIVERY, STORAGE AND HANDLING

- A. Deliver, store, protect and handle products to site under provisions of Division 1.
- B. Accept products on site. Inspect for damage.

1.08 COORDINATION

- A. Coordinate junction box, fixture supports and brackets with other trades.

1.09 EXTRA MATERIALS

- A. Furnish under provisions of Division 1.
- B. Provide two of each lamp type and wattage installed.

1.10 SUMMARY

- A. This Section includes exterior lighting fixtures, lamps, ballasts, and accessories.

1.11 DEFINITIONS

- A. Fixture: A complete lighting unit. Fixtures include a lamp or lamps and parts required to distribute the light, position and protect lamps, and connect lamps to the power supply.
- B. Lighting Unit: A fixture, or an assembly of fixtures with a common support, including a pole or bracket plus mounting and support accessories.
- C. Luminaire: A fixture.
- D. Protect certification signed by manufacturers of lighting units certifying that their products comply with specified requirements.
- E. Maintenance data for products for inclusion in Operating and Maintenance Manual specified in Division 1.

1.12 QUALITY ASSURANCE

- A. Comply with NFPA 70 "National Electrical Code" for components and installation.
- B. Comply with ANSI C2, "National Electrical Safety Code."
- C. Listing and Labeling: Provide fixtures and accessories that are listed and labeled for their indicated use and location on the Project.

1.13 WARRANTY

- A. Special Project Warranty: Submit a warranty, mutually executed by manufacturer and the Installer, agreeing to replace external parts of lighting fixtures exhibiting a failure of finish as specified below. This warranty is in addition to, and not a limitation of, other rights and remedies the Owner may have under the Contract Documents.
 - 1. Protection of Metal from Corrosion: Warranty against perforation or erosion of the finish due to weathering.
 - 2. Color Retention: Warranty against fading, staining, and chalking due to the effects of weather and solar radiation.
 - 3. Special Project Warranty Period: 2 years, beginning on the date of Substantial Completion.

PART 2 PART 2 - PRODUCTS

2.01 FIXTURE COMPONENTS, GENERAL

- A. Metal Parts: Free from burrs and sharp edges and corners.

- B. Sheet Metal Components: Corrosion-resistant aluminum, except as indicated. Form and support to prevent warping and sagging.
- C. Housings: Rigidly formed, weather-tight and light-tight enclosures that will not warp, sag, or deform in use. Provide filter/breather for enclosed fixtures.
- D. Doors, Frames, and Other Internal Access Provisions: Smooth operating, free from light leakage under operating conditions, and arranged to permit relamping without use of tools. Arrange doors frames, lenses, diffusers, and other pieces to prevent accidental falling during relamping and when secured in the operating position. Provide for door removal for cleaning or replacing lens. Arrange for door opening to disconnect ballast.
- E. Exposed Hardware Material: Stainless steel.
- F. Reflecting Surfaces: Minimum reflectances as follows, except as otherwise indicated:
 1. White Surfaces: 85 percent.
 2. Specular Surfaces: 83 percent.
 3. Diffusing Specular Surfaces: 75 percent.
- G. Plastic Parts: Resistant to yellowing and other changes due to aging and exposure to heat and UV radiation.
- H. Lenses and Refractors: Materials as indicated. Use heat-resistant and aging-resistant, resilient gaskets to seal and cushion lens and refractor mounting in fixture doors.
- I. Photoelectric Relay: UL 773, Plug-in, Locking Type Photocontrols for Use With Area Lighting, if shown on plans.
 1. Contact Relays: Single-throw, arranged to fail in the "on" position and factory set to turn light unit on at 1.5 to 3 footcandles and off at 4.5 to 10 footcandles with 15 seconds' minimum time delay.
 2. Relay Mounting: In fixture housing.
- J. For LED fixtures, they shall include a 5 year warranty as minimum. See the Light Fixture Schedule on the plans for additional information.

2.02 HIGH-INTENSITY-DISCHARGE (HID) FIXTURES

- A. Fixtures: Conform to UL 1572, "High-Intensity-Discharge Lighting Fixtures."
- B. Ballasts: Conform to UL 1029, "High-Intensity-Discharge Lamp Ballasts and ANSI C82.4, "Ballasts for High-Intensity-Discharge and Low-Pressure Sodium Lamps (Multiple-Supply Type). " Provide constant wattage autotransformer (CWA) or regulating high-power-factor type, unless otherwise indicated.
 1. Operating voltage matches system voltage.
 2. Single-Lamp Ballasts: Minimum starting temperature of minus 30 deg. C.
 3. Construct ballasts so open circuit operation will not reduce the average life.
 4. High-Pressure Sodium (HPS) Ballasts: Equipped with a solid-state igniter/starter having an average life in the pulsing mode of 10,000 hours at an igniter/starter case temperature of 90 deg. C.
 5. Noise: Uniformly quiet operation, with a noise rating of B or better.

2.03 FIXTURE SUPPORT COMPONENTS

- A. Arm, Bracket and Tenon Mount Materials: Match the fixtures.
- B. Mountings, Fastenings, and Appurtenances: Corrosion-resistant components compatible with the fixtures that will not cause galvanic action at contact points. Provide mountings that will correctly position the luminaire to provide the indicated light distribution.

2.04 LAMPS

- A. Conform to ANSI Standards, C78 series, applicable to each type of lamp. Provide fixtures with indicated lamps. Where lamps are not indicated, provide lamps recommended by manufacturer.

2.05 FINISH

- A. Metal Parts: Manufacturer's standard finish except as otherwise indicated. Color of exterior fixtures shall match Architect's samples. Exterior fixtures shall be provided in 3 colors. Finish applied over corrosion-resistant primer, free of streaks, runs, holidays, stains, blisters, and similar defects. Remove poles, fixtures, and accessories showing evidence of corrosion or finish failure during Project warranty period and replace with new items.
- B. Other Parts: Manufacturer's standard finish except as otherwise indicated.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Set units plumb, square, level, and secure according to manufacturer's written instructions and shop drawings.

3.02 FIELD QUALITY CONTROL

- A. Inspect installed units for damage.
- B. Tests: Verify normal operation of lighting units after installing fixtures and energizing circuits with normal power source. Include the following:
 - 1. Check for excessive noisy ballasts.
 - 2. Check for uniformity of illuminations.
- C. Replace or repair damaged and malfunctioning units and retest.

3.03 ADJUSTING AND CLEANING

- A. Clean components on completion of installation. Use methods and materials recommended by manufacturer.

END OF SECTION

SECTION 31 13 15
SITE PREPARATION

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Protection of improvements, plants, and utilities.
 - 2. Removal and replacement of improvements.
 - 3. Location of utilities and coordination with utility companies.
 - 4. Temporary erosion control.
 - 5. Clearing and grubbing trees and vegetation.
 - 6. Topsoil salvage.
 - 7. Miscellaneous demolition.

- B. Related Sections:
 - 1. Section 31 25 10 - Temporary Erosion Control

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.01 PREPARATION

- A. Verify that existing plant life and features designated to remain are tagged or identified.

3.02 PROTECTION

- A. Protect improvements on site and on adjoining properties. Provide barricades, coverings or other types of protection as necessary to prevent damage and to safeguard against injury. Restore to original condition improvements damaged by the work or improvements that required temporary removal during construction.

- B. Protect existing vegetation indicated to remain against unnecessary cutting, breaking, bruising, or smothering by stockpiling excavated materials or parking of vehicles within drip line. Provide temporary fences, tree wells, barricades or guards; repair or replace trees and vegetation damaged by construction operations.

- C. Protect survey monuments, reference points, and bench marks from movement. Should removal be necessary, notify Engineer who will set reference stakes and give notice that monument may be removed. Owner will reset monument after construction at no cost to Contractor. Contractor shall pay cost for reestablishing monuments lost due to his negligence or failure to notify Engineer.

- D. No extra payment or time will be allowed for protection work that could have been suspected or anticipated by site inspection and interpretation of bidding documents prior to execution of contract.

3.03 UTILITIES

- A. Notify all affected utility companies of construction operations at least 3 working days before beginning work near their facilities. Locate existing utilities; provide adequate protection and support during construction operations. If uncharted or incorrectly charted piping or other utilities are encountered

during earthwork, consult Engineer immediately for directions as to procedure. Cooperate with Owner, and public and private utility companies to keep their services and facilities in operation. Repair damaged utilities to satisfaction of utility owner.

3.04 TEMPORARY EROSION CONTROL

- A. Furnish, install and maintain temporary erosion or sedimentation control devices. Devices include hay bales, silt fences, sediment traps, flotation silt curtains and diversion mounds.
- B. Coordinate erosion control measures with earthwork and turf establishment operations. Complete work on a drainage area basis to prevent excessive soil erosion.
- C. Construct items in conformance with typical sections and elevation controls as shown on plans.
- D. Remove all items upon completion of contract work. Spread and shape accumulated sediment to permit natural drainage and provide for turf establishment.

3.05 SITE CLEARING AND GRUBBING

- A. Remove trees, stumps, snags, shrubs, brush, heavy growths of grass, weeds and other vegetation, improvements, rubbish and debris, and obstructions that interfere with proposed construction; remove items only as necessary for completion of work.
- B. Cut brush and vegetation flush with ground. Grub out stumps, roots having a diameter of 2 inches or larger, and root clusters to a depth of least 2 feet below subgrade elevation for pavements, structures, and embankments and 6 inches below ground surface in other areas.
- C. Carefully and cleanly cut roots and branches of trees indicated to be left standing, where such roots and branches obstruct new construction. Cut back roots to a minimum of 1 foot from concrete work, paving, and structures and to a depth of not less than 2 feet below structures, foundations, and embankments.

3.06 TOPSOIL

- A. Topsoil shall include all friable, fertile, organic clay loam soil suitable for grass and plants, found at surface to a depth of approximately 6 to 12 inches, reasonably free of subsoil, clay lumps, stones, objects over 2 inches diameter, weeds, large roots, root clusters, and other objectionable material.
- B. Strip topsoil from project area to whatever depths encountered; prevent intermingling with underlying subsoil or other objectionable material. Remove heavy growths of grass from areas before stripping topsoil.
- C. Where trees are indicated to remain, terminate stripping a sufficient distance from such trees to prevent damage to root system.
- D. Stockpile topsoil in storage piles in areas where designated. Construct storage piles to freely drain surface water. Cover or sprinkle water on storage piles to prevent windblown dust.

3.07 DEMOLITION

- A. Remove structures, pavements and improvements within construction limits as shown and as required for construction. Saw cut bituminous and concrete pavement to provide a smooth straight joint. Remove below-grade items encountered, such as slabs and foundations that interfere with construction.

3.08 DEBRIS DISPOSAL

- A. Remove debris and excess materials from site and legally dispose of it; do not burn debris or wood unless properly permitted.

END OF SECTION

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SECTION 31 22 10

SITE GRADING

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes regrading of a site to accommodate the construction of a well house addition.
- B. The Work includes the following:
 - 1. Topsoil removal.
 - 2. Excavation.
 - 3. Embankment.
 - 4. Compaction.
 - 5. Fine grading.
 - 6. Topsoil placement.
- C. Related Sections:
 - 1. Section 31 25 10 - Temporary Erosion Control
 - 2. Section 32 92 12 - Turf Establishment
 - 3. Section 32 93 00 - Exterior Plants

1.02 DESCRIPTION

- A. Grade Site as shown on Drawings.
- B. Contours and spot elevations indicate finished surface grades.
- C. Construct uniform slopes between contours and spot elevations.
- D. Set Site control and grade stakes as required to ensure conformance with Drawings.

1.03 SEQUENCING AND SCHEDULING

- A. Complete topsoil removal and general grading prior to structure erection.
- B. Perform fine grading and topsoil placement after structure erection.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Granular Borrow Material: WisDOT Granular Borrow.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that native materials are suitable for reuse on Site.
- B. Notify Engineer of any materials that do not appear suitable for reuse.

3.02 PROTECTION

- A. Conduct all operations within designated grading limits.
- B. Protect all existing structures, plantings, turf, and other facilities or natural features which are not scheduled for removal.

3.03 CONSTRUCTION OPERATIONS

- A. Topsoil Removal:
 - 1. Excavate all topsoil, root, and organic material within designated grading area and stockpile separately.
 - 2. Separate all debris, large roots, and rocks greater than 1 inch from the topsoil and remove from Site.
- B. Excavation:
 - 1. Excavate designated areas to proposed subgrade elevations indicated on Drawings.
 - 2. Perform additional excavation as required to provide for foundation construction of proposed structure.
 - 3. Advise Engineer immediately if any unsuitable soils, wet conditions or previously undisclosed conditions are unearthed.
 - 4. Locate and protect inplace utilities within or adjacent to excavation area.
- C. Embankment:
 - 1. Place embankment material in designated areas to proposed subgrade elevations indicated on Drawings.
 - 2. Place granular borrow material in locations and at dimensions shown on Drawings.
 - 3. Use suitable excavated material from Site prior to import of common borrow material.
 - 4. Scarify existing subgrade areas prior to placement of embankments thereon.
 - 5. Place embankment materials in maximum 12-inch layers and compact each layer.
 - 6. Maintain proper moisture content during placement and compaction of embankment materials.
 - 7. Remove excess materials not required for embankment from Site.
 - 8. Place excess materials in accordance with these requirements in locations on Site as directed by Engineer.
- D. Compaction:
 - 1. Compact granular borrow placed in structure excavation to 98 percent of standard Proctor density.
 - 2. Compact remaining areas with approved compaction equipment until there is no further evidence of consolidation.
- E. Fine Grading: Finish grade all earthwork areas to within 1/10 foot of proposed subgrade elevations.
- F. Topsoil Placement:
 - 1. Place 6 inches of salvaged topsoil over all disturbed areas.
 - 2. Drag topsoiled areas to remove wheel tracks and provide a uniform texture and appearance.
 - 3. Finish topsoiled areas to within 1/10 foot of proposed finished elevations.

END OF SECTION

SECTION 31 22 20

EARTHWORK FOR BUILDING SITES

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Preparation of subgrade for:
 - a. Slabs-on-grade.
 - b. Walks.
 - c. Pavements.
 - d. Landscaping.
 - 2. Excavating and backfilling for:
 - a. Buildings and structures.
 - b. Buried mechanical and electrical utilities and pits for buried utility structures.
 - 3. Drainage course for slabs-on-grade.
 - 4. Subbase course for:
 - a. Concrete walks and pavements.
 - b. Asphalt paving.
 - 5. Subsurface drainage backfill for walls and trenches.
 - 6. Dewatering (if required):
 - a. Lowering and controlling groundwater levels during excavation and construction.
 - b. Control of hydrostatic pressures during excavation and construction.
 - c. Control of surface and sub-surface water, ice, and snow related to dewatering.
 - d. Disposal of water removed from excavations.
- B. Related Sections:
 - 1. Section 02 41 33 - Removing Pavement and Miscellaneous Structures
 - 2. Section 03 30 00- Cast-in-Place Concrete
 - 3. Section 31 22 10 - Site Grading
 - 4. Section 31 25 10 - Temporary Erosion Control
 - 5. Section 32 92 12 - Turf Establishment
 - 6. Section 33 11 00 - Water Distribution Systems
 - 7. Section 33 31 00 - Sanitary Sewer Systems
 - 8. Section 33 41 00 - Storm Sewer Systems
- C. Explosives: Not permitted.

1.02 REFERENCES

- A. ASTM:
 - 1. C578 - Standard Test Methods for Rigid Cellular Polystyrene
 - 2. D448 and D2940 - Standard Test Methods for Aggregates
 - 3. D1557 or D698 - Standard Test Methods for Soils Compaction
 - 4. D2487 - Standard Test Methods for Soils
- B. Wisconsin Department of Transportation – Facilities Development Manual.
- C. City of Madison Standard Specifications

1.03 DEFINITIONS

- A. Borrow: Satisfactory soil brought to Site from another location for use as fill or backfill.

- B. Drainage Course: Course supporting the slab-on-grade that also minimizes upward capillary flow of pore water.
- C. Excavation: Removal and subsequent disposal of materials encountered to subgrade elevations indicated.
- D. Fill: Soil materials used to raise existing grades.
- E. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below ground surface.
- F. Subgrade: Surface or elevation remaining after completing excavation, or top surface of a fill or backfill immediately below subbase, drainage fill, or topsoil materials.
- G. Unauthorized Excavation: Removal of materials beyond indicated subgrade elevations or dimensions without specific instruction from Engineer or soils engineer.
- H. Utilities: On-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

1.04 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with applicable requirements of governing authorities and referenced portions of state standards.
- B. For operations that disturb 1 acre or more of land area, submit WPDES Application for General Stormwater Permit for Construction Activity (WI-S067832-4).
 - 1. For the WPDES permit process, operator is the Contractor.
 - 2. Construction may begin 7 days after application is postmarked.
 - 3. Complete and attach SWPPP form to WPDES permit.
 - a. SWPPP to be kept at Site.
 - b. SWPPP must be available to federal, state, and local officials within 72 hours upon request for duration of the permit and for 3 years following Notice of Termination (NOT).
 - c. Submit NOT within 30 days of final stabilization.
 - 4. See WDNR website for more information:
<http://dnr.wi.gov/topic/Stormwater/construction/forms.html>.
- C. Sites within 200 feet of surface water are subject to time limits exposed soils can remain unstabilized.
- D. Testing and Inspection Services: See requirements of 01 45 29.

1.05 SUBMITTALS

- A. Refer to Section 01 33 00.
- B. Product Data: Submit manufacturer's current Product Data including specifications, handling, storage and installation instructions, and maintenance and cleaning recommendations for the following:
 - 1. Detectable plastic warning tape.
 - 2. Geotextile.
 - 3. Controlled low-strength material, including design mixture.
 - 4. Geofoam.
- C. Pre-excavation Photographs or Videotape: Show existing conditions of adjoining construction and Site improvements, including finish surfaces that might be misconstrued as damage caused by earthwork operations. Submit before earthwork begins.
- D. Blasting Plan:
 - 1. Approved by authorities having jurisdiction.

2. Types of explosives and sizes of charge to be used.
3. Types of blasting mats.
4. Sequence of blasting operations.
5. Procedures to prevent damage to Site improvements and structures on Site and adjacent properties.

E. NPDES Permit (WI-S067831-4).

F. Proposed schedule for accomplishment of Work within, adjacent to, or affecting surface water.

G. Erosion control schedule.

1.06 PROJECT/SITE CONDITIONS

A. Verification of Conditions:

1. Subsurface Conditions:
 - a. Owner not responsible for interpretations or conclusions drawn by Contractor.
2. Additional Test Borings, Other Exploratory Operations: Contractor's option at no cost to Owner.

B. Underground Utilities:

1. Contact Diggers Hotline (811) at least 48 hours prior to conducting any underground operations to ascertain the location of all existing underground utilities.
2. Where the 48-hour notification period has elapsed and surface markings have not been made by municipalities or public utility companies known to have underground utilities in the area, contact the utility owner in question for location before digging.
3. Uncharted or Incorrectly Charted Existing Piping or Utilities: Consult utility owner immediately for directions.
4. Neither Engineer nor Owner warrant that the size, location, or extent of utilities shown on the Drawings is a complete and accurate record of existing utilities which may affect the Contractor's operations.
5. Contact Engineer not less than 2 days in advance of proposed utility interruptions.
6. Conduct earthwork in manner to prevent damage to existing utilities.
7. Cooperate with Owner and utility companies to keep services and facilities in operation.
 - a. Do not interrupt utilities serving occupied facilities unless permitted in writing by Engineer, and then only after arranging to provide temporary utility services as required.
8. Repair damaged utilities to satisfaction of utility owner.

C. Dust Control: Control dust on and near Work and all off-site borrow areas caused by Work of this Section.

D. Soils Information:

1. Soil Bearing Capacities:
 - a. Refer to structural engineer's recommendation.
 - b. Allow soil engineer to observe and test soils at bottom of excavations before any filling, compaction, other construction is begun.
 - c. Notify Engineer if conditions are less than recommended.

PART 2 PRODUCTS

2.01 EARTHWORK MATERIALS

A. Imported Material:

1. Notify Engineer at least 4 days prior to intention to import material.
2. Designate proposed borrow area.
3. Provide Engineer with samples if requested.
4. Acceptance tests: As required to prove quality.

- B. Satisfactory Soil Materials:
 - 1. Comply with ASTM D2487 soil classification groups GW, GP, GM, SM, SW and SP.
 - 2. Free of rock or gravel larger than 3 inches in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.
- C. Unsatisfactory Soil Materials:
 - 1. Those complying with ASTM D2487 soil classification groups GC, SC, ML, MH, CL, CH, OL, OH, PT, and all soils with fines over 5 percent.
 - 2. Includes satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.
- D. Site Grading Material:
 - 1. Granular, free of debris, boulders, organic material, excessive silt and clay.
 - 2. If not sufficiently available on Site, provide from off-site sources.
- E. Fill Below Water Table:
 - 1. Clean, coarse granular material.
 - 2. Less than 50 percent passing No. 40 sieve.
 - 3. Less than 5 percent passing No. 200 sieve.
- F. Compacted Fill and Backfill:
 - 1. SW, SP, or SP-SM sand (Unified Soil Classification System), clean and free of organic materials.
 - 2. Obtained from excavation and cutting at Site.
 - 3. Not more than 12 percent passing No. 200 sieve.
 - 4. If not suitable or insufficiently available, provide from off-site sources.
- G. Subslab Base Fill for Slabs-On-Grade:
 - 1. Reasonably well-graded sand (SW or SP), clean and free of organic material.
 - 2. Not to exceed 3/4-inch in size.
 - 3. Suitable material obtained from excavation at Site may be used with acceptance of Engineer.
- H. Base Course Material:
 - 1. Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand.
 - 2. ASTM D2940.
 - 3. Minimum 95 percent passing 1-1/2-inch sieve.
 - 4. Maximum 8 percent passing No. 200 sieve.
- I. Engineered Fill:
 - 1. Naturally or artificially-graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand.
 - 2. ASTM D2940.
 - 3. Minimum 90 percent passing 1-1/2-inch sieve.
 - 4. Maximum 12 percent passing No. 200 sieve.
- J. Bedding Course:
 - 1. Naturally or artificially-graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand.
 - 2. ASTM D2940.
 - 3. 100 percent passing 1-inch sieve.
 - 4. Maximum 8 percent passing No. 200 sieve.
- K. Drainage Course:
 - 1. Narrowly-graded mixture of washed, crushed stone, or crushed or uncrushed gravel.
 - 2. ASTM D448.
 - 3. Coarse-aggregate grading Size 57.
 - 4. 100 percent passing a 1-1/2-inch sieve.
 - 5. 0 to 5 percent passing a No. 8 sieve.

- L. Filter Material:
 1. Narrowly-graded mixture of natural or crushed gravel, or crushed stone and natural sand.
 2. ASTM D448.
 3. Coarse-aggregate grading Size 67.
 4. 100 percent passing a 1-inch sieve.
 5. 0 to 5 percent passing a No. 4 sieve.

- M. Impervious Fill: Clayey gravel and sand mixture capable of compacting to a dense state.

- N. Other Materials: As required for complete and proper installation, selected by Contractor subject to acceptance of Engineer.

- O. Topsoils:
 1. Black or brown earth or growing soil; natural friable loam possession characteristics of best soils of vicinity; reasonably free from subsoil, clay lumps; stones, peat, brush, objectionable weeds, other litter subject to rot or corrosion, excess acid or alkali, other substance harmful to plant growth or hindrance to fine grading, planting or maintenance operations.
 2. Salvage and stockpile a quantity sufficient to cover lawn areas with 6-inch layer.
 3. Engineer will determine most suitable topsoil available within Project during construction.
 4. If quantity of stockpiled topsoil is insufficient to complete Work, provide topsoil meeting specifications from other locations.

2.02 ACCESSORIES

- A. Warning Tape:
 1. Acid and alkali-resistant polyethylene film manufactured for marking and identifying underground utilities.
 2. 6 inches wide and 4 mils thick.
 3. Metallic core detectable by metal detector when buried up to 30 inches.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verification of Conditions: Examine area and conditions. Correct conditions detrimental to timely and proper completion of Work before proceeding.

- B. Backfilling Prior to Acceptance:
 1. Not allowed.
 2. If any Work is enclosed or covered up before being accepted by Engineer, uncover all such Work at no additional cost to Owner, and restore to condition found at time of uncovering.

3.02 PREPARATION

- A. Protection of Persons and Property:
 1. Barricade at open holes and depressions.
 2. Warning Lights: Post on property adjacent to or within public access. Operate from dusk to dawn each day and as otherwise required.
 3. Structures, Utilities, Sidewalks, Pavements, Other Facilities: Protect from damage caused by settlement, lateral movement, washout and other hazards created by earthwork operations.
 4. Damage involving streets, curbs, walks, utilities, other Site amenities:
 - a. Repair to satisfaction of Owner or authority having jurisdiction over Site improvement.
 - b. Furnish letter to Engineer from Owner or authority indicating acceptance of corrective Work.

- B. Protect and maintain erosion and sedimentation controls during earthwork operations. See Section 31 25 10.

- C. Cold Weather:
 1. Protect bottoms of excavations from frost and freezing.
 2. Do not excavate to full depth during freezing weather unless footings or slabs can be placed immediately after completion of excavation work.
- D. Remove vegetation, topsoil, debris, obstructions, and deleterious materials from subgrade and ground surface: See Sections 02 41 33 and 31 11 00.
- E. Finish Elevations and Lines: Set and establish, using services of registered civil engineer or land surveyor.
- F. Data and Monument Preservation: If displaced or lost, replace to acceptance of Engineer at no cost to Owner.
- G. Dewatering:
 1. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Site and surrounding area.
 2. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.
 3. Remove all water, including rainwater, encountered during trench, substructure work to accepted location, natural channels, or storm sewer.
 4. Do not drain water into sanitary sewer.
 5. Do not allow excavated trenches as temporary drainage ditches.
 6. Provide dewatering trenches when required.
 7. Remove by pumps, drains, well points, sumps and other accepted methods.
 8. Continue dewatering while excavations remain open.
- H. Access: Maintain to adjacent areas.

3.03 EXCAVATION

- A. Unclassified Excavation: Excavate to subgrade elevations regardless of character of surface and subsurface conditions encountered.
- B. Satisfactory Excavated Materials: Transport to and place in fill or embankment areas within limits of Work.
- C. Unsatisfactory Excavated Materials: Excavate to a distance below grade as directed by soil engineer. Replace with satisfactory materials.
- D. Rocks: Remove or excavate using means that cause no additional cost to Owner, without endangering buildings or structures on or off Site.
- E. Drainage: Excavate and backfill in manner and sequence to provide proper drainage.
- F. Ditches and Gutters:
 1. Cutting: Accurately cut to cross sections, grades, and elevations shown.
 2. Leaves, Sticks, Trash, Debris: Prevent accumulation in excavations until completion of Work.
 3. Disposal of Excavated Materials:
 - a. As shown on Drawings or directed by soil engineer.
 - b. Do not deposit within 3 feet from edge of ditch.
- G. Additional Borrow Required: Obtain from borrow areas selected and paid for by Contractor, and accepted by soils engineer.
- H. Unauthorized Excavation under Footings, Foundations, or Retaining Walls:
 1. Fill by extending indicated bottom elevation of footing or base to excavation bottom, without altering required top elevation.
 2. When acceptable to soils engineer, place clean fill material in footing excavations in 6-inch lifts.

3. Trenches:
 - a. Bring to specified grade and level.
 - b. Compact to receive footings.
 - c. Lean concrete fill may be used to bring bottom elevation to proper position with permission of soils engineer.
 4. Elsewhere: Backfill and compact as specified for authorized excavations, unless otherwise directed by soils engineer.
- I. Stability of Excavations:
1. Sides:
 - a. Slope to 1:1 or flatter, unless otherwise directed by soils engineer.
 - b. Where sloping not possible, shore and brace.
 2. Maintain sides and slopes in safe condition until completion of backfilling.
- J. Shoring and Bracing:
1. Provide materials necessary for safety of personnel and protection of Work. Comply with requirements of governmental agencies having jurisdiction.
 2. Maintain at all times excavations are open. Carry down as excavation progresses.
 3. Contractor is responsible for design and adequacy of shoring and bracing.
- K. Excavating for Structures:
1. Tolerance: Within 1 inch, extending sufficient distance from footings and foundations to permit placing and removing concrete form work, installation of services, other construction required, and inspection.
 2. Bottom of Excavation:
 - a. Do not disturb.
 - b. Excavate by hand tools to final grade just before concrete is placed.
 - c. Trim bottoms to required lines and grades to leave solid base to receive concrete.
 3. Areas Within Footing Forms: Compact with motorized hand compactor to consolidate loose or scarified soils until firm "skin" results and there is no further loss of elevation.
 4. Correction of Subgrade:
 - a. Carry excavation below footing elevation to depth shown or as required to remove unsuitable soil.
 - b. Oversize excavation with a side slope no steeper than 1:1 downwards and outwards.
- L. Excavating for Walks and Pavements: Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.
- M. Excavation for Utility Trenches:
1. Width required for item to be installed: Wide enough to provide ample working room.
 2. Excavate no more than 100 feet in advance of pipe laying operation.
 3. Clearance: 12 inches on both sides of pipe or conduit.
 4. Depth of trenches for piping: Carry depth to establish indicated flow lines and invert elevations.
 5. Bottom of Trenches:
 - a. Beyond building perimeter, keep sufficiently below finish grade to avoid freeze-ups.
 - b. Shape to provide uniform bearing and support of pipes and conduit.
 - c. Remove projecting stones and sharp objects along trench subgrade.
 6. Pipes, conduit 6 inches or less in nominal size, flat-bottomed multiple-duct, conduit units:
 - a. Do not excavate beyond indicated depths.
 - b. Hand-excavate bottom cut to accurate elevations.
 - c. Support pipe or conduit on undisturbed subgrade.
 7. Pipes, conduit larger than 6 inch in nominal size, tanks, other mechanical/electrical work indicated to receive subbase:
 - a. Excavate to subbase depth indicated or, if not indicated, to 6 inches below bottom of Work to be supported.
 8. Exterior Water-bearing Piping (water, steam, condensate, drainage):
 - a. Except as otherwise indicated, excavate so top of piping is not less than 7 feet below finished grade.

- b. Grade bottoms of trenches as indicated, notching under pipe bells to provide solid bearing for entire body of pipe.

3.04 SUBGRADE INSPECTION

- A. Notify Engineer when excavations have reached required subgrade.
- B. Proof-roll subgrade with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding.
- C. Do not proof-roll wet or saturated subgrades.
- D. Replace unsatisfactory soil, soft spots, and areas of excessive pumping or rutting with compacted backfill or fill material as directed by Engineer.
- E. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Engineer.

3.05 STORAGE OF SOIL MATERIALS

- A. Stockpile borrow and excavated satisfactory soil without intermixing.
- B. Place, grade, and shape stockpiles to drain surface water and away from edge of excavations. Do not store within drip line of trees.
- C. Cover to prevent windblown dust.

3.06 FILLING AND BACKFILLING

- A. For each classification listed, place acceptable soil material in layers to required subgrade elevations.
- B. Backfilling: Backfill excavations as promptly as progress of Work permits, but not until:
 - 1. Acceptance of construction below finish grade including, where applicable, damproofing and waterproofing.
 - 2. Inspection, testing, acceptance, recording locations of underground utilities.
 - 3. Removal of concrete formwork.
 - 4. Removal of temporary shoring and bracing, and sheeting.
 - 5. Removal of trash, debris, vegetation, unsatisfactory soil materials, obstructions.
 - 6. Placement of horizontal bracing or permanent structure on horizontally supported walls.
- C. Ground Surface Preparation:
 - 1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.
 - 2. Slope surfaces steeper than 1 vertical to 4 horizontal: Plow, bench, or break up so fill material will bond with existing surface.
 - 3. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 2 percent of optimum moisture content.
 - 4. Do not allow free water to appear on surface during or after compacting operation.
 - 5. Remove and replace, or scarify and air dry, otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight. Assist drying by spreading soil, discing, harrowing, or pulverizing.

3.07 PLACING AND COMPACTING

- A. Loose Depth of Layers: Maximum 8 inches by heavy compaction equipment, or 4 inches for hand-operated tampers.
- B. Density:
 - 1. Compact each layer to required percentage maximum density for area.
 - 2. Place evenly adjacent to structures, and to required elevations.

3. Prevent wedging action against structures by carrying material uniformly around structure to same approximate elevation in each lift.
- C. Basement, other underground walls having structural floors over them: Do not backfill until structural floors are in place with sufficient strength to support walls.
- D. Control soil compaction during construction to provide minimum percentage density as specified by ASTM D698 and ASTM D1557:
 1. Structures, Slabs, Steps, and Pavements: Top 12 inches of existing subgrade and each layer of backfill or fill soil material at 95 percent.
 2. Walks: Top 6 inches below subgrade and compact each layer of backfill or fill soil material at 92 percent.
 3. Lawn or Unpaved Areas: Top 6 inches below subgrade and compact each layer of backfill or fill soil material at 85 percent.
 4. For Utility Trenches: Each layer of initial and final backfill soil material at 85 percent.

3.08 PLACEMENT OF TOPSOIL

- A. Grade subgrade to smooth, even grade approved by Engineer after fill has been placed to subgrade level.
- B. Spread 6-inch layer of topsoil from stockpile evenly, and blade to smooth finish with allowable tolerance of 0.05 foot from grades on Drawings.
- C. Till to depth of 9 inches with rototiller or other approved equipment.
- D. After tilling, remove rocks and rock fragments by means of human or mechanical rock pickers or rakes.

3.09 GRADING

- A. Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated in Drawings.
- B. Change of Slope Indicated on Drawings: Construct rolled transition section with minimum radius of approximately 8'-0", unless adjacent construction will not permit such transition, or if such transition defeats positive control of drainage.
- C. Slope grades to direct water away from buildings and to prevent ponding.
- D. Surface of Areas Under Walks: Shape to line, grade, and cross-section, within 0.10 foot of required subgrade elevation.
- E. Surface of Areas Under Pavement: Shape to line, grade, and cross-section, within 0.05 foot of required subgrade elevation.

3.10 SUBBASE AND BASE COURSES

- A. Place under pavements and walks as follows:
 1. Place base course material over subbase course under hot-mix asphalt pavement.
 2. Shape subbase and base course to required crown elevations and cross-slope grades.
 3. Place subbase and base course 6 inches or less in compacted thickness in a single layer.
 4. Place subbase and base course that exceeds 6 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches thick.
 5. Compact subbase and base course at optimum moisture content to required grades, lines, cross sections, and thickness.
- B. Pavement Shoulders:
 1. Place shoulders along edges of subbase and base course to prevent lateral movement.

2. Construct minimum 12 inches wide of satisfactory soil material.
3. Compact simultaneously with each subbase and base layer.

3.11 DRAINAGE COURSE

- A. Place and compact drainage course under cast-in-place concrete slabs-on-grade as follows:
 1. Place drainage course 6 inches or less in compacted thickness in a single layer.
 2. Place drainage course that exceeds 6 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches.
 3. Compact each layer of drainage course to required cross sections and thicknesses.

3.12 REPAIR/RESTORATION

- A. Settled, Eroded, Rutted Areas: Repair and reestablish grades to specified tolerances.
- B. Completed Compacted Areas Disturbed by Subsequent Construction Operations or Adverse Weather: Scarify surface, reshape, and compact to required density prior to further construction.
- C. Settling before Project Correction Period Ends: Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.
- D. Repair damage or displacement of surface facilities resulting from trench settlements that occurs within 1 year of final Project approval.

3.13 PROTECTION

- A. Newly Graded Areas: Protect from traffic, freezing, and erosion. Keep free from trash and weeds.

3.14 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Remove surplus soil and waste material and legally dispose off Owner's property.
- B. Transport surplus satisfactory soil to designated storage areas on Owner's property. Stockpile or spread soil as directed by Engineer.

END OF SECTION

SECTION 31 23 10

EXCAVATION AND EMBANKMENT (WisDOT 205 AND 207)

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes construction of excavations and embankments within the designated construction limits.

1.02 REFERENCES

- A. WisDOT:
 - 1. 205 - Roadway and Drainage Excavation
 - 2. 207 - Embankment
- B. City of Madison Public Works
 - 1. STANDARD SPECIFICATIONS FOR PUBLIC WORKS CONSTRUCTION, Part II
 - 2. <http://www.cityofmadison.com/business/pw/specs.cfm>

PART 2 PRODUCTS

2.01 MATERIALS

- A. Granular Borrow: WisDOT 209, Grade 2, except that all material must pass the 1-inch sieve.
- B. Random fill includes all soils except those classified in ASTM D2487 as Pt, OH, OL, MH or CH. Free from ice, snow, frozen earth, trash, debris, organic material, stones larger than 3 inches in any dimension

PART 3 EXECUTION

3.01 GENERAL REQUIREMENTS

- A. If present, remove ice and snow prior to grading operations.
- B. All grading shall conform to the planned grades, cross-sections and stakes.
- C. Confine operations to established limits.
- D. Maintain Site in a well-drained condition at all times.
 - 1. Install planned drainage facilities concurrent with embankment operations.
 - 2. Provide temporary drainage facilities to maintain existing drainage courses until permanent facilities are operative.

3.02 PREPARATION OF EMBANKMENT FOUNDATION

- A. Remove topsoil, organic and unstable material from the roadbed prior to placing embankment.

3.03 EXCAVATING OPERATIONS

- A. Conform to lines, grades and slopes staked by Engineer.

- B. Provide seepage trenches for granular backfill replacement of unstable areas.

3.04 DISPOSAL OF EXCAVATED MATERIAL

- A. Use suitable excavated materials for embankment construction.
- B. Construct embankment layers from uniform materials.
- C. Place granular materials in upper most portion of the embankment.
- D. Mechanically mix non-uniform soils to produce uniform moisture content and density.
- E. Excavate all suitable topsoil material separately and stockpile.
- F. Do not place snow, ice, or frozen lumps in the roadbed embankment.
- G. Do not place stone, concrete or bituminous fragments exceeding 3 inches in any dimension roadbed embankment.
- H. Do not place stone, concrete, or bituminous fragments exceeding 3 inches in the upper 6 inches of roadbed embankment or within 18 inches of the structure.
- I. All surplus excavated materials shall become the property of the Contractor for disposal.

3.05 PLACING EMBANKMENTS

- A. Do not place material on soil which is frozen.
- B. Backfill excavations below subgrade and seepage trenches in accordance with this Section.
- C. Deposit and spread material in uniform layers parallel to the profile grade extending over the full width of the embankment.
- D. Place upper 3 feet of roadbed in maximum 8-inch layers.
- E. Place remainder of roadbed in maximum 12-inch layers.

3.06 COMPACTING EMBANKMENTS

- A. Compact upper 3 feet of embankment to not less than 100 percent of Standard Proctor Density.
- B. Compact remainder of embankment to not less than 95 percent of Standard Proctor Density.
- C. Maintain proper moisture content during placement and compaction.

3.07 FINISHING OPERATIONS

- A. Finish all earthwork to within 0.1 foot of the staked grade.
- B. Conduct finishing and topsoiling concurrent with the grading operations to provide for erosion control.

END OF SECTION

SECTION 31 23 16

STRUCTURE EXCAVATIONS AND BACKFILLS (WisDOT 206)

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Structure excavation.
 - 2. Foundation preparation.
 - 3. Backfill placement.
 - 4. Surplus excavated material disposal.
- B. Related Sections:
 - 1. Section 31 22 10 - Site Grading
 - 2. Section 31 23 10 - Excavation and Embankment
 - 3. Section 31 25 10 - Temporary Erosion Control

1.02 REFERENCES

- A. WisDOT:
 - 1. 205 - Roadway and Drainage Excavation
 - 2. 206 - Excavation for Structures
 - 3. 209 - Granular Backfill

1.03 SEQUENCING AND SCHEDULING

- A. Do not commence construction of the structure foundation until soil test results are confirmed.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Granular Backfill: WisDOT 209.
- B. Aggregate Backfill: WisDOT 209.
- C. Granular Bedding: WisDOT 209.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that foundation soils are in suitable condition to begin construction.
- B. Advise Engineer of any soil types or conditions that are not in accordance with the soil borings.

3.02 PREPARATION

- A. Temporary Construction:
 - 1. Provide sheeting, shoring, or other temporary facilities as required to prosecute the work.
 - 2. Provide warning signs, fencing or other temporary facilities as required to prevent unnecessary hazards to the public.

3. Provide pumping or other temporary means as required to establish and maintain dry conditions in the excavation.

3.03 CONSTRUCTION REQUIREMENTS

- A. Excavation:
 1. Excavate, shape, and prepare all foundation soils to the elevations and dimensions designated on the Drawings.
 2. Perform additional excavation as required to permit erection of forms and other temporary construction and to provide for proper compaction of backfill materials.
- B. Foundation Preparation:
 1. Compact foundation soils as necessary to achieve required stability.
 2. Replace unsuitable foundation soils within acceptable materials.
 3. Place and compact replacement materials in minimum 6-inch layers.
 4. Rock Foundations:
 - a. Remove all loose or disintegrated rock material from the excavation.
 - b. Clean out all rock seams and fill with concrete.
- C. Backfilling:
 1. Uniformly distribute backfill materials in maximum 8-inch layers and compact to 100 percent of Standard Proctor Density prior to placement of successive layers.
 2. Do not place backfill material on frozen foundations.
 3. Do not place material that will freeze during backfill or compaction.
 4. Dispose of suitable surplus materials as embankment for the site grading. Remove excess and/or undesirable material from site.

3.04 FIELD QUALITY CONTROL

- A. Soil Tests:
 1. Soil bearing test on the foundation soils will be taken at the Owner's discretion.
 2. Soil density tests on the backfill material will be taken at the Owner's discretion.

3.05 PROTECTION

- A. Protect prepared foundation soils from freezing.
- B. Protect and maintain prepared foundation soils during dewatering operations.

END OF SECTION

SECTION 31 23 30

EXCAVATION, BACKFILLING AND COMPACTING

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
1. Trenching for sanitary sewers, water main, and appurtenances, including excavation, backfill, and compaction.
 2. Dewatering, protection of excavation and Site, existing utilities and other obstructions, and excesses and shortages of backfill.
 3. Excavating, filling, stockpiling, borrow, rough and finish grading, and placement of topsoil.
 4. Control of surface drainage.

1.02 REFERENCES

- A. ASTM:
1. C136 - Standard Method for Sieve Analysis of Fine and Course Aggregate
 2. C331 - Standard Specification for Lightweight Aggregate for Concrete Masonry Units
 3. D420 - Standard Guide for Investigating and Sampling Soil and Rock
 4. D698 - Standard Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures using 5.5 pound Hammer and 12 inch Drop
 5. D1682 - Standard Test Methods for Breaking Load and Elongation of Textile Fabrics
 6. D2487 - Standard Test Methods for Classification of Soils for Engineering Purposes
 7. D6938 - Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)
- B. WisDOT Standards for Road and Bridge Construction:
1. 209 - Granular Backfill
- C. Standard Specifications for Sewer and Water Construction in Wisconsin

1.03 SUBMITTALS

- A. Submit 10-pound sample of each type of fill to testing laboratory, in accordance with ASTM D420.

1.04 DEFINITIONS

- A. Suitable Materials: ASTM D2487 classified as GW, GP, SP and SW.
- B. Unsuitable Materials: Roots or other organic matter, trash, debris, frozen materials and stones larger than 3 inches, and other materials classified in ASTM D2487 not defined as Suitable Materials. Person-made fills, refuse, or backfill from previous construction.
- C. Rock: Boulders measuring 1/2 cubic yard or more and materials that cannot be removed without systematic drilling and blasting, and below ground concrete or masonry structures, exceeding 1/2 cubic yard in volume. Pavements shall not be considered rock.
- D. Unstable Materials: Too wet to support utility pipe, conduit, or appurtenant structure.
- E. Topsoil: Fertile, friable, natural loam, surface soil. Free of subsoil, clay lumps, brush, weeds, litter, roots, stumps, stones larger than 1 inch in any dimension, and other extraneous or toxic matter harmful to plant growth.

PART 2 PRODUCTS

2.01 MATERIAL

- A. Bedding Material: WisDOT 209. Remove all partials retained on a 1-inch screen.
- B. Granular Material: WisDOT 209.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Prior to construction, inspect existing utility structures and surface features with Engineer and document condition.
- B. Verify with Engineer that permits necessary to do work are obtained.

3.02 PREPARATION

- A. Have utility owners field mark utility locations and verify location of existing utilities prior to excavation.
- B. Protect surface features that are not designated to be removed.
- C. Notify utility companies of progress schedule so they can accomplish any necessary or previously agreed to relocations, removals, or supporting of lines.
- D. Implement traffic control. Place traffic warning signs.
- E. Strip off existing topsoil from within excavation limits and stockpile. Separate vegetation from salvageable topsoil and dispose of as appropriate.
- F. Notify Engineer and regulatory agencies of location of dewatering discharges and dewatering sedimentation basins.

3.03 UTILITY TRENCH EXCAVATION

- A. Excavate trenches to line and grade shown on Drawings.
- B. Pipe Envelope: Trench width and initial backfill depth, as indicated on Drawings. Width at top of excavation will vary depending on soil and depth.
- C. Over-excavation below grade shall be corrected by replacing and compacting with granular material to 100 percent of Standard Proctor density.
- D. Slopes: Excavated to at least the angle of repose and as required by the Accident Prevention Division of the State Industrial Commission or OSHA, whichever is more restrictive. Brace, shore, or sheet and drain excavation to protect property and provide worker safety.
- E. Pile excavated material in a manner that will not endanger work or obstruct sidewalks, driveways, or gutters.
- F. Segregate soils in excavated material that are unsuitable for trench backfill and dispose of as specified in this Section.
- G. Dewater ground as necessary to excavate trench and install pipe. Hold ground water level to a minimum 2 feet below pipe invert.

- H. Direct surface and groundwater discharges to natural drainage channels, drains, or storm sewers. Provide energy dissipation at discharge point of dewatering wells or points. Provide dewatering sedimentation basins at discharge point of trench sump pump.
- I. Over-excavate when bottom of trench contains unstable or unsuitable material. Bring excavation up to pipe grade with compacted select granular or suitable material taken from excavation. Notify Engineer of soil conditions which may be poor bearing capacity and when organic soils are encountered. Install additional rock stabilization or geotextile fabric at direction of Engineer.
- J. Provide temporary support, remove, relocate, or reconstruct existing utilities located within trench excavation. Utility owner shall designate method employed. Use care and provide compacted fill or other stable support for utility crossings to prevent displacement, rupture, or failure.
- K. Excavate to expose existing utilities that cross in close proximity to new pipe line to determine utilities' location ahead of pipe installation to avoid grade conflict. Measure to determine utilities' location relative to new pipe line location. Engineer may order deviation from alignment, grade, and location to avoid conflict. Plan work with Engineer at preconstruction conference and coordinate activities during course of work.
- L. Install and maintain barricades, guards, and warning lights to protect persons from injury and avoid property damage.
- M. Maintain activities within limits shown on Drawings.

3.04 STRUCTURE EXCAVATION

- A. Excavate to elevations and dimensions indicated, plus space required for construction operations, forming and inspection.
- B. Footings and foundation to rest on undisturbed soil, unless shown otherwise on Drawings, or required by the Engineer.
- C. Verify soil bearing capacity at base of footings exceeds 2,000 psf.

3.05 INITIAL BACKFILL

- A. Bedding for sewers and structures: Shown on the Drawings.
- B. Remove ledge rock, boulders, and large stones to provide at least 6-inch clearance from pipe.
- C. Dig bell holes in pipe bedding at each joint such that pipe barrel rests continuously on bedding.
- D. Place backfill in uniform layers not to exceed 6 inches before compaction. Tamp each layer to eliminate possibility of lateral displacement and provide uniform support. Compact to a minimum of 95 percent of Standard Proctor density.
- E. Install trench dams at locations indicated.

3.06 FINAL BACKFILL

- A. Backfill with suitable materials selected from excavated materials.
- B. Place backfill in uniform depth layers not to exceed 12 inches before compaction. Compact each layer before placing material for succeeding layer.
- C. Compact each layer by mechanical means. Trenches shall be compacted to a minimum of 95 percent of Standard Proctor density, except to 100 percent of Standard Proctor density in upper 3 feet of boulevard areas, shoulders, and paved surfaces. If moisture content of backfill material is greater than 3 percent above optimum moisture, compact material to minimum density of 3 pounds/cubic foot less

than Standard Proctor curve at that moisture content, except that minimum compaction shall be 85 percent of Standard Proctor density.

- D. Plastic Marking Tape: Installed 12 inches above underground electrical, telephone, gas conduits and 18 inches below finish grade, continuous along route of conduit.
- E. Excavated material not suitable or required for backfill shall be disposed of.
- F. Spread salvaged topsoil uniformly over disturbed area.
- G. Use select granular backfill within any building areas. Fill other areas with material from the Site.
- H. Fill in unsurfaced areas of more than 2 feet in depth shall be placed in maximum 2-foot lifts, and mechanically compacted.
- I. Scarify slopes receiving fill to permit new fill to bond. Allow clay, heavy loams or sandy loam soils to dry before using as fill.

3.07 FINISH GRADING

- A. Finish site grading true to grade within 0.1 foot of the grade shown on Drawings.
- B. Plow, disk and drag any areas compacted by trucks, other vehicles or storage of materials to match texture of adjacent areas.
- C. Insure a minimum of 6 inches of topsoil covers all unsurfaced areas. Fertilizing, seeding and landscaping will be by others.

3.08 DEWATERING

- A. Install dewatering equipment necessary to hold groundwater level to a minimum 2 feet below bottom of excavation.
- B. Direct surface and groundwater discharges to natural drainage channels, drains, or storm sewers. Provide energy dissipation at discharge point.
- C. Conduct dewatering operations in accordance with applicable regulations and permits.
- D. Assure proper erosion control methods.

3.09 COMPACTION

- A. Compact all fill within building areas to minimum 98 percent modified proctor density (ASTM D1557).
- B. Notify Engineer minimum 48 hours prior to starting compaction that requires testing.
- C. Prior to filling in areas requiring compaction, remove all topsoil, vegetation, roots, and other organic materials. Place and compact material in 6-inch maximum lifts.

3.10 TOLERANCES

- A. Trench settlements which occur in paved surfaces or yard areas during the guarantee period that are greater than 1 inch as measured by a 10-foot straight edge shall be repaired. Trench settlements of greater than 4 inches in remaining areas as measured by a 10-foot straight edge shall be repaired.

3.11 FIELD QUALITY CONTROL

- A. Independent Testing Laboratory: Sample backfill materials, determine Moisture/ Density relationship (Standard Proctor), and perform Field Moisture/Density tests at locations determined by Engineer.

Testing laboratory shall also perform gradation testing of Pipe Foundation Improvement and Bedding materials.

- B. Standard Proctor Tests: Performed exclusively for this Section and in accordance with ASTM D698.
- C. Field Moisture/Density Tests: Performed exclusively for this Section, 1 for every foot of lift in 200 lineal feet of excavation, and in accordance with ASTM D6938.
- D. Gradation Tests: Performed exclusively for this Section for material specified in Part 2 of this Section and in accordance with ASTM C136.

END OF SECTION

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SECTION 31 23 33

TRENCH EXCAVATION AND BACKFILL

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Trench excavation.
 - 2. Special pipe foundation.
 - 3. Trench backfill.
 - 4. Compaction.
 - 5. Pipe grade and alignment conflicts.

- B. Related Sections:
 - 1. Section 33 11 00 - Water Distribution Systems
 - 2. Section 33 31 00 - Sanitary Sewer Systems
 - 3. Section 33 41 00 - Storm Sewer Systems

1.02 SUBMITTALS

- A. Provide for each granular material:
 - 1. Name and location of source.
 - 2. Sample gradation.

1.03 SITE CONDITIONS

- A. Groundwater: Provide trench dewatering if groundwater surface is above or within 3 feet of pipe zone.

1.04 WARRANTY

- A. Repair all trench settlements and resulting damage or displacement of surface facilities that occur within the Contract correction period.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Crushed Rock Pipe Foundation: WisDOT 209.
- B. Granular Pipe Foundation: WisDOT 209.
- C. Aggregate Pipe Foundation: WisDOT 209.
- D. Replacement Backfill: WisDOT 209.

PART 3 EXECUTION

3.01 CONSTRUCTION REQUIREMENTS

- A. Trench Excavation:
 - 1. Alignment and Grade:
 - a. Excavate trench to alignment and grade as staked.
 - b. Excavate no more than 100 feet in advance of pipe laying operation.

2. Trench Width at Pipe Zone:
 - a. Center trench on pipe alignment.
 - b. Minimum width: Pipe outside dimension plus 12 inches.
 - c. Maximum width: Pipe outside dimension plus 24 inches (except rock excavation).
 3. Excavated Materials:
 - a. Use stable material for backfill.
 - b. Waste unstable material as directed.
 - c. Do not place materials on sidewalk, driveways, or drainageways.
 4. Drainage:
 - a. Provide dewatering trenches when required.
 - b. Drain trench water into natural channels or storm sewer.
 - c. Do not drain trench water into sanitary sewer.
 5. Rock Excavation:
 - a. Blasting shall conform to all local and state ordinances.
 - b. Submit blasting schedule for approval.
 - c. Minimum trench width: 36-inch.
 - d. Provide minimum 6-inch vertical clearance between pipe and rock trench bottom.
 - e. Provide minimum 12-inch horizontal clearance between pipe and rock trench walls.
 - f. Provide pipe foundation material for pipe in rock trenches.
- B. Pipe Foundations:
1. Engineer to determine condition of trench bottom.
 2. Stable Trench Bottom Condition:
 - a. Shape trench bottom to conform to bottom half of pipe.
 - b. Excavate bell holes to permit proper jointing.
 3. Unstable Trench Bottom Condition:
 - a. Excavate below pipe grade to specified depth.
 - b. Refill with specified foundation material in accordance with Drawings details and compact.
- C. Trench Backfill:
1. Pipe Zone:
 - a. Use specified foundation material free of rocks and other unsuitable debris.
 - b. Deposit material uniformly on both sides of pipe throughout entire trench width.
 - c. Place material in 6-inch lifts and mechanically compact.
 2. Above Pipe Zone:
 - a. Use native materials free of debris and rock, concrete or clay lumps with a volume greater than 1/3 cubic foot.
 - b. Place in uniform lifts no more than 1 foot thick.
 - c. Mechanically compact each lift of the upper 3 feet of trench to a standard Proctor density of 100 percent.
 - d. Mechanically compact each lift under the upper 3 feet of trench to a standard Proctor density of 95 percent.
 - e. Do not backfill unless approved compaction equipment is operating.
 - f. Fine grade street subgrade to staked elevation and cross section.
 3. Replacement Backfill:
 - a. Engineer to determine suitability of native material for backfill.
 - b. Use replacement backfill in lieu of native materials as directed.
 4. Excess or Deficiency of Backfill Material:
 - a. Dispose of excess backfill material as directed after all trenches are backfilled.
 - b. Provide replacement backfill as required to establish required surface elevation.

3.02 FIELD QUALITY CONTROL

- A. Density tests on backfill materials will be as directed by Engineer.
- B. Recompact all areas represented by failed density tests.

3.03 PIPE CLEARANCES AND CONFLICTS

- A. Provide clearance between sewers and water main as follows:
 - 1. Maintain 10-foot horizontal between pipes.
 - 2. Maintain 18-inch vertical separation between pipes.

- B. When 18-inch vertical separation between sewer and water main cannot be maintained, provide special pipe crossing as follows:
 - 1. Advise Engineer of pipe conflict.
 - 2. Lower water main in accordance with Drawing or as directed.
 - 3. Provide 18-inch vertical separation between pipes.
 - 4. Construct sewer using pipe material and joints equal to water main at crossing point.
 - 5. Center pipe lengths at crossing point.
 - 6. Provide special foundation material for both pipes.
 - 7. Place insulation as directed.

END OF SECTION

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SECTION 31 23 50

PREPARING THE FOUNDATION (WisDOT 211)

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes shaping and compacting of subgrade prior to placement of base course.
- B. Related Sections:
 - 1. Section 31 23 10 - Excavation and Embankment
 - 2. Section 31 23 16 - Structure Excavations and Backfills
 - 3. Section 31 23 33 - Trench Excavation and Backfill
- C. Method of Measurement:
 - 1. Measurement shall be on a lump sum basis.
- D. Basis of Payment:
 - 1. Payment for subgrade preparation shall be at the contract unit price as listed on the Bid Form. All associated work items shall be considered incidental.

1.02 REFERENCES

- A. WisDOT 211 - Preparing the Foundation

1.03 SEQUENCING AND SCHEDULING

- A. Prepare subgrade after unstable areas have been repaired and in-place surface courses have been removed.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.01 PREPARATION

- A. Re-excavate, compact and shape the top 6 inches of subgrade area to provide smooth, stable surface for the placement of base course thereon.
- B. Compact subgrade material to 100 percent of Standard Proctor Density.
- C. Produce and maintain the necessary moisture content in the subgrade material by scarification or application of water.
- D. Continue operations until no rutting or displacement occurs under construction traffic.
- E. Provide a finished surface within 0.05 foot of the prescribed elevation at all locations.

END OF SECTION

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SECTION 31 25 10

TEMPORARY EROSION CONTROL

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Temporary measures to control soil erosion and sedimentation.
 - 2. Furnishing, installing and maintaining erosion or sediment control devices.

1.02 REFERENCES

- A. Wisconsin Department of Transportation
 - 1. 628 - Erosion Control
- B. Wisconsin Department of Natural Resources – Bureau of Watershed Management
 - 1. Erosion Control Notes
 - a. <http://dnr.wi.gov/news/input/documents/guidance/ErosionControlNotesGuidanceFinal.pdf>

PART 2 PRODUCTS

2.01 MATERIALS

- A. Materials: WisDOT 628.2.

PART 3 EXECUTION

3.01 GENERAL

- A. Coordinate erosion control measures with earthwork and turf establishment operations.
- B. Complete grading, finishing, erosion control and turf establishment on a drainage area basis to prevent excessive soil erosion.

3.02 EROSION CONTROL NOTES

- A. Post WDNR Certificate of permit coverage on site and maintain until construction activities have ceased, the site is stabilized, and a notice of termination is filed with the WDNR.
- B. Keep a copy of the current erosion control plan on site throughout the duration of the project.
- C. Submit plan revisions or amendments to the WDNR at least 5 days prior to field implementation.
- D. Provide routine site inspections at least once every 7 days and within 24 hours after a rainfall event of 0.5 inches or greater. Keep inspection reports on-site and make them available upon request.
- E. Inspect and maintain all installed erosion control practices until the contributing drainage area has been stabilized.
- F. When possible: preserve existing vegetation, minimize land-disturbing construction activity on slopes of 20% or more, minimize soil compaction, and preserve topsoil.

- G. Refer to the WDNR Stormwater Construction Technical Standards at http://dnr.wi.gov/topic/stormwater/standards/constr_standards.html
- H. Install perimeter erosion controls and rock tracking pad construction entrance(s) prior to any land-disturbing activities.
- I. Install inlet protection prior to land disturbing activities in the contributing drainage area and/or immediately upon inlet installation.
- J. Stage construction grading activities to minimize the cumulative exposed area. Conduct temporary grading for erosion control per WDNR Technical Standard Temporary Grading Practices for Erosion Control #1067.
- K. Provide anti-scour protection and maintain non-erosive flow during dewatering. Limit pumping rates to either (A) the sediment basin/trap design discharge rate, or (B) the basin design release rate with the correctly fitted hose and geotextile filter bag. Perform dewatering of accumulated surface runoff in accordance with Section 31 23 19 Dewatering.
- L. Install and maintain silt fencing per WDNR Technical Standard Silt Fence #1056. Remove sediment from behind silt fences and sediment barriers before sediment reaches a depth that is equal to one-half of the fence and/or barrier height.
- M. Repair breaks and gaps in silt fences and barriers immediately. Replace decomposing straw bales (typical bale life is 3 months). Locate, install and maintain straw bales per WDNR Technical Standard Ditch Checks #1062.
- N. Immediately stabilize stockpiles and surround stockpiles as needed with silt fence or other perimeter control if stockpiles will remain inactive for 7 days or longer.
- O. Immediately stabilize all disturbed areas that will remain inactive for 14 days or longer. Between September 15 and October 15: Stabilize with mulch, tackifier, and a perennial seed mixed with winter wheat, annual oats, or annual rye, as appropriate for region and soil type. October 15 through cold weather: Stabilize with a polymer and dormant seed mix, as appropriate for region and soil type.
- P. Stabilize areas of final grading within 7 days of reaching final grade.
- Q. Sweep/clean up all sediment/trash that moves off-site due to construction activity or storm events before the end of the same workday or as directed by WDNR> Separate swept materials (soils and trash) and dispose of appropriately.
- R. Control dust per WDNR Technical Standard Dust Control on Construction Sites #1068.
- S. Properly dispose of all waste and unused building materials (including garbage, debris, cleaning water, or other construction materials) and do not allow these materials to be carried by runoff into the receiving channel.
- T. Coordinate with Engineer to update the land disturbance permit to indicate the anticipated or likely disposal locations for any excavated soils or construction debris that will be hauled off-site for disposal. The deposited or stockpiled material needs to include perimeter sediment control measures (such as silt fence, hay bales, filter socks, or compacted earthen berms).
- U. For non-channelized flow on disturbed or constructed areas, provide erosion control matting. Select erosion matting from appropriate matrix in WDOT's WIDOT Product Acceptability list (PAL); install and maintain per WDNR Technical Standard Non-Channel Erosion Mat #1052.
- V. For channelized flow on disturbed or constructed areas, provide erosion control matting. Select erosion matting from appropriate matrix in WDOT's WIDOT Product Acceptability list (PAL); install and maintain per WDNR Technical Standard Channel Erosion Mat #1053.

- W. Make provisions for watering during the first 8 weeks following seeding or planting of disturbed areas whenever more than 7 consecutive days of dry weather occur.
- X. Install additional erosion and sediment control measures as directed by Engineer.
- Y. Refer to the Site Specific Stormwater Management Plan if there is a discharge of sediment and/or other contaminant. The Contractor shall furnish a spill plan if there is a potential to discharge contaminants to waters of the state.

3.03 PLACING TEMPORARY EROSION CONTROL ITEMS

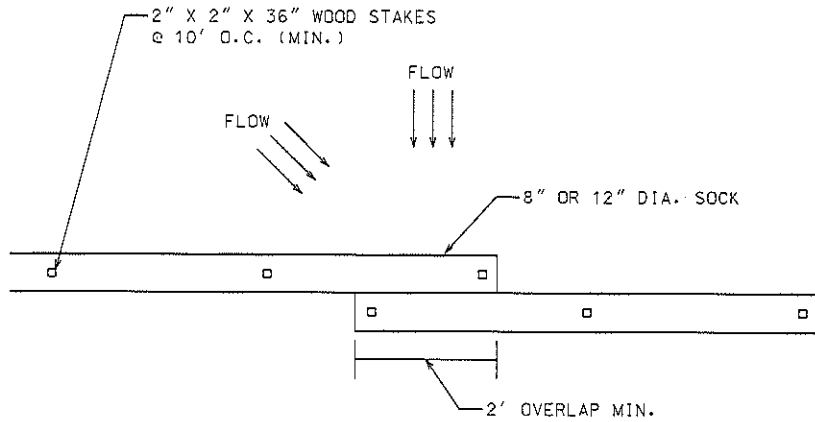
- A. Construct items in conformance with typical sections and elevation controls shown on the Drawings.
- B. Remove all items upon completion of the contract work.
- C. Spread and shape accumulated sediment to permit natural drainage and provide for turf establishment.

3.04 ACCEPTANCE OF WORK

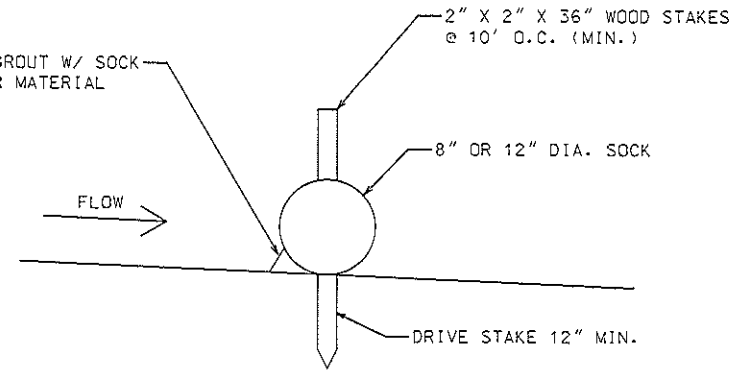
- A. Maintain and repair erosion control items to insure proper function.

END OF SECTION

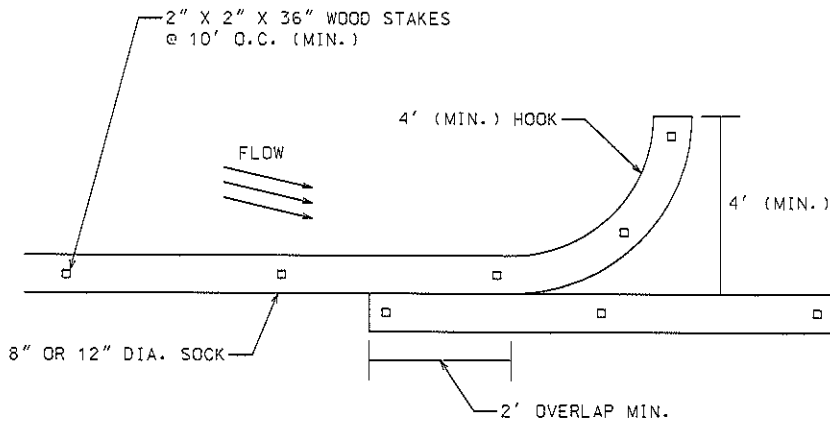
SILT SOCK (NTS)



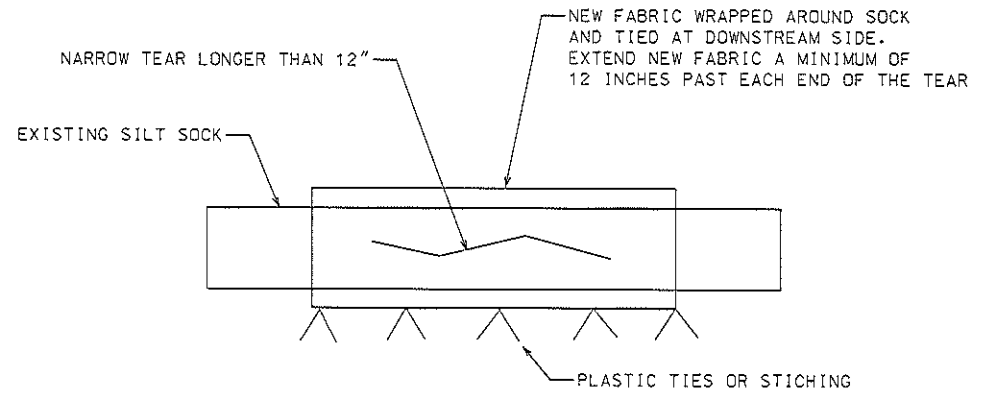
PLAN VIEW - FLOW 45 TO 90 DEG. TO SOCK



SECTION VIEW



PLAN VIEW - FLOW LESS THAN 45 DEG. TO SOCK



REPAIR DETAIL - TEAR GREATER THAN 12 INCHES

GENERAL NOTES:

1. SOCK MATERIAL PER STANDARD SPECIFICATIONS. SILT SOCK FILLER SHALL BE COMPOST OR WOOD CHIPS (2" MAX.)
2. WHEN SILT SOCK IS USED ON A PAVED SURFACE CONCRETE BLOCKS SHALL BE USED TO SECURE SILT SOCK IN PLACE OF STAKING
3. ACCUMULATED SEDIMENT SHALL BE REMOVED FROM BEHIND THE SILT SOCK WHEN IT HAS REACHED A HEIGHT EQUAL TO HALF OF THE SOCK HEIGHT.
4. SMALL HOLES OR NARROW RIPS LESS THAN 12' LONG MAY BE STICHED CLOSED USING PLASTIC ZIP TIES. LARGER RIPS SHALL BE FIXED PER THE REPAIR DETAIL. HEAVILY DAMAGED SECTIONS SHALL BE REPLACED ENTIRELY. MAINTAIN 2' MINIMUM OVERLAP AT EACH END.
5. 8" OR 12" DIAMETER SOCK AS SPECIFIED IN THE EROSION CONTROL PLAN OR AS DIRECTED BY THE CONSTRUCTION ENGINEER.

CITY OF MADISON
ENGINEERING DIVISION

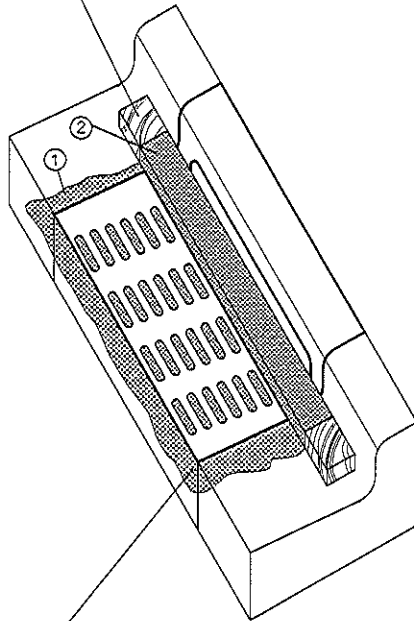
SILT SOCK

STANDARD DETAIL DRAWING 1.09

2012

1.09

WOOD 2X4 EXTENDS 8" BEYOND GRATE
WIDTH ON BOTH SIDES. LENGTH = 52 " FOR
H--S INLETS. 94" FOR HH INLETS.



TYPE C = GEOTEXTILE FABRIC TYPE FF
TYPE C "MODIFIED" = GEOTEXTILE FABRIC TYPE HR

GENERAL NOTES:

CLEANING IS REQUIRED WHEN FABRIC HOLDS $\frac{1}{2}$ "
OR MORE OF SEDIMENT OR WATER, OR AS DIRECTED
BY THE CONSTRUCTION ENGINEER.

FABRIC SHALL BE REPLACED WHEN AN AREA UNDER THE GRATE
HAS A TEAR 1" OR GREATER IN LENGTH,
OR AT THE ENGINEERS DISCRETION.

THE WOOD SHALL NOT BLOCK THE ENTIRE HEIGHT OF THE
CURB BOX.

MANUFACTURED ALTERNATIVES APPROVED AND LISTED ON THE
WISDOT EROSION CONTROL PRODUCT ACCEPTIBILITY
LIST MAY BE SUBSTITUTED.

WHEN REMOVING OR MAINTAINING INLET PROTECTION, CARE
SHALL BE TAKEN SO THAT THE SEDIMENT TRAPPED ON THE
GEOTEXTILE FABRIC DOES NOT FALL INTO THE INLET. ANY
MATERIAL FALLING INTO THE INLET SHALL BE REMOVED
IMMEDIATELY.

- ① FABRIC SIZE SHALL BE 8" (MIN) GREATER ON ALL SIDES
OF THE INLET COVER TO PROVIDE A HAND HOLD WHEN
MAINTENANCE OR REMOVAL IS REQUIRED.
- ② FOR INLET PROTECTION, TYPE C WITH A CURB BOX,
AN ADDITIONAL 18" OF FABRIC IS WRAPPED AROUND
THE WOOD AND SECURED WITH STAPLES.

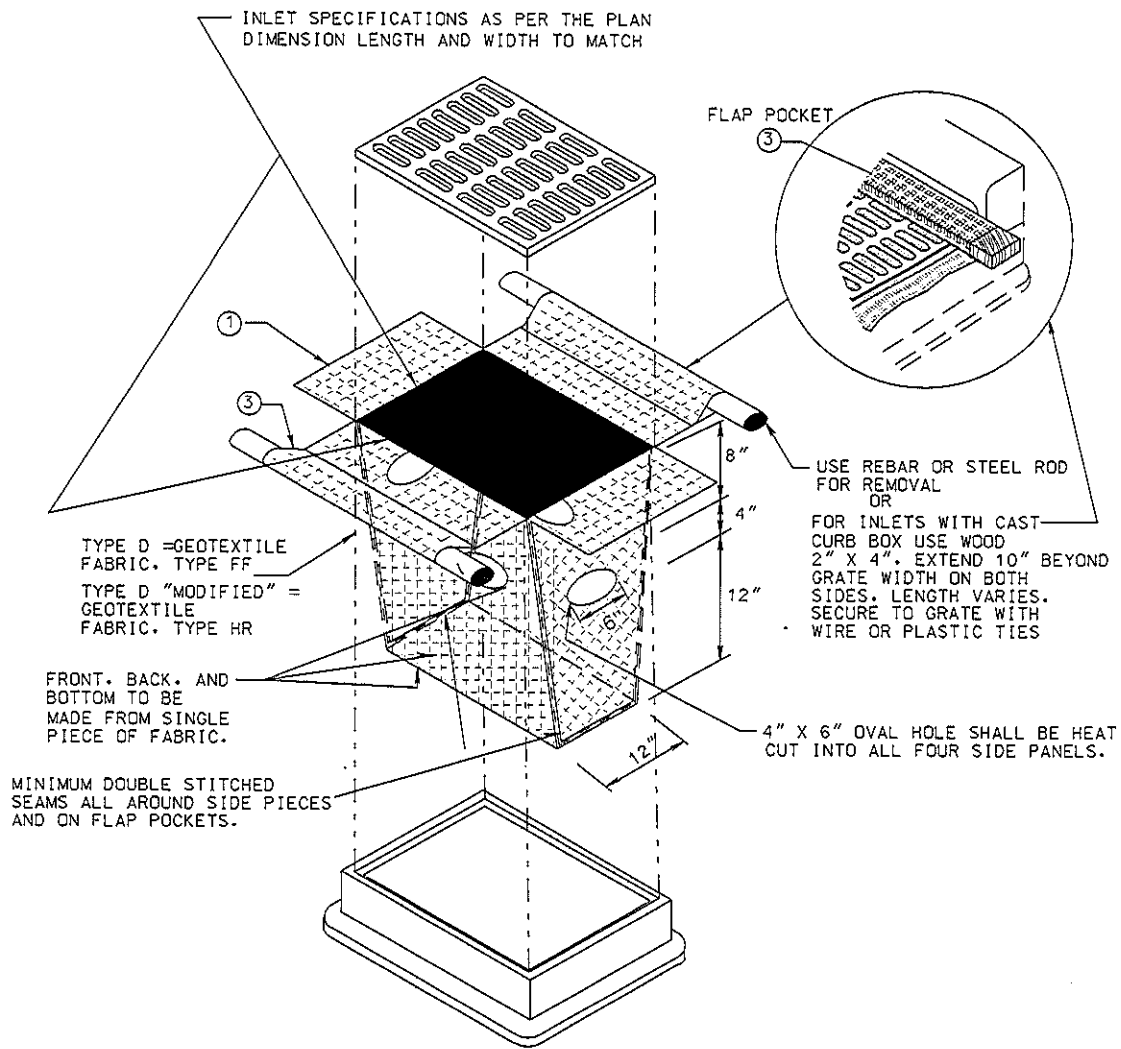
1.04

2012

CITY OF MADISON
ENGINEERING DIVISION

INLET PROTECTION
TYPE C AND
TYPE C "MODIFIED"

STANDARD DETAIL DRAWING 1.04



(CAN BE INSTALLED IN ANY INLET TYPE WITH OR WITHOUT A CURB BOX AS PER NOTE ②)

GENERAL NOTES

MANUFACTURED ALTERNATIVES APPROVED AND LISTED ON THE WISDOT'S EROSION CONTROL PRODUCT ACCEPTABILITY LIST MAY BE SUBSTITUTED.

CLEANING SHALL BE REQUIRED WHEN SEDIMENT OR STANDING WATER IS WITHIN 6" OF OVERFLOW HOLES OR AS DIRECTED BY THE CONSTRUCTION ENGINEER.

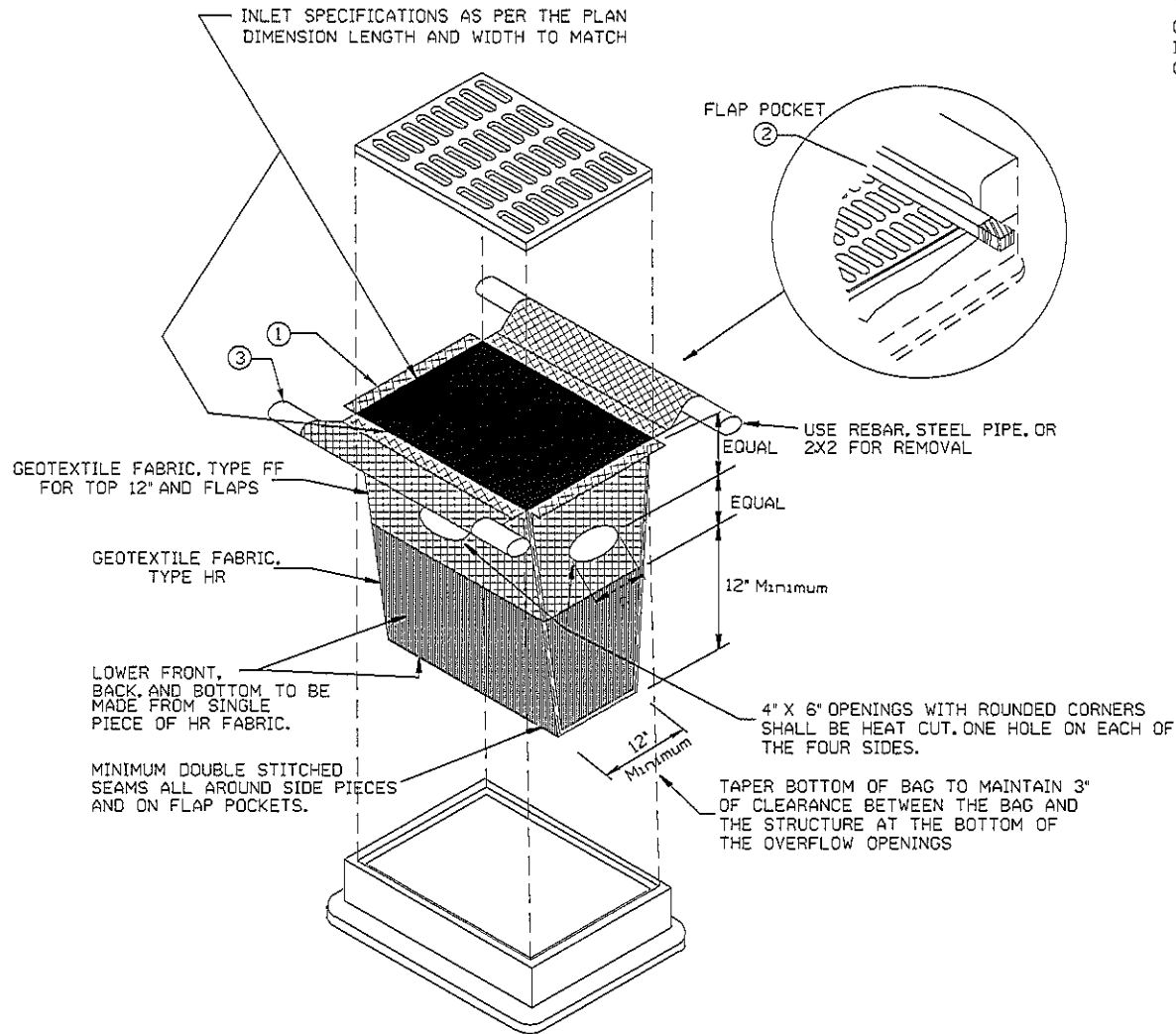
WHEN REMOVING OR MAINTAINING INLET PROTECTION, CARE SHALL BE TAKEN SO THAT THE SEDIMENT TRAPPED ON THE GEOTEXTILE FABRIC DOES NOT FALL INTO THE INLET. ANY MATERIAL FALLING INTO THE INLET SHALL BE REMOVED IMMEDIATELY.

THE INSTALLED BAG SHALL HAVE A MINIMUM SIDE CLEARANCE, BETWEEN THE INLET WALLS AND THE BAG, MEASURED AT THE BOTTOM OF THE OVERFLOW HOLES, OF 3". WHERE NECESSARY THE CONTRACTOR SHALL CINCH THE BAG, USING PLASTIC ZIP TIES, TO ACHIEVE THE 3" CLEARANCE. THE TIES SHALL BE PLACED AT A MAXIMUM OF 4" FROM THE BOTTOM OF THE BAG.

① TRIM EXCESS FABRIC IN THE FLOW LINE TO WITHIN 3" OF THE GRATE.

② FOR INLET PROTECTION WITH CURB BOX AN ADDITIONAL 18" OF FABRIC IS WRAPPED AROUND THE WOOD AND SECURED WITH STAPLES. THE WOOD SHALL NOT BLOCK THE ENTIRE HEIGHT OF THE CURB BOX OPENING.

③ FLAP POCKETS SHALL BE LARGE ENOUGH TO ACCEPT WOOD 2X4.



CAN BE INSTALLED IN ANY INLET TYPE WITH
OR WITHOUT A CURB BOX.

GENERAL NOTES

CLEANING SHALL BE REQUIRED WHEN SEDIMENT OR STANDING WATER IS WITHIN 6' OF THE OVERFLOW HOLES OR AS DIRECTED BY THE CONSTRUCTION ENGINEER.

WHEN REMOVING OR MAINTAINING INLET PROTECTION, CARE SHALL BE TAKEN SO THAT THE SEDIMENT TRAPPED ON THE GEOTEXTILE FABRIC DOES NOT FALL INTO THE INLET. ANY MATERIAL FALLING INTO THE INLET SHALL BE REMOVED IMMEDIATELY.

THE INSTALLED BAG SHALL HAVE A MINIMUM SIDE CLEARANCE, BETWEEN THE INLET WALLS AND THE BAG, MEASURED AT THE BOTTOM OF THE OVERFLOW HOLES, OF 3'.

- ① SIDE FLAPS SHALL BE A MAXIMUM OF 2' LONG. FOLD THE FABRIC OVER AND REINFORCE WITH MULTIPLE STICHES. FLAP POCKETS SHALL BE LARGE ENOUGH TO
- ② ACCEPT WOOD 2X2. THE 2X2 SHALL BE INSTALLED IN THE REAR FLAP AND SHALL NOT BLOCK THE TOP HALF OF THE CURB FACE OPENING.
- ③ FRONT LIFTING FLAP IS TO BE USED WHEN REMOVING AND MAINTAINING FILTER BAG.

CITY OF MADISON
ENGINEERING DIVISION

INLET PROTECTION
TYPE D
HYBRID

STANDARD DETAIL DRAWING 1.11

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SECTION 31 25 20

SILT FENCE

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes silt fence.
- B. Related Sections:
 - 1. Section 31 23 33 - Trench Excavation and Backfill

1.02 REFERENCES

- A. United States Department of Agriculture - Soil Conservation Service - Silt fences

1.03 SUBMITTALS

- A. Product data in accordance with Section 01 78 23.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Wire mesh, posts and geotextile fabric: In accordance with the Soil Conservation Service criteria.

PART 3 EXECUTION

3.01 LOCATION

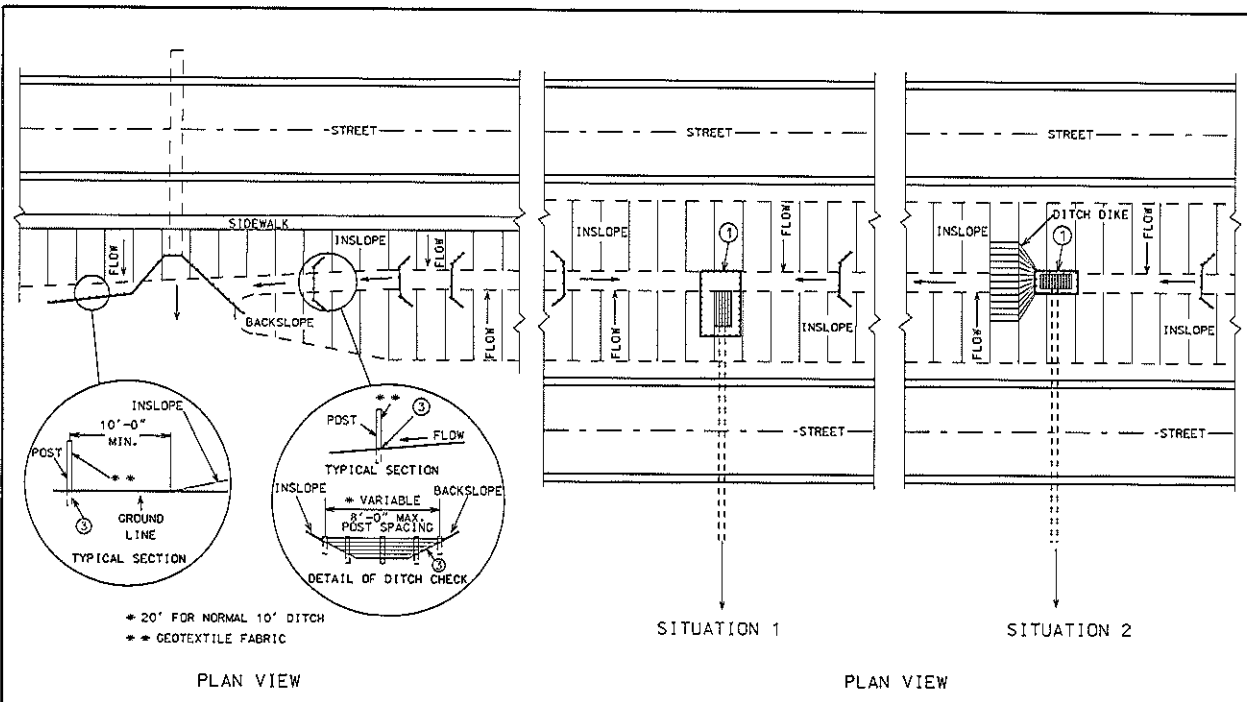
- A. Locate silt fence at the Site as required to keep silt out of surface water, floodplain, drainageways and stormwater inlets and sewers.
- B. Locate silt fence along contour, arranged so runoff cannot bypass ends.
- C. Locate silt fence in independent units, each less than 600 feet long.

3.02 CONSTRUCTION

- A. Maximum post spacing 8 feet. Drive posts minimum 2 feet in ground.
- B. Secure wire mesh supporting fence and geotextile fabric to posts. Bury mesh and fabric in 6-inch by 6-inch trench along bottom and 1 side. Backfill and compact trench.
- C. Locate splices at supporting post, with minimum 6-inch overlay, folded over and securely fastened.
- D. Inspect silt fence immediately after each runoff event, and at least daily during prolonged rain.
- E. Repair any damaged areas immediately.
- F. When sediment deposits are 1/2 the height of the fence, remove silt or construct second silt fence.

G. Remove silt fence when vegetation is re-established.

END OF SECTION



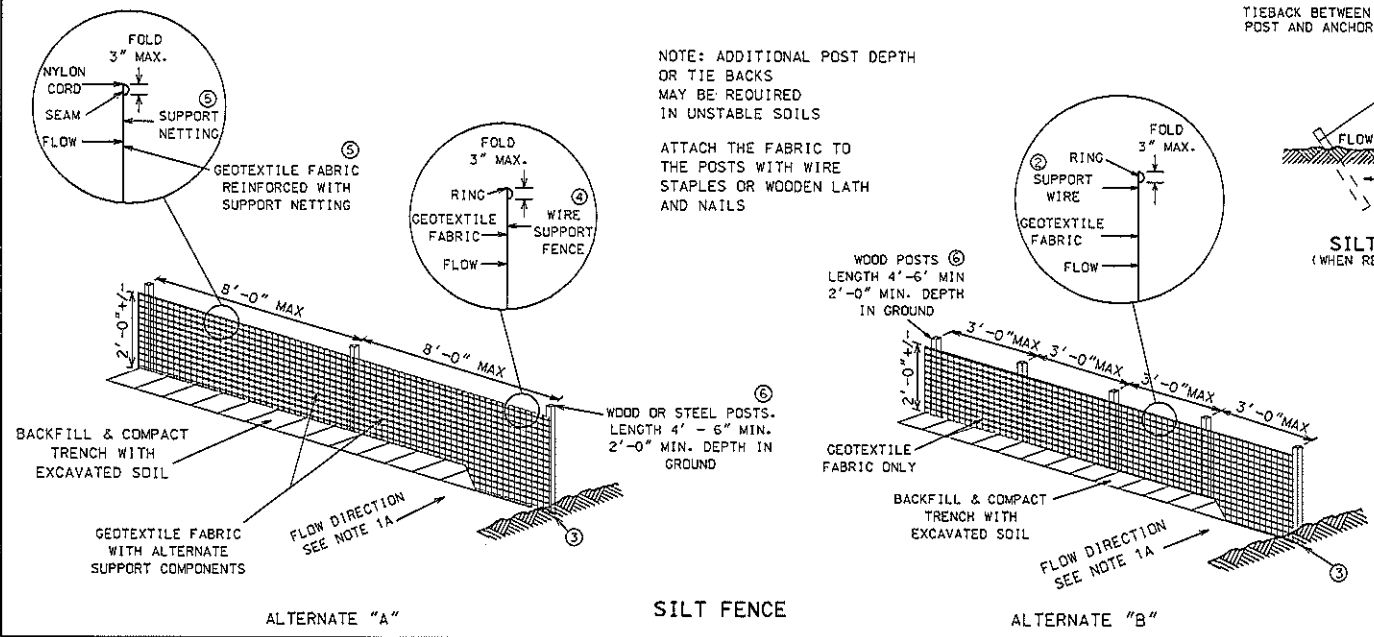
TYPICAL APPLICATIONS OF SILT FENCE

SILT FENCE AT MEDIAN SURFACE DRAINS

GENERAL NOTES

DETAIL OF CONSTRUCTION NOT SHOWN ON THIS DRAWING SHALL CONFORM TO THE PERTINENT REQUIREMENTS OF THE STANDARD SPECIFICATIONS AND APPLICABLE SPECIAL PROVISIONS.

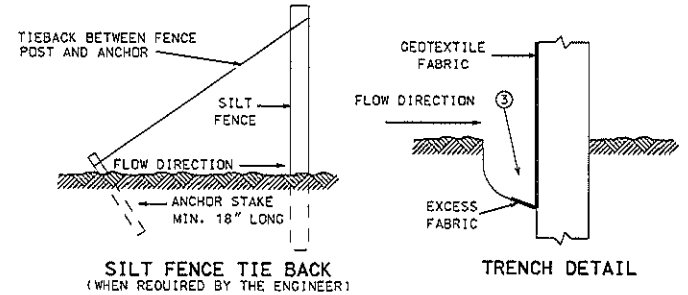
- ① WHEN POSSIBLE THE SILT FENCE SHOULD BE CONSTRUCTED IN AN ARC OR HORSESHOE SHAPE WITH THE ENDS POINTING UPSLOPE TO MAXIMIZE BOTH STRENGTH AND EFFECTIVENESS.
 - ① CROSS BRACE WITH 2" X 4" WOODEN FRAME OR EQUIVALENT AT TOP OF POSTS AS DIRECTED BY THE ENGINEER.
 - ② MINIMUM 14 GAGE WIRE REQUIRED. FOLD FABRIC 3" OVER THE WIRE AND STAPLE OR PLACE WIRE RINGS ON 12" C-C.
 - ③ EXCAVATE A TRENCH A MINIMUM OF 4" WIDE & 6" DEEP TO BURY AND ANCHOR THE GEOTEXTILE FABRIC. FOLD MATERIAL TO FIT TRENCH AND BACKFILL & COMPACT TRENCH WITH EXCAVATED SOIL.
 - ④ WIRE SUPPORT FENCE SHALL BE 14 GAGE MINIMUM WOVEN WIRE WITH A MAXIMUM MESH SPACING OF 6". SECURE TOP OF GEOTEXTILE FABRIC TO TOP OF FENCE WITH STAPLES OR WIRE RINGS AT 12" C-C.
 - ⑤ GEOTEXTILE FABRIC SHALL BE REINFORCED WITH AN INDUSTRIAL POLYPROPYLENE NETTING WITH A MAXIMUM MESH SPACING OF 3/4" OR EQUAL. A HEAVY DUTY NYLON TOP SUPPORT CORD OR EQUIVALENT IS REQUIRED.
 - ⑥ STEEL POSTS SHALL BE STUDDED "TEE" OR "U" TYPE WITH A MINIMUM WEIGHT OF 1.28 LBS/LINEAL FOOT (WITHOUT ANCHOR). FIN ANCHORS SUFFICIENT TO RESIST POST MOVEMENT ARE REQUIRED. WOOD POSTS SHALL BE A MINIMUM SIZE OF 4" DIA. OR 1 1/2" X 3 1/8" EXCEPT WOOD POSTS FOR GEOTEXTILE FABRIC REINFORCED WITH NETTING SHALL BE A MINIMUM SIZE OF 1 1/8" X 1 1/8" OAK OR HICKORY.
- ALTERNATES A & B ARE EQUAL AND EITHER MAY BE USED.
- ⑦ REMOVAL OF ACCUMULATED SILT IS REQUIRED ONCE IT REACHES HALF THE HEIGHT OF THE SILT FENCE.



ALTERNATE "A"

SILT FENCE

ALTERNATE "B"



SILT FENCE TIE BACK (WHEN REQUIRED BY THE ENGINEER)

TRENCH DETAIL

2012

CITY OF MADISON
ENGINEERING DIVISION

SILT FENCE

STANDARD DETAIL DRAWING 1.01

SECTION 32 11 26

CRUSHED AGGREGATE BASE COURSE (WisDOT 305)

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes construction of crushed aggregate base course on a prepared subgrade.
- B. Related Sections:
 - 1. Section 31 23 50 - Preparing the Foundation
 - 2. Section 32 12 18 – Hot Mix Asphalt Pavement

1.02 REFERENCES

- A. WisDOT - Standard Specifications for Highway and Structure Construction:
 - 1. 305 - Dense Graded Base
- B. City of Madison Public Works
 - 1. STANDARD SPECIFICATIONS FOR PUBLIC WORKS CONSTRUCTION
 - 2. <http://www.cityofmadison.com/business/pw/specs.cfm>

1.03 SUBMITTALS

- A. Provide for each aggregate material:
 - 1. Name and location of source.
 - 2. Two sample gradations taken within the past 30 days from each potential source, delivered to Engineer at least 10 days prior to placement on the project.

1.04 HANDLING AND DELIVERY

- A. Stockpile and drain aggregate removed from below water for a minimum 24 hours prior to delivery.

1.05 SITE CONDITIONS

- A. Deposit aggregate only on dry, compact subgrade so that no rutting or displacement will occur under construction traffic.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Crushed Aggregate Base Course Materials: WisDOT 305.
- B. Aggregate Gradations, as described in the City specifications:
 - 1. The crushed aggregate base course shall be constructed in two or more layers as directed by the Engineer in the Drawings.
 - 2. Gradation 1: Maximum 3-inches, not to exceed 5 inch uncompacted lifts
 - 3. Gradation 2: Maximum 1-1/2-inches, not to exceed 3.5 inches uncompacted lifts
 - 4. Gradation 3: Maximum 3/4-inches, not to exceed 1.5 inches uncompacted lifts

PART 3 EXECUTION

3.01 CONSTRUCTION REQUIREMENTS

- A. Placing and Mixing:
 - 1. Place aggregate in layers to produce a maximum 3 inches of compacted thickness.
 - 2. With vibratory compaction, place to produce maximum 6 inches of compacted thickness.
 - 3. Deposit only the amount of aggregate that is intended to be spread and compacted during the same day.
 - 4. Add water as may be required during mixing to produce proper compaction.
 - 5. The following instructions are taken directly from the City Specifications; see the City specifications for definitions or explanations.
 - a. When directed by the Engineer, the Contractor shall spread a layer of Gradation No. 3 (3/4" maximum size) crushed aggregate over the subbase (if present) before the application of the Gradation No. 1 (3" maximum size) crushed aggregate. It shall not be necessary to compact the lift of Gradation No. 3 crushed aggregate when placed directly on the subbase.
 - b. Top dressing and final finishing of the crushed aggregate base course shall be performed with Gradation No. 3 (3/4" maximum size) crushed aggregate after compaction of the surfaces of the base is complete, and after depressions and high points in the crown and along the gutter edges have been brought to grade. This material shall also be water sprinkled and compacted. The maximum compacted depth of this material shall be one (1) inch.

- B. Spreading and Compacting:
 - 1. Mix aggregate uniformly to maintain proper gradation.
 - 2. Spread and compact each layer to the required cross section and density prior to placing a succeeding layer.
 - 3. Compact each layer to 100 percent of Standard Proctor Density.

- C. Tolerances: Construct each course to within 0.05 foot of the planned grades and staked elevations at all locations.

3.02 PROTECTION

- A. Place initial surface course or otherwise protect the in-place aggregate base within 72 hours after placement.

- B. Remove and replace any portion of the material that becomes contaminated after placement.

END OF SECTION

SECTION 32 12 18

HOT MIX ASPHALT PAVEMENT (WisDOT 460)

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Hot mix asphaltic pavement.

1.02 REFERENCES

- A. WisDOT - Standard Specifications for Highway and Structure Construction:
 - 1. 211 - Preparing the Foundation
 - 2. 305 - Dense Graded Base
 - 3. 350 - Subbase
 - 4. 450 - General Requirements for Asphaltic Pavements
 - 5. 455 - Asphaltic Materials
 - 6. 460 - Hot Mix Asphalt Pavement

1.03 SUBMITTALS

- A. Submittals in accordance with Section 01 33 00 - including:
 - 1. Asphalt mix design in accordance with WisDOT Section 460.2.7.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Asphaltic surface: Type E-1 per WisDOT 460.2.
- B. Asphaltic material: PG 58-28.

PART 3 EXECUTION

3.01 APPLICATION

- A. Construct pavement conforming to the general provisions of WisDOT 450.3.
- B. Compaction of the pavement shall be in accordance with the HMA Pavement Density Maximum Density Method of WisDOT 460.3.3.

3.02 ADJUSTING

- A. Adjust valve boxes, manholes, cleanouts or other appurtenances to new surface elevation. Engineer shall approve method of adjustment.

END OF SECTION

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SECTION 32 12 50

SAW CUTTING PAVEMENT (WisDOT 690)

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes partial-depth or full-depth sawing of old, existing concrete or asphaltic pavements, curb and gutter, driveways, sidewalks and similar work as shown on the Drawings or as directed by Engineer.

PART 2 PRODUCTS

2.01 EQUIPMENT

- A. Use diamond blades for full depth saw cuts of concrete pavement.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Sawing Existing Pavement:
 - 1. Saw cut to be straight.
 - 2. Minimum depth is 2 inches.
 - 3. Remaining surface to be generally vertical for full depth.
- B. Sawing Concrete Pavement - Full Depth:
 - 1. Remove saw cutting sludge after each cut.
 - 2. Minimize sludge flow into live traffic lane.
 - 3. Clean traffic control devices of sludge daily.
 - 4. Dispose of sludge where approved by Engineer.
 - 5. Maximum cut into existing pavement is 12 inches.

END OF SECTION

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SECTION 32 17 23
PAVEMENT MARKING

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes application of permanent markings on pavement surfaces.

1.02 REFERENCES

- A. WisDOT - Standard Specifications for Highway and Structure Construction:
 - 1. 646 - Pavement Markings
 - 2. 647 - Special Pavement Markings
- B. Wisconsin Manual on Uniform Traffic Control Devices

1.03 SCHEDULE

- A. Apply paint to bituminous surface not less than 7 days after placement.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Paint: WisDOT 646.2.
- B. Glass Beads: WisDOT 646.2.
- C. Epoxy: WisDOT 646.2.

2.02 EQUIPMENT

- A. Self-propelled, pressure type applicator, subject to approval.

PART 3 EXECUTION

3.01 SURFACE PREPARATION

- A. Prepare the surface in accordance with WisDOT 646.3.

3.02 APPLICATION

- A. Apply pavement markings in accordance with WisDOT 646.3 and WisDOT 647.3 for special pavement markings.

END OF SECTION

Marking the Stall

All spaces must be designated by an approved accessible parking sign. Signs cannot be less than 12" x 18" in size. There should be a minimum of 48" between the bottom of the sign and the ground. Local sign companies have the required sign in stock.

Painting the accessible symbol on the pavement is not an acceptable replacement for approved parking signs.

Paint cross-hatching on the access aisles so people don't park in these areas.

Accessible Route

The route that a person with a disability takes to get from the parking stall to the building is called the *accessible route*.

The accessible route must be 3-foot wide. Special requirements will apply to curb ramp, ramps and sidewalks with curb ramp built into them. Contact Building Inspection, 266-4551.

Accessible ramps must be located adjacent to the access aisle, *not* in the parking stall.

Accessible parking stalls shall be located on the shortest route possible to the accessible entrance.

Note: If you are designing a parking lot with angled stalls, contact Building Inspection at 266-4551.

Changing Your Parking Lot

Restriping an existing parking lot, as is, does not require a permit.

Changing parking stalls or drive aisle width or location in your parking lot may require a permit.

Call Zoning staff at 266-4551 if you have questions about your proposed parking lot changes.

If a permit is required, you will need the application packet called *Getting Your Parking Lot Approved*. The packet contains a checklist and instructions on how and what to submit when applying for a permit. Zoning can send you a packet or you can get one at the Zoning Counter.

Allow a minimum of 7 working days for review of your plans before a permit can be issued.

Submit your plans and application at the Zoning Counter.

Madison Municipal Building
Building Inspection
215 Martin Luther King Jr. Boulevard
Suite LL-100
Madison, Wisconsin 53703

Accessible Parking Stalls



VAN ACCESSIBLE

Meeting requirements of the *Americans with Disabilities Act* in the City of Madison

4/8/2010

The City of Madison accepts the size and design standards of ANSI A117.1 for barrier-free parking stalls.

Here are guidelines to use in providing usable accessible parking for everything except multi-family dwellings.

Number of Stalls

Total Parking Stalls in Lot	Minimum Stalls Required*	
	Accessible	Van Accessible
1-25	1	1
26-50	2	1
51-75	3	1
76-100	4	1
101-150	5	1
151-200	6	1
201-300	7	2
301-400	8	2
401-500	9	2
501-1000	2% of total (20 +1 for each 100 over 1000)	2-4
1000 and over	1000	4+

* The van accessible stall is included in the total stalls required.

For multi-family dwellings, 2% of the total number of each type of parking stall shall be accessible. One out of every six stalls or fraction thereof shall be van accessible.

Slope

Parking stalls and access aisles must be level. This means a slope no greater than 1:48 in all directions.

Access ramps and routes should not exceed a 1:12 (8.34%) slope.



Stall Width

There are 2 types of stalls, van accessible and accessible. Each stall must be 8 feet wide. An 8-foot wide access aisle must be next to one stall in every six. This stall must be marked *Van Accessible* as shown on the front cover.

Two adjacent 8-foot wide stalls may share the same 8-foot wide access aisle.

If the lot has 1 to 12 accessible stalls, the first 2 stalls can share an 8-foot wide access aisle. The access aisle for remaining stalls can be 5-foot wide.

If the lot has more than 6 accessible stalls, there must be a 8-foot wide access aisle for every sixth stall.

Van accessible stalls need a vertical clearance height of at least 8 feet 2 inches.

See the illustrations for examples of the parking stall layouts described.

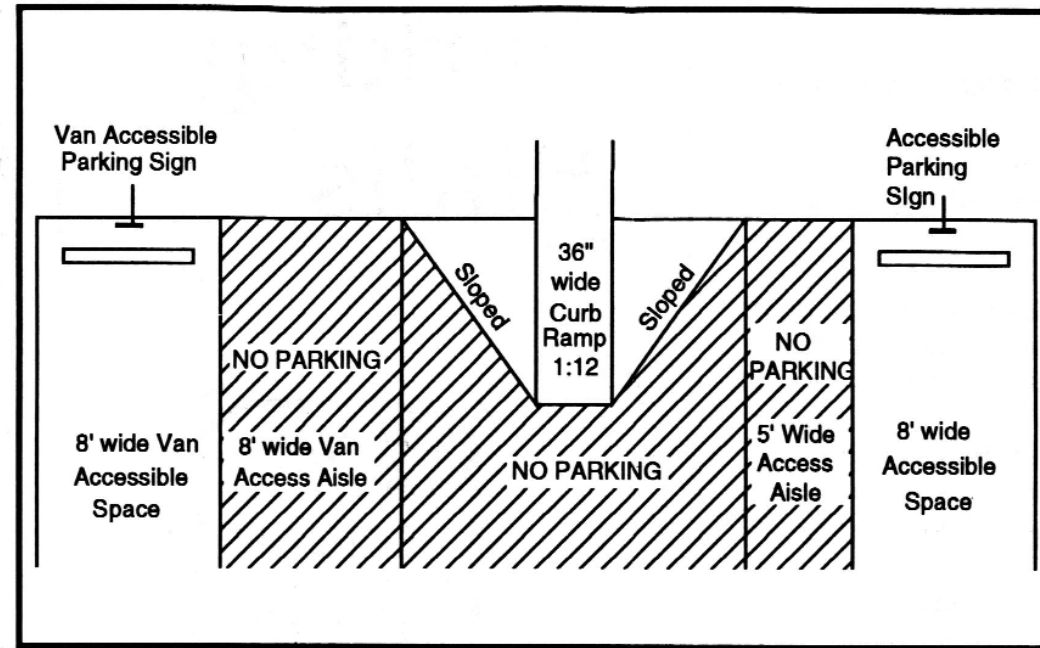


Need Help?

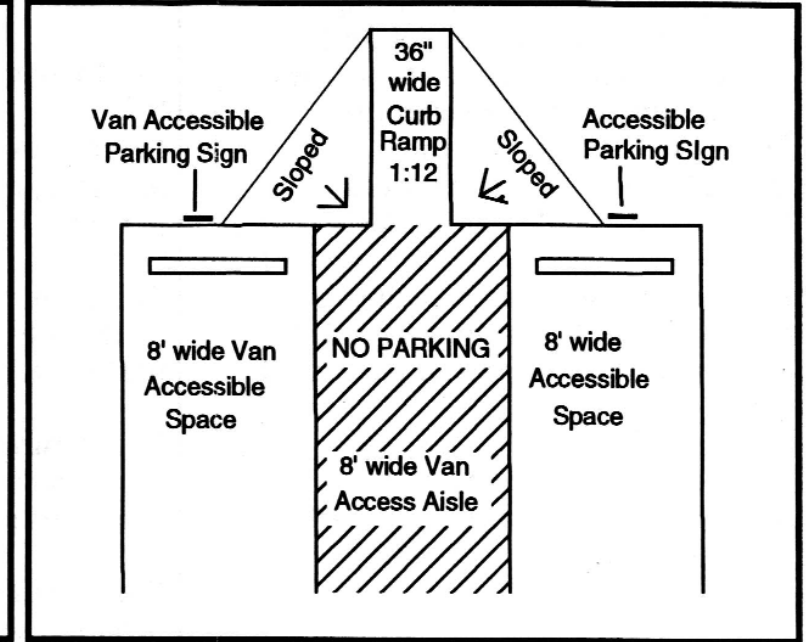
Give us a call at 266-4551 and ask for help with accessible parking lots.

Accessible Parking Stall Configurations

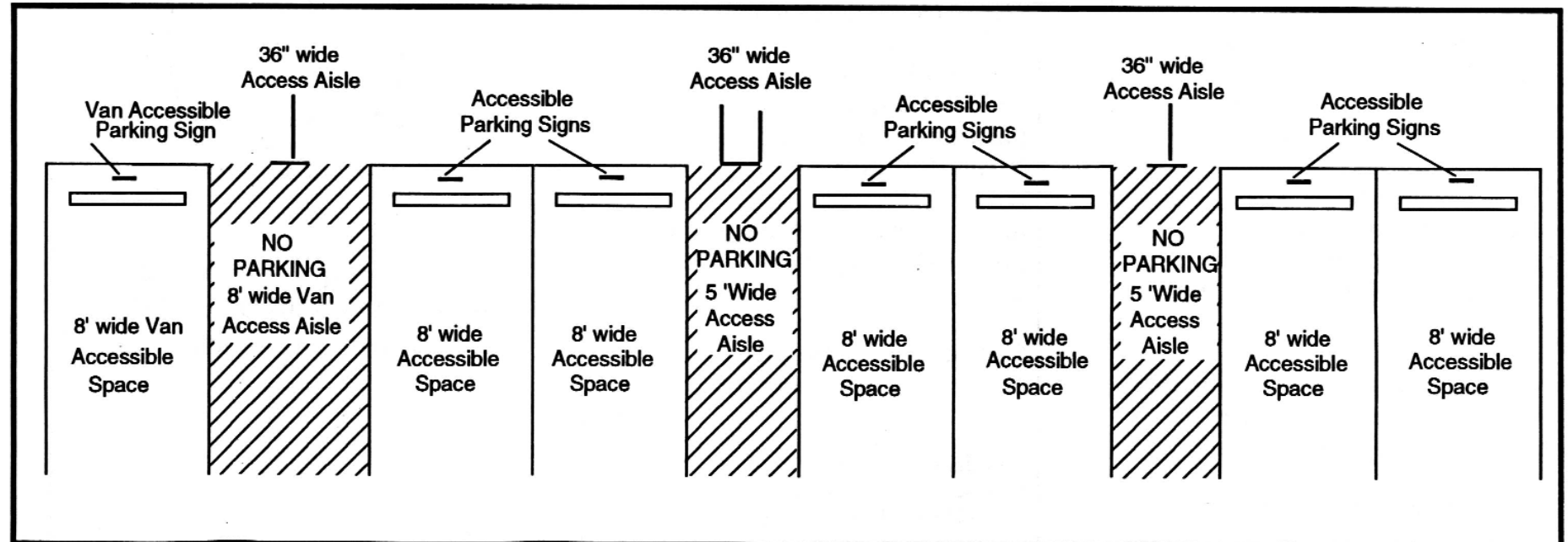
Stall design with built-up curb ramp



Stalls with curb ramp outside of accessible parking



Multi-stall design



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SECTION 32 18 40

CONCRETE SIDEWALKS, SAFETY ISLANDS AND STEPS (WisDOT 602)

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes construction of concrete walkway.
- B. Related Sections:
 - 1. Section 31 22 10 - Site Grading
 - 2. Section 31 23 10 - Excavation and Embankment
 - 3. Section 32 11 26 - Crushed Aggregate Base Course

1.02 REFERENCES

- A. WisDOT - Standard Specifications for Highway and Structure Construction:
 - 1. 602 - Concrete Sidewalks, Loading Zones, Safety Islands and Steps
- B. City of Madison Public Works
 - 1. STANDARD SPECIFICATIONS FOR PUBLIC WORKS CONSTRUCTION
 - 2. <http://www.cityofmadison.com/business/pw/specs.cfm>

PART 2 PRODUCTS

2.01 MATERIALS

- A. All materials shall be in accordance with the respective WisDOT specifications as follows:
 - 1. Granular Materials: WisDOT 209.
 - 2. Expansion Joint Filler: WisDOT 415.2.3.
 - 3. Concrete Masonry: WisDOT 501.
 - 4. Reinforcement: WisDOT 505.

2.02 ACCESSORIES

- A. All materials shall be in accordance with the respective WisDOT specifications as follows:
 - 1. Curing Materials: WisDOT 415.2.4.
- B. Forms:
 - 1. Forms shall be of wood or metal with a smooth contact face.
 - 2. Minimum form height shall be that of the proposed concrete thickness.

2.03 MIXTURE PROPORTIONS

- A. Concrete shall be Grade A, A-WR, A-FA or A-IP.
- B. Concrete shall be air entrained to within 4.5 to 7.5 percent.

PART 3 EXECUTION

3.01 PREPARATION

- A. Foundation:
 - 1. Excavate, shape and compact subgrade soils as shown on the Drawings.

2. Remove unstable subgrade soils as directed.
 3. Provide and compact granular materials in accordance with the Drawings or as directed.
- B. Forms:
1. Coat the contact face with form treating material.
 2. Stake sufficiently to prevent any movement.
 3. Sidewalk forms shall be of steel construction and have a vertical height of at least five (5) inches. Wooden forms may be used only with the Engineer's approval on short radius curves and in special cases where accessibility is limited.
 4. All forms shall be free of hardened concrete, mud, dirt, and debris, and shall be free of bends and twists which would make their use unacceptable on the project.
 5. All forms shall be oiled, to the satisfaction of the Engineer, before depositing or placing concrete in them.
 6. When concrete sidewalk is constructed on a curve, flexible forms shall be used for all curves having a radius of two hundred (200) linear feet or less.
 7. The foundation and forms, and reinforcement when required, shall be checked and approved by the Engineer before the concrete is placed.

3.02 CONCRETE INSTALLATION

- A. Concrete sidewalks shall be five (5) inches in thickness, five (5) feet in width, constructed of nonreinforced concrete, with a transverse slope of 1.50%, unless otherwise noted on the plans or in the special provisions of the contract, or unless otherwise directed by the Engineer.
- B. Where directed by the Engineer, all existing sidewalk in the terrace between the curb and public sidewalk that is removed during the construction of new curb and gutter, shall be replaced in the same location and to the same dimensions as was true of original terrace walks.
- C. All concrete driveways, concrete sidewalk at commercial driveways, curb ramps and where otherwise designed by the Engineer shall be seven (7) inches and constructed of nonreinforced concrete unless otherwise noted on the plans or in the Special Provisions of the contract. Expansion joints shall conform to the requirements of Subsection 303.2(d) of City specs. Contraction joint shall conform to the requirements of Subsection 303.2(d) of City specs, except that the Contractor may cut diagonal joints in order to control the cracking of the concrete in the curved areas of commercial drives.
- D. Placing and Finishing:
1. Thoroughly wet foundation and forms prior to concrete placement.
 2. Place and consolidate concrete to fill all voids.
 3. Strike off to the required grade.
 4. Float surface smooth.
 5. Edge all joints.
 6. Lightly brush surface to a uniform texture.
 7. Maintain forms in-place for a minimum 12 hours after concrete placement.
- E. Tolerances:
1. Surface: plus or minus 3/16-inch from a 10-foot straight edge.
 2. Edges: plus or minus 1/2 inch from the staked location and grade.
- F. Joint Construction
1. Divide walk into uniform sized panels and outline with contraction or expansion joints.
 2. Provide square panels with maximum 36 square feet of area.
 3. Joints shall be:
 - a. Vertical and straight.
 - b. Parallel to or at right angles to the edge of the walk.
 - c. Aligned with like joints in adjoining work.
 - d. 1/8 inch wide for contraction joint.
 - e. 1/2 inch wide for expansion joint.
 4. Round all joints and edges with a 1/4-inch radius edging tool.
 5. Extend contraction joints to at least 1/3 of the thickness of the walk.

6. Extend expansion joints to the full thickness of the walk.
7. Place 1/2 inch preformed joint filler adjacent to all fixed objects.
8. Unless otherwise directed by the Engineer, the sidewalk shall be cut into blocks five (5) feet in length.
9. Transverse joints shall be constructed at right angles to the center line of the sidewalk, and longitudinal joints shall be constructed parallel to the center line of the walk, unless otherwise provided. The joints shall be constructed as laid out in the field by the Engineer. Whenever the entire area between the back of the curb and the right-of-way or lot line is to be covered with concrete sidewalk and when a permanent structure is located within such area or on the right-of-way or lot line, such sidewalk shall be constructed in alternate sections extending from the back of the curb to the permanent structure, and such sections shall not exceed twelve (12) linear feet of sidewalk length. When the alternate sections placed in the first operation have been cured as specified, the intervening sections shall be placed to complete the walk.
10. When the sidewalk is constructed in partial width slabs, transverse joints in adjacent slabs shall be placed in line with like joints in the previously constructed slabs. In the case of widening existing sidewalks, transverse joints shall be placed in line with like joints in the existing sidewalk.
11. Insofar as feasible large sidewalk slabs shall be divided into sections not less than five (5) feet nor more than twelve (12) feet in any dimension. The unit areas shall be produced by use of metal slab division forms extending to the full depth of the concrete, or, when so approved by the Engineer, by contraction joints, as defined hereinafter.
12. Whenever the concrete walk abuts on or is adjacent to buildings, walls, ramps, steps, castings, sidewalks, or other structures, one-half (1/2) inch expansion joint filler shall be placed. Whenever the walk abuts on or is adjacent to the curb, one (1) inch expansion joint filler shall be placed between the curb and the sidewalk. Sidewalk ramps and driveways shall have one-half (1/2) inch expansion joint filler installed between the sidewalk ramp or driveway and the City sidewalk, and one (1) inch expansion joint filler installed between the sidewalk ramp or driveway and the curb. At intervals at approximately fifty (50) feet on continuous sidewalk construction and at the ends of all radii, one-half (1/2) inch expansion joint filler shall be placed. Where the sidewalk extends from buildings to curbs, expansion joints shall be located not more than thirty (30) feet apart.
13. Joints shall not be sealed, unless otherwise specified.
14. Where the concrete walk abuts the buildings, walls, other pavement or as directed by the engineer in placing exposed aggregate sidewalk the material shall be left 1/2" below the surface and shall extend to the bottom of the concrete. A removable plastic strip, flush with the surface of the concrete, shall be placed over the foam or sponge rubber material while the concrete is being poured and cured.
15. The Contractor shall place a troweled joint at standard back edge of sidewalk where sidewalk extends to meet buildings.
16. Expansion joint material shall be non-staining and compatible with the sealant and of resilient nature such as closed cell resilient foam or sponge rubber. Materials impregnated with oil, bitumen or similar materials shall not be used.

G. Sealant

1. Joints shall not be sealed, unless otherwise specified.
2. All joints along buildings and exposed aggregate concrete joints as directed by the engineer shall be sealed. The sealants shall be the gun grade Sonolastic NPI urethane as manufactured by Sonneborn, or an approved equal. The color shall match the adjoining work and shall be approved by the Engineer. Primers shall be used only where the manufacturer recommends.
3. Modifications of a sealant by the addition of liquids or powders to alter the flow properties SHALL NOT be permitted.
4. A sealant SHALL NOT be used if the date of manufacture indicates that the sealant is more than twelve (12) months old. Where a lesser period is recommended by the manufacturer, the lesser period shall govern.
5. All joint surfaces shall be dry and thoroughly clean. The Contractor shall remove all loose particles, dirt, paint, foreign matter, or curing compound by means not injurious to the materials to be sealed.
6. Concrete shall be cured (seven (7) days minimum) and dry before sealant application.
7. No sealant shall be applied to a joint at temperatures under 40°F

- H. Curing and Protection:
 - 1. Provide curing for minimum 72 hour period after finishing.
 - 2. Apply curing media within 30 minutes after side forms are removed.
 - 3. During cold weather, protect concrete from frost damage.
 - 4. Blanket Curing Method:
 - a. Cover concrete with waterproof plastic after finishing.
 - b. Envelop concrete and prevent water vapor loss.
 - c. After curing, treat exposed surfaces with 2 coats of treating oil totaling 0.06 gallons/square yard coverage.
 - 5. Membrane and Extreme Service Curing Method:
 - a. Coat all exposed surfaces with curing compound within 1 hour after finishing.
 - b. Apply uniformly at a rate of 1 gallon per 150 square feet of surface area with an approved airless sprayer.
 - c. Mix as required to maintain a homogenous mixture.
 - d. Respray as directed to provide proper coating.

3.03 BACKFILLING

- A. Backfill areas adjacent to the walk with excavated materials.
- B. Grade and finish adjacent areas in accordance with the proposed typical section.

END OF SECTION

SECTION 32 91 00

TOPSOIL PLACEMENT

PART 1 GENERAL

1.01 SUMMARY

- A. Provide the following:
 - 1. Subsoil preparation.
 - 2. Soil composition.
 - 3. Placement of topsoil.
 - 4. Soils Report:
 - a. Existing topsoil.
 - b. Amended topsoil.

- B. Related Sections:
 - 1. Section 31 22 10 - Site Grading
 - 2. Section 31 22 20 - Earthwork for Building Sites
 - 3. Section 31 25 10 - Temporary Erosion Control
 - 4. Section 32 92 00 - Lawns and Grasses
 - 5. Section 32 92 12 - Turf Establishment
 - 6. Section 32 93 00 - Exterior Plants

1.02 SUBMITTALS

- A. Refer to Section 01 33 00.

- B. Quality Assurance/Control Submittals:
 - 1. Test Reports:
 - a. Provide following qualification tests and information for topsoil either imported or prepared from on-site material.
 - b. Submittal to be prepared by independent testing lab, state university soils science department, or other recognized soil physics testing laboratory to indicate that proposed material complies with specified requirements.
 - 1) Mechanical gradation analysis, ASTM D422.
 - 2) Materials qualification test.
 - 3) Recommendation for type and application rate of amendments needed to adjust topsoil to required nutrient levels for each proposed landscape operation, including, seeding, sodding, planting.

- C. Delay resulting from rejected submittals is Contractor's responsibility and will not be considered as basis for subsequent delay claim.

PART 2 PRODUCTS

2.01 SOILS MATERIALS

- A. Topsoil for Irrigated Areas:
 - 1. Material consisting of fertile, friable, fine sandy loam, uniform in composition.
 - 2. Capable of sustaining vigorous plant growth.
 - 3. Free of subsoil, stones, lumps, clods of hard earth, plants, plant roots, sticks, noxious weeds, slag, cinders, demolition debris or other extraneous matter over 1 inch in largest dimension.

4. Conforming to following chemical and physical attributes:
 - a. Allowable limits of topsoil mechanical analysis based on percent of dry weight of samples:

	Minimum Percent	Maximum Percent
No. 4 Sieve	100	---
No. 10 Sieve	80	90
No. 200 Sieve	15	25
Silt (particles 0.005-0.05 mm) ⁽¹⁾	10	20
Clay (particles < 0.005 mm) ⁽¹⁾	5	10

⁽¹⁾ Silt-Clay ratio: 2:1 or less

- B. Topsoil for Non-Irrigated Areas:
 1. Material consisting of fertile, friable, loam, uniform in composition.
 2. Capable of sustaining vigorous plant growth.
 3. Free of subsoil, stones, lumps, clods of hard earth, plants, plant roots, sticks, noxious weeds, slag, cinders, demolition debris or other extraneous matter over 1 inch in largest dimension.
 4. Conforming to following chemical and physical attributes:
 - a. Allowable limits of topsoil mechanical analysis based on percent of dry weight of samples:

	Minimum Percent	Maximum Percent
No. 4 Sieve	100	---
No. 10 Sieve	80	90
No. 200 Sieve	40	60
Silt (particles 0.005-0.05 mm) ⁽¹⁾	10	40
Clay (particles < 0.005 mm) ⁽¹⁾	5	20

⁽¹⁾ Silt-Clay ratio: 2:1 or less

- b. Allowable maximum limits of mechanical analysis of sand and gravel fraction based on dry weight of total fraction sample:

	Minimum Percent	Maximum Percent
Very Fine Sand (< 0.15 mm)	0	5
Fine Sand (0.15-0.25 mm)	0	20
Coarse Sand (0.25-1.00 mm)	60	100
Very Coarse Sand (1.00-2.00 mm)	0	10
Gravel (> 2.00 mm)	0	5

⁽¹⁾ Silt-Clay ratio: 2:1 or less

- C. Final Topsoil Nutrient Values After Amendment (if required):
 1. Organic Matter: 4.0 percent minimum, 10.0 percent maximum.
 2. Extractable Phosphorus: 25 parts per million by weight minimum.
 3. Exchangeable Potassium: 125 parts per million by weight minimum.
 4. pH: 5.5 minimum, 7.0 maximum, 6-6.5 preferred.
 5. Soluble Salts: 3 mmhos/cm maximum.
 6. Lead Content: Less than 400 parts per million.
- D. On-site Base Mixture: To extent available, and if modified to meet requirements, select on-site material may be used as base mixture for preparation of topsoil.
- E. Import supplemental materials as necessary to satisfy specified topsoil requirements.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine areas and conditions under which topsoil preparation and placement are to be performed.
 1. Verify final subgrade has been established.

2. Verify topsoil meets requirements of this Section and soils testing lab report identifying required amendments is completed.
 3. Verify compaction requirements in Section 31 22 20 have not been exceeded.
- B. Discrepancies:
1. Immediately notify Engineer.
 2. Do not proceed in areas of discrepancy until fully resolved.
 3. Commencement of topsoil placement signifies acceptance of surface conditions. Do not proceed until unsatisfactory conditions have been corrected.

3.02 STORAGE/STOCKPILE

- A. Stockpile location: As directed by Engineer.
- B. Stockpile topsoil/planter soil component materials in such a manner that natural drainage is not obstructed and that no off-site sediment transmission will result.
- C. Place stockpiles with maximum 2:1 sideslopes.
- D. Construct a temporary perimeter dike with gravel outlet, or fabric sediment barrier around topsoil component stockpiles.
- E. Provide temporary seeding of stockpiles within 2 days of formation of stockpile.
- F. Place mulch per Section 32 92 00.

3.03 PREPARATION AND PLACEMENT

- A. Topsoil Placement Preparation:
 1. Provide erosion and sediment control items such as diversions, berms, dikes, waterways, sediment basins, as specified or as needed.
 2. Remove debris from areas to be topsoiled, including excess concrete and concrete spoils adjacent to back of curb locations, and excavation spoils.
 3. Eliminate uneven areas and low spots; maintain indicated grades and make changes in grade gradual by blending slopes into more level areas.
 4. After the areas to be topsoiled have been brought to inferred subgrade elevations, and immediately prior to dumping and spreading approved topsoil, loosen and condition the subgrade by power rototilling to a minimum depth of 8 inches to ensure removal of gross subgrade debris and bonding of the topsoil and subsoil; no substitute operations acceptable.
 5. After rototilling and prior to placement of the topsoil, scalp or otherwise remove all visible stones, clods of hard earth, roots, plant parts, stumps, sticks, weeds, demolition or construction debris, or any other extraneous non-earth material in excess of 1 inch in size.
- B. Topsoil Placement:
 1. Do not place topsoil more than 2 weeks prior to planned commencement of Project planting operations.
 2. Do not place wet or muddy topsoil, when subgrade is excessively wet, or in condition that may otherwise be detrimental to subsequent Work.
 3. Uniformly place approved topsoil material where indicated to minimum compacted depth of 6 inches on 3:1 on steeper slopes, minimum of 8 inches on flatter slopes, and at greater depths as indicated on Drawings.
 4. Topsoil in excess of 8 inches is acceptable and desirable if excess is available.
 5. Correct irregularities in surface resulting from placement or other operations to prevent formation of depressions or water pockets.
 6. Avoid excessive compaction of topsoil; refer to limits in Section 31 22 20.
 7. Protect topsoiled areas from weather based erosion until planting operations commence.

END OF SECTION

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SECTION 32 92 00
LAWNS AND GRASSES

PART 1 GENERAL

1.01 SUMMARY

- A. Provide the following:
 - 1. Seeding.
 - 2. Plugging.
 - 3. Sprigging.
 - 4. Native Plantings: Meadow grasses and wildflowers.
 - 5. Lawn renovation.
 - 6. Accessories including, but not limited to:
 - a. Weed barrier.
 - b. Landscape rock.
 - c. Mulch.
 - d. Landscape woodwork.
 - e. Precast concrete splash blocks.

- B. Perform the following:
 - 1. Finish grading. (see Section 31 22 20)
 - 2. Preparation of topsoil.
 - 3. Initial maintenance.

- C. Related Sections:
 - 1. Section 31 22 10 - Site Grading
 - 2. Section 31 22 20 - Earthwork for Building Sites
 - 3. Section 31 25 10 - Temporary Erosion Control

1.02 REFERENCES

- A. ASTM:
 - 1. C602 - Standard for Agricultural Liming Materials
 - 2. D5268 - Standard for Topsoil Used for Landscaping Purposes

- B. TPI - Guideline Specifications to Turfgrass Sodding

1.03 SUBMITTALS

- A. Refer to Section 01 33 00.

- B. Product Data:
 - 1. For each type of product indicated.

- C. Certification of Grass Seed: From seed vendor for each grass seed, including:
 - 1. Botanical and common name and percentage by weight of each species and variety.
 - 2. Percentage of purity, germination, and weed seed.
 - 3. Year of production and date of packaging.
 - 4. Local source of seed mixture, including name and telephone number of supplier.

- D. Qualification Data: For landscape installer.

- E. Maintenance Instructions: Recommended procedures to be established by Owner for maintenance of lawns during a calendar year. Submit before expiration of required maintenance periods.

1.04 QUALITY ASSURANCE

- A. Qualifications:
 - 1. Installer: A qualified landscape installer whose work has resulted in successful lawn establishment.
 - 2. Field Supervisor: Installer to maintain an experienced full-time supervisor on Site when planting is in progress.
 - 3. Soil Testing Laboratory: An independent laboratory recognized by the State DOA.
- B. Topsoil Analysis:
 - 1. Furnish soil analysis by qualified soil-testing laboratory stating percentages of organic matter, gradation of sand, silt and clay content; cation exchange capacity; deleterious material; pH; and mineral and plant-nutrient content of topsoil.
 - 2. Report suitability of topsoil for plant growth. State recommended quantities of nitrogen, phosphorus, and potash nutrients and soil amendments to be added to produce a satisfactory topsoil.
- C. Substitutions: Do not make substitutions. If specified landscape material is not obtainable, submit proof of non-availability to Engineer, together with proposal for use of equivalent material.
- D. Preinstallation Meetings: If requested, the installer shall meet with Engineer and landscaping supplier's representative prior to the start of installation.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Seed: Deliver in original sealed, labeled, and undamaged containers.

1.06 PROJECT CONDITIONS

- A. Existing Conditions:
 - 1. Inspect the Project prior to installation;
 - 2. If conditions do not meet approval, notify Engineer.
 - 3. Proceeding without notification implies acceptance of conditions.
- B. Excavation: When conditions detrimental to plant growth are encountered, such as rubble fill, adverse drainage conditions, or obstructions, notify Engineer before planting.

1.07 SEQUENCING AND SCHEDULING

- A. Planting Time: Proceed with, and complete landscape work as rapidly as portions of site become available, working within seasonal limitations for each kind of landscape work required:
 - 1. Plant or install materials during normal planting seasons for each type of plant material required.
 - 2. Correlate planting with specified maintenance periods to provide maintenance from date of Substantial Completion.

1.08 WARRANTY

- A. Warranty for a period of 1 year after date of substantial completion against defects, including death and unsatisfactory growth, except for defects resulting from neglect by Owner, abuse or damage by others, or unusual phenomena or incidents which are beyond landscape installer's control.
- B. Replacement: Remove and replace lawns and grasses found to be dead or in unhealthy condition during warranty period.

1.09 LAWN MAINTENANCE

- A. Begin maintenance immediately after each area is planted and continue until acceptable lawn is established, but for not less than the following periods:
 - 1. Seeded Lawns:
 - a. 60 days from date of Substantial Completion.
 - b. When full maintenance period has not elapsed before end of planting season, or if lawn is not fully established, continue maintenance during next planting season.
 - 2. Sodded Lawns: 30 days from date of Substantial Completion.
 - 3. Plugged Lawns: 30 days from date of Substantial Completion.
 - 4. Sprigged Lawns: 30 days from date of Substantial Completion.
- B. Maintain and establish lawn by watering, fertilizing, weeding, mowing, trimming, replanting, and other operations.
 - 1. Roll, regrade, and replant bare or eroded areas and remulch to produce a uniformly smooth lawn.
 - 2. In areas where mulch has been disturbed by wind or maintenance operations, add new mulch.
 - 3. Anchor as required to prevent displacement.
- C. Watering:
 - 1. Provide and maintain temporary piping, hoses, and lawn-watering equipment to convey water from sources and to keep lawn uniformly moist to a depth of 4 inches.
 - 2. Schedule watering to prevent wilting, puddling, erosion, and displacement of seed or mulch.
 - 3. Lay out temporary watering system to avoid walking over muddy or newly planted areas.
 - 4. Water lawn at a minimum rate of 1 inch per week.
 - 5. Provide soil moisture gage and monitor to determine soil water retention.
 - 6. Water appropriately. Do not overwater.
- D. Mowing:
 - 1. Begin as soon as top growth is tall enough to cut.
 - 2. Repeat mowing to maintain specified height without cutting more than 40 percent of grass height.
 - 3. Remove no more than 40 percent of grass-leaf growth in initial or subsequent mowings.
 - 4. Do not delay mowing until grass blades bend over and become matted.
 - 5. Do not mow when grass is wet.
 - 6. Schedule initial and subsequent mowings to maintain the following grass height:
 - a. Bentgrass: 1/2 inch high or less.
 - b. Bermudagrass: 1/2 to 1 inch high.
 - c. Carpetgrass, centipedegrass, perennial ryegrass, and zoysiagrass: 1 to 2 inches high.
 - d. Kentucky bluegrass, buffalograss, annual ryegrass, and chewing red fescue: 2-1/2 to 4 inches high.
 - e. Bahiagrass, turf-type tall fescue, and St. Augustine grass: 2 to 3 inches high.
- E. Lawn Postfertilization:
 - 1. Apply fertilizer after initial mowing and when grass is dry.
 - 2. Use fertilizer that will provide actual nitrogen of at least 1 pound per 1000 square feet to lawn area.

PART 2 PRODUCTS

2.01 SOIL PREPARATION MATERIALS

- A. Topsoil:
 - 1. Native topsoil stockpiled on site.
 - 2. ASTM D5268, pH range of 5.5 to 7.
 - 3. Fertile, friable natural sandy loam, without admixture of subsoil material, obtained not more than 2 or 3 feet from top of deposit, from well-drained arable site.
 - 4. Free from heavy alkaline soil, coarse sand, stones larger than 2 inches in diameter, lumps, sticks, other foreign matter.

5. Supplement with imported or manufactured topsoil from off-site sources when quantities are insufficient.
 - a. Obtain topsoil displaced from naturally well-drained construction or mining sites where topsoil occurs at least 4 inches deep.
 - b. Do not obtain from agricultural land, bogs or marshes.

2.02 INORGANIC SOIL AMENDMENTS

- A. Lime:
 1. ASTM C602, agricultural limestone containing a minimum 80 percent calcium carbonate equivalent and as follows:
 - a. Class: Class T, with a minimum 99 percent passing through No. 8 sieve and a minimum 75 percent passing through No. 60 sieve.
 - b. Class: Class O, with a minimum 95 percent passing through No. 8 sieve and a minimum 55 percent passing through No. 60 sieve.
 2. Provide lime in form of dolomitic limestone.
- B. Sulfur:
 1. Granular, biodegradable, containing a minimum of 90 percent sulfur, with a minimum 99 percent passing through No. 6 sieve and a maximum 10 percent passing through No. 40 sieve.
 2. Iron Sulfate: Granulated ferrous sulfate containing a minimum of 20 percent iron and 10 percent sulfur.
 3. Aluminum Sulfate: Commercial grade, unadulterated.
- C. Perlite: Horticultural perlite, soil amendment grade.
- D. Agricultural or Recycled Gypsum: Finely ground, containing a minimum of 90 percent calcium sulfate. Free of contaminants.
- E. Sand: Clean, washed, natural or manufactured, free of toxic materials.
- F. Diatomaceous Earth: Calcined, diatomaceous earth, 90 percent silica, with approximately 140 percent water absorption capacity by weight.
- G. Zeolites: Mineral clinoptilolite with at least 60 percent water absorption by weight.

2.03 ORGANIC SOIL AMENDMENTS

- A. Compost:
 1. Well-composted, stable, and weed-free organic matter.
 2. pH range of 5.5 to 8.
 3. Moisture content 35 to 55 percent by weight.
 4. 100 percent passing through 3/4-inch sieve.
 5. Soluble salt content of 5 to 10 decisiemens/m.
 6. Not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings; and as follows:
 - a. Organic Matter Content: 50 to 60 percent of dry weight.
 - b. Feedstock: Agricultural, food, or industrial residuals; biosolids; yard trimmings; or source-separated or compostable mixed solid waste.
 - c. Peat: Sphagnum peat moss, partially decomposed, finely divided or granular texture, with a pH range of 3.4 to 4.8.
- B. Wood Derivatives:
 1. Decomposed, nitrogen-treated sawdust, ground bark, or wood waste.
 2. Of uniform texture, free of chips, stones, sticks, soil, or toxic materials.
- C. Manure:
 1. Well-rotted, unleached, stable or cattle manure containing not more than 25 percent by volume of straw, sawdust, or other bedding materials.

2. Free of toxic substances, stones, sticks, soil, weed seed, and material harmful to plant growth.

2.04 PLANTING ACCESSORIES

- A. Selective Herbicides: EPA registered and approved, of type recommended by manufacturer for application.
- B. Fertilizers:
 1. Bonemeal: Commercial, raw or steamed, finely ground; a minimum of 14 percent nitrogen and 10 percent phosphoric acid.
 2. Superphosphate: Commercial, phosphate mixture, soluble; a minimum of 20 percent available phosphoric acid.
 3. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:
- C. Mulches:
 1. Straw Mulch: Provide air-dry, clean, mildew- and seed-free, salt hay or threshed straw of wheat, rye, oats, or barley.
 2. Peat Mulch: Sphagnum peat moss, partially decomposed, finely divided or granular texture, with a pH range of 3.4 to 4.8.
 3. Compost Mulch:
 - a. Well-composted, stable, and weed-free organic matter.
 - b. pH range of 5.5 to 8.
 - c. Moisture content 35 to 55 percent by weight.
 - d. 100 percent passing through 1-inch sieve; soluble salt content of 5 to 10 decisiemens/m.
 - e. Not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings; and as follows:
 - 1) Organic Matter Content: 50 to 60 percent of dry weight.
 - 2) Feedstock: Agricultural, food, or industrial residuals; biosolids; yard trimmings; or source-separated or compostable mixed solid waste.
 4. Fiber Mulch: Hardwood shredded mulch.
- D. Weed Barrier:
 1. 6-mil black polyethylene film **OR** Filtration/Separation Fabric: Water permeable filtration fabric of fiberglass or polypropylene fabric.
 2. Environmentally-responsible projects: Use cellulosic mulch.
 - a. 60 to 100 percent post-consumer recycled content shredded paper or newspaper.

2.05 EROSION-CONTROL MATERIALS

- A. Erosion-Control Blankets:
 1. Biodegradable wood excelsior, straw, or coconut-fiber mat enclosed in a photodegradable plastic mesh.
 2. Acceptable manufacturer and product:
 - a. SI Geosolutions, *LandLok Series*, applicable format.
 - b. RoLanka *Erosion Control Mats*.
 - c. Comparable products of other manufacturer.
 3. Include manufacturer's recommended steel wire staples, 6 inches long.
- B. Erosion-Control Fiber Mesh:
 1. Biodegradable twisted jute or spun-coir mesh.
 2. A minimum of 0.92 pound/square yard, with 50 to 65 percent open area.
 3. Acceptable Manufacturer and Product:
 - a. SI Geosolutions, *LandLok Series*, applicable format.
 - b. RoLanka *Erosion Control Mats*.
 - c. Comparable products of other manufacturer.
 4. Include manufacturer's recommended steel wire staples, 6 inches long.

2.06 LAWNS AND GRASSES

- A. No-Mow Lawn Seeding:
 - a. Fresh, clean, dry, new seed.
 - b. Species mix: "No Mow Lawn Mix With Annual Rye Nurse Crop": From Prairie Nursery Inc., P.O. Box 306, Westfield, WI 53964, 1-800-476-9453, www.prairienursery.com, or approved equal.

PART 3 EXECUTION

3.01 PREPARATION

- A. Planting Soil:
 - 1. Subsoil:
 - a. After subgrade is established and accepted, loosen to depth of minimum 4 inches.
 - b. Remove sticks, stones, roots and rubbish.
 - c. Smooth over to remove ridges and depressions so surface is parallel to finished grade.
 - 2. Topsoil:
 - a. Before mixing, clean topsoil of roots, plants, sods, stones, clay lumps, and other extraneous materials harmful or toxic to plant growth.
 - b. Do not turn existing vegetation over into soil being prepared for lawns.
 - 3. Soil Amendments:
 - a. Mix Lime with dry soil prior to mixing of fertilizer; prevent lime from contacting roots of acid-loving plants.
 - b. Apply phosphoric acid fertilizer (other than that constituting a portion of complete fertilizers) directly to subgrade before applying planting soil and tilling.
 - c. Mix specified soil amendments and fertilizers with topsoil at rates specified.
 - d. Delay mixing of fertilizer if planting will not follow placing of planting soil within a few days.
- B. Lawns and Grasses:
 - 1. Prepare subsoil and lawn areas just prior to actual seeding.
 - 2. Place approximately 1/2 of total amount of topsoil required.
 - 3. Work into top of loosened subgrade to create a transition layer and then place remainder of planting soil.
 - 4. Add specified soil amendments and mix thoroughly into upper 4 inches of topsoil.
 - 5. Unchanged Grades: Where lawns are to be planted in areas that have not been altered or disturbed by excavating, grading, or stripping operations, prepare soil for lawn planting as follows:
 - a. Till to a depth of not less than 6 inches.
 - b. Apply soil amendments and initial fertilizers as specified.
 - c. Remove high areas and fill in depressions.
 - d. Till soil to a homogenous mixture of fine texture, free of lumps, clods, stones, roots and other extraneous matter.
 - e. If undisturbed areas contain grass or turf, prior to preparation of unchanged areas remove existing grass, vegetation and turf.
 - 6. Allow for sod thickness in areas to be sodded.
 - 7. Apply specified commercial fertilizer at rates specified and thoroughly mix into upper 2 inches of topsoil. Delay application of fertilizer if lawn planting will not follow within a few days.
 - 8. Fine grade lawn areas to smooth, even surface with loose, uniformly fine texture.
 - 9. Roll, rake, and drag lawn areas, remove ridges and fill depressions, as required to meet finish grades.
 - 10. Limit fine grading to areas which can be planted immediately after grading.
 - 11. Moisten prepared lawn areas before planting if soil is dry.
 - a. Water thoroughly and allow surface moisture to dry before planting lawns.
 - b. Do not create a muddy soil condition.
 - 12. Restore lawn areas to specified condition, if eroded or otherwise disturbed, after fine grading and prior to planting.

3.02 LAWNS AND GRASSES

- A. Seeding New Lawns:
 - 1. Seed at time favorable to growth of grass, only at time acceptable to Engineer.
 - 2. Do not seed after rain unless ground surface thoroughly loosened.
 - 3. Do not seed when wind velocity exceeds 5 miles per hour.
 - 4. Do not use wet seed or seed that is moldy or otherwise damaged in transit or storage.
 - 5. Sow seed using a spreader or seeding machine.
 - 6. Distribute seed evenly over entire area by sowing equal quantity in 2 directions at right angles to each other.
 - 7. Sow not less than one pound of seed per 150 square feet.
 - 8. Rake seed lightly into top 1/8 inch of soil, roll lightly, and water with a fine spray.
 - 9. Protect seeded slopes against erosion.

- B. Hydroseeding New Lawns:
 - 1. Mix specified seed, fertilizer, and pulverized mulch in water, using equipment specifically designed for hydroseed application.
 - 2. Continue mixing until uniformly blended into homogenous slurry suitable for hydraulic application.
 - 3. Mix slurry with tackifier.
 - 4. Apply slurry uniformly to all areas to be seeded.
 - 5. Rate of application as required to obtain specified seed sowing rate.

3.03 MISCELLANEOUS LANDSCAPE WORK

- A. Weed Barrier: Lay film continuously over compacted subgrade prior to placing gravel. Overlap edges 4 inches at joints between sheets.

- B. Woodchip Mulch: Install to depth shown on drawings, or if not shown, 2 inches.

- C. Landscape Woodwork:
 - 1. Install wood headers and edgings where indicated.
 - 2. Anchor with wood stakes spaced not more than 3 feet on center, and driven at least 1 inch below top elevation of header or edging.
 - 3. Use 2 galvanized nails per stake to fasten headers and edging, and clinch point of each nail.

- D. Placing Erosion Mats:
 - 1. Place immediately after mulch or sod has been placed.
 - 2. Overlap adjacent strips between 2 inches and 4 inches with upstream strip placed on top.
 - 3. Secure netting with wire staples, place 2 to 3 feet apart.

- E. Placing Wood Fiber Blanket:
 - 1. Place within 24 hours after seeding.
 - 2. Overlap strip ends 10 inches minimum with upgrade strip on top.
 - 3. Bury upgrade end of each strip minimum 6 inches into soil.
 - 4. Secure with wire staples placed at maximum 3-foot spacing.

- F. Splash block: Install where indicated on Drawings.

3.04 CLEANUP, MAINTENANCE, AND PROTECTION

- A. During landscape work, keep pavements clean and work area in an orderly condition.

- B. Promptly remove soil and debris created by lawn work from paved areas.

- C. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.

- D. Erect barricades and warning signs as required to protect newly planted areas from traffic. Maintain barricades throughout maintenance period and remove after lawn is established.

- E. Remove erosion-control measures after grass establishment period.
- F. Disposal:
 - 1. Remove waste and foreign materials, including weeds, stones, soil cores, grass, vegetation, and sod and legally dispose of them off Owner's property.
 - 2. Divert from landfill disposal whenever possible.
 - 3. Topsoil containing foreign materials resulting from Contractor's operations, including oil drippings, fuel spills, shall be disposed of legally.

3.05 INSPECTION AND ACCEPTANCE

- A. Inspection: Landscape work may be inspected for acceptance in portions as agreeable to Engineer, provided each portion of work offered for inspection is complete, including maintenance.
- B. Rejected Work: When inspected landscape work does not comply with requirements, replace rejected work and continue specified maintenance until reinspected by Engineer and found to be acceptable.

END OF SECTION

SECTION 32 92 12
TURF ESTABLISHMENT

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes establishment of herbaceous ground cover on designated areas.
- B. Related Sections:
 - 1. Section 31 23 10 - Excavation and Embankment
 - 2. Section 31 25 10 - Temporary Erosion Control

1.02 REFERENCES

- A. WisDOT - Standard Specifications for Highway and Structure Construction:
 - 1. 625 - Topsoil and Salvaged Topsoil
 - 2. 627 - Mulching
 - 3. 629 - Fertilizer and Agricultural Limestone
 - 4. 630 - Seeding
 - 5. 631 - Sodding Except 631.3.5 Watering

1.03 SUBMITTALS

- A. Submit certified test report for each seed mixture.
- B. Submit certification from the grower stating the grass varieties contained in the sod.

1.04 ACCEPTANCE OF WORK

- A. Turf establishment will be accepted on a total project basis.
- B. All erosion control items must also be in place and properly maintained prior to acceptance.
- C. Once accepted, Contractor is relieved of any further maintenance or repair.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Protect seed from moisture, heat, rodents, and other damage prior to use.
- B. Deliver fertilizer in waterproof bags showing weight, chemical analysis and name of manufacturer.

1.06 SCHEDULE OF WORK

- A. Coordinate turf establishment to minimize lag time after topsoil placement.
- B. Plant seed between May 1 and September 20.
- C. Place sod between May 5 and June 10 or between August 10 and November 1.

1.07 MAINTENANCE

- A. Maintain and repair all areas until acceptance.
- B. Maintain and water sod for 30 days.

- C. Contractor shall apply water as needed in accordance with the requirements of WisDOT 631.3.5.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Topsoil: WisDOT 625.2.
- B. Mulch: WisDOT 627.
- C. Fertilizer: WisDOT 629, Type B.
- D. Seed: WisDOT 630.2.1.5.

PART 3 EXECUTION

3.01 SOIL PREPARATIONS

- A. Remove all undesirable weeds as directed.
- B. Loosen topsoil on all areas with 2:1 slopes or flatter prior to seeding or sodding.
- C. Cultivate to a depth of 3 inches using discs or other suitable equipment.
- D. Operate equipment at right angles to direction of drainage.
- E. Fill all washouts prior to cultivation.
- F. Finish all areas to provide a smooth, moist, even-textured foundation of uniform density.
- G. Approval of the Engineer is required prior to placing seed.

3.02 CONSTRUCTION REQUIREMENTS

- A. Applying Fertilizer and Conditioners:
 - 1. Apply fertilizer uniformly over the designated area using mechanical spreading devices.
 - 2. Apply at a rate of 7 pounds per 1,000 square feet.
 - 3. Apply fertilizer prior to placing sod.
 - 4. Apply fertilizer no more than 48 hours prior to seeding.
- B. Sowing Seed:
 - 1. Apply seed mixture 10 and 30 over designated areas at a rate of 1.5 pounds per 1,000 square feet for each mixture for a total rate of 3 pounds per 1,000 square feet.
 - 2. Apply seed uniformly by mechanical or hydrospreading method.
 - 3. Firm all seeded areas with a drag or cultipacker immediately after seeding and prior to mulching.

END OF SECTION

SECTION 32 93 00

EXTERIOR PLANTS

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Trees.
 - 2. Shrubs.
 - 3. Perennials.
 - 4. Plants and bulbs.
 - 5. Landscape accessories including, but not limited to:
 - a. Weed barrier.
 - b. Mulch.
 - c. Edging.
 - d. Wrapping.
 - e. Stakes and guys.

- B. Perform the following:
 - 1. Finish grading. (Section 31 22 20)
 - 2. Preparation of topsoil.
 - 3. Plant installation.
 - 4. Initial maintenance of landscape materials.
 - 5. Pruning and relocation of existing plant materials.

- C. Related Sections:
 - 1. Section 31 22 20 - Earthwork for Building Sites

1.02 REFERENCES

- A. ANSI :
 - 1. 60.1 - American Standard for Nursery Stock

- B. ASTM:
 - 1. C602 - Standard for Agricultural Liming Materials
 - 2. D5268 - Standard for Topsoil Used for Landscaping Purposes

- C. USCC - The US Composting Council

1.03 SUBMITTALS

- A. Refer to Section 01 33 00.

- B. Product Data: For each type of product indicated.

- C. Samples for Verification:
 - 1. 5 pounds of mineral mulch in labeled plastic bag.
 - 2. Edging materials, accessories.

- D. Plant and Material Certifications:
 - 1. Certificates of inspection as required by governmental authorities.
 - 2. Manufacturer's or vendor's certified analysis for soil amendments and fertilizer materials and standard products.
 - 3. Label data substantiating that plants, trees, shrubs and planting materials comply with specified requirements.

- E. Maintenance: Typed instructions recommending procedures to be established by Owner for maintenance of landscape work for 1 full year. Submit prior to expiration of required maintenance period.
- F. Material Test Reports: Provide for existing surface soil and imported topsoil.

1.04 QUALITY ASSURANCE

- A. Qualifications:
 - 1. Installer: A qualified landscape installer whose work has resulted in successful plant and tree establishment.
 - 2. Field Supervisor: Installer to maintain an experienced full-time supervisor on Site when planting is in progress.
 - 3. Soil Testing Laboratory: An independent laboratory recognized by the State DOA.
- B. Trees, Shrubs and Plants:
 - 1. Measurements:
 - a. Measure according to ANSI Z60.1 with branches and trunks or canes in their normal position.
 - b. Do not prune to obtain required sizes.
 - c. Take caliper measurements 6 inches above ground for trees up to 4-inch caliper size and 12 inches above ground for larger sizes.
 - d. Measure main body of tree or shrub for height and spread.
 - e. Do not measure branches or roots tip-to-tip.
 - 2. Labeling:
 - a. Label each tree and shrub with securely attached waterproof tag bearing legible designation of botanical and common name.
 - b. Where formal arrangements or consecutive order of trees or shrubs are shown, select stock for uniform height and spread, and label with number to assure symmetry in planting.
- C. Observation:
 - 1. Engineer may observe trees and shrubs either at place of growth or at Site before planting, for compliance with requirements for genus, species, variety, size, and quality.
 - 2. Engineer retains right to further inspect trees and shrubs for size and condition of balls and root systems, insects, injuries and latent defects, and to reject unsatisfactory or defective material at any time during progress of Work.
 - 3. Remove rejected trees or shrubs immediately from Site.
- D. Topsoil Analysis:
 - 1. Furnish soil analysis by qualified soil-testing laboratory stating percentages of organic matter, gradation of sand, silt and clay content; cation exchange capacity; deleterious material; pH; and mineral and plant-nutrient content of topsoil.
 - 2. Report suitability of topsoil for plant growth. State recommended quantities of nitrogen, phosphorus, and potash nutrients and soil amendments to be added to produce a satisfactory topsoil.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver trees and shrubs after preparations for planting have been completed and plant immediately.
- B. Deliver packaged materials in containers showing weight, analysis, and name of manufacturer.
- C. Trees and Shrubs:
 - 1. Protect bark, branches, and root systems from sun scald, drying, sweating, whipping, and other handling and tying damage.
 - 2. Balled and Burlapped Stock:
 - a. Do not drop during delivery.
 - b. Handle planting stock by root ball.

- c. Set on ground and cover with soil, peat moss, sawdust, or other acceptable material.
 - 3. Bare Root Stock:
 - a. Immediately after digging up, pack root system in wet straw, hay, or other suitable material to keep root system moist until planting.
 - b. Soak roots in water for 2 hours if dried out.
 - 4. Container-grown Stock: Do not remove container-grown stock from containers until planting time.
 - 5. Water root systems of plants stored on-site with a fine-mist spray as often as necessary to maintain in a moist condition.
 - 6. If planting is delayed more than 6 hours after delivery, set trees and plants in shade, protect from weather and mechanical damage, and keep roots moist by covering with mulch, burlap or other acceptable means of retaining moisture.
- D. Bulbs:
- 1. Keep dormant bulbs dry and protected.
 - 2. Keep disease-free.
- E. Annuals:
- 1. Keep well watered and in a protected location.
 - 2. Do not remove annuals from containers until ready to plant.

1.06 PROJECT CONDITIONS

- A. Existing Conditions:
- 1. Inspect the Site prior to installation. If conditions do not meet approval, notify Engineer.
 - 2. Proceeding without notification implies acceptance of conditions.
- B. Environmental: Work within seasonal limitations for each kind of landscape work required.
- C. Utilities:
- 1. Determine location of underground utilities and perform work in a manner which will avoid possible damage.
 - 2. Contact Diggers Hotline (811) at least 48 hours prior to conducting any underground operations.
 - 3. Hand excavate, as required.
 - 4. Maintain grade stakes set by others until removal is mutually agreed upon by parties concerned.

1.07 SEQUENCING AND SCHEDULING

- A. Planting Time: Proceed with, and complete landscape work as rapidly as portions of Site become available, working within seasonal limitations for each kind of landscape work required:
- 1. Plant or install materials during normal planting seasons for each type of plant material required.
 - 2. Correlate planting with specified maintenance periods to provide maintenance from date of Substantial Completion.
- B. Coordination with Lawns:
- 1. Plant trees and shrubs after final grades are established and prior to planting of lawns, unless otherwise acceptable to Engineer.
 - 2. If planting of trees and shrubs occurs after lawn work, protect lawn areas and promptly repair damage to lawns resulting from planting operations.

1.08 WARRANTY

- A. Trees, Shrubs and Perennials: Warranty for a period of 1 year after date of Substantial Completion, against defects including death and unsatisfactory growth, except for defects resulting from neglect by Owner, abuse or damage by others, or unusual phenomena or incidents which are beyond Landscape Installer's control.
- B. Replacement:
- 1. Remove and replace immediately trees, shrubs, or other plants found to be dead or in unhealthy condition.

2. Replace immediately unless required to plant in succeeding planting season.
3. Replace exterior plants that are more than 25 percent dead or in an unhealthy condition at end of warranty period.
4. A limit of 1 replacement of each exterior plant will be required, except for losses or replacements due to failure to comply with requirements.

1.09 MAINTENANCE

- A. Trees and Shrubs:
 1. Maintain for 12 months from date of Substantial Completion.
 2. Prune, cultivate, water, weed, fertilize, restore planting saucers, tighten and repair stakes and guy supports, and reset to proper grades or vertical position, as required to establish healthy, viable plantings.
 3. Spray as required to keep trees and shrubs free of insects and disease.
 4. Restore or replace damaged tree wrappings.
- B. Perennials and Bulbs:
 1. Maintain for 12 months from date of Substantial Completion.
 2. Water, weed, fertilize, and perform other operations as required to establish healthy, viable plantings.

PART 2 PRODUCTS

2.01 SOIL PREPARATION MATERIALS

- A. Topsoil:
 1. See Specification 32 91 00, for Topsoil requirements.
 2. Native topsoil stockpiled on Site or existing topsoil may be reused only with acceptance of Engineer.
 3. ASTM D5268, pH range of 5.5 to 7.
 4. Fertile, friable natural sandy loam, without admixture of subsoil material, obtained not more than 2 or 3 feet from top of deposit, from well-drained arable site.
 5. Free from heavy alkaline soil, coarse sand, stones larger than 2 inches in diameter, lumps, sticks, other foreign matter.
 6. Supplement with imported or manufactured topsoil from off-site sources when quantities are insufficient.
 - a. Obtain topsoil displaced from naturally well-drained construction or mining sites where topsoil occurs at least 4 inches deep.
 - b. Do not obtain from agricultural land, bogs, or marshes.
- B. Inorganic Soil Amendments:
 1. Lime: ASTM C602, agricultural limestone containing a minimum 80 percent calcium carbonate equivalent and as follows:
 - a. Class: Class T, with a minimum 99 percent passing through No. 8 sieve and a minimum 75 percent passing through No. 60 sieve.
 - b. Class: Class O, with a minimum 95 percent passing through No. 8 sieve and a minimum 55 percent passing through No. 60 sieve.
 - c. Provide lime in form of dolomitic limestone.
 - d. Untreated finely ground gypsum board scrap, free of contaminants.
 2. Sulfur:
 - a. Granular, biodegradable, containing a minimum of 90 percent sulfur, with a minimum 99 percent passing through No. 6 sieve and a maximum 10 percent passing through No. 40 sieve.
 - b. Iron Sulfate: Granulated ferrous sulfate containing a minimum of 20 percent iron and 10 percent sulfur.
 - c. Aluminum Sulfate: Commercial grade, unadulterated.
 3. Perlite: Horticultural perlite, soil amendment grade.
 4. Agricultural Gypsum: Finely ground, containing a minimum of 90 percent calcium sulfate.

5. Sand: Clean, washed, natural or manufactured, free of toxic materials.
 6. Diatomaceous Earth: Calcined, diatomaceous earth, 90 percent silica, with approximately 140 percent water absorption capacity by weight.
 7. Zeolites: Mineral clinoptilolite with at least 60 percent water absorption by weight.
- C. Organic Soil Amendments:
1. Compost:
 - a. Well-composted, stable, and weed-free organic matter.
 - b. pH range of 5.5 to 8.
 - c. Moisture content 35 to 55 percent by weight.
 - d. 100 percent passing through 1/2-inch sieve.
 - e. Soluble salt content of 5 to 10 decisiemens/m.
 - f. Not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings; and as follows:
 - 1) Organic matter content: 50 to 60 percent of dry weight.
 - 2) Feedstock: Agricultural, food, or industrial residuals; biosolids; yard trimmings; or source-separated or compostable mixed solid waste.
 - 3) Peat: Sphagnum peat moss, partially decomposed, finely divided or granular texture, with a pH range of 3.4 to 4.8.
 2. Wood Derivatives:
 - a. Decomposed, nitrogen-treated sawdust, ground bark, or wood waste.
 - b. Of uniform texture, free of chips, stones, sticks, soil, or toxic materials.
 3. Manure:
 - a. Well-rotted, unleached, stable or cattle manure containing not more than 25 percent by volume of straw, sawdust, or other bedding materials.
 - b. Free of toxic substances, stones, sticks, soil, weed seed, and material harmful to plant growth.

2.02 TREES, SHRUBS AND PLANTS

- A. Provide freshly-dug nursery-grown trees and shrubs complying with ANSI Z60.1.
 1. Healthy root systems developed by transplanting or root pruning.
 2. Well-shaped, fully branched, healthy, vigorous stock.
 3. Free of disease, insects, eggs, larvae, and defects such as knots, sun scald, injuries, abrasions, and disfigurement.
 4. Sizes and grades complying with ANSI Z60.1 for type of trees and shrubs required.
 5. Provide trees and shrubs raised in the local region, acclimated to the appropriate climate conditions. Verify source of plant materials and location of nursery where grown.
- B. Deciduous Trees:
 1. Provide trees of height and caliper scheduled or shown and with branching configuration recommended by ANSI Z60.1 for type and species required.
 2. Provide single stem trees except where special forms are shown or listed.
 3. Provide balled and burlapped stock.
 4. Container grown deciduous trees will be acceptable in lieu of balled and burlapped deciduous trees subject to specified limitations of ANSI Z60.1 for container stock.
- C. Deciduous Shrubs:
 1. Provide shrubs of the height shown or listed and with not less than minimum number of canes required by ANSI Z60.1 for type and height of shrub required.
 2. Provide balled and burlapped (B&B) deciduous shrubs.
 3. Provide bare root deciduous shrubs, except where shown as "B&B", provide balled and burlapped shrubs.
 4. Container grown deciduous shrubs will be acceptable in lieu of balled and burlapped deciduous shrubs subject to specified limitations for container grown stock.
- D. Coniferous and Broad-Leafed Evergreens:
 1. Form and Size:
 - a. Normal-quality, well-balanced, of type, height, spread, and shape required.

2. Complying with ANSI Z60.1.
3. Dimensions indicate minimum spread for spreading and semi-spreading type evergreens and height for other types, such as globe, dwarf, cone, pyramidal, broad upright, and columnar.
4. Provide balled and burlapped (B&B) evergreens.
5. For small evergreens, container grown evergreens will be acceptable, subject to specified limitations for container grown stock.

E. Perennials:

1. Provide healthy, field-grown plants from a commercial nursery, in removable containers or integral peat pots.
2. Not less than minimum number and length of runners required by ANSI Z60.1 for the pot size shown or listed.
3. Vines: Fast growing, complying with ANSI Z60.1.
 - a. 2-year plants with heavy, well-branched tops, with not less than 3 runners 18 inches or more in length.
 - b. Vigorous, well-developed root system.
 - c. Field-grown **OR** Grown in pots of other containers of adequate size and acclimated to outside conditions.

F. Bulbs:

1. Provide healthy bulbs from a commercial nursery.
2. Dry and dormant.
3. Disease free.
4. Well developed bulb and root system.
5. Complying with ANSI A60.1.

G. Annuals:

1. Provide healthy plants from a commercial nursery in removable containers or integral peat pots.
2. Adequate size and acclimated to outside conditions.
3. Complying with ANSI A60.1.

2.03 ACCESSORIES

A. Fertilizers:

1. Bonemeal: Commercial, raw or steamed, finely ground; a minimum of 1 percent nitrogen and 10 percent phosphoric acid.
2. Superphosphate: Commercial, phosphate mixture, soluble; a minimum of 20 percent available phosphoric acid.
3. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:
 - a. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing agency.
4. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:
 - a. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing agency.

B. Mulches:

1. Organic Mulch: Free from deleterious materials and suitable as a top dressing of trees and shrubs.
 - a. Shredded hardwood.
 - b. Ground or shredded bark.
 - c. Pine straw.
 - d. Salt hay or threshed straw.
 - e. Wood and bark chips.
 - f. Pine needles.
 - g. Peanut, pecan, and cocoa-bean shells.

2. Compost Mulch:
 - a. Well-composted, stable, and weed-free organic matter.
 - b. pH range of 5.5 to 8.
 - c. Moisture content 35 to 55 percent by weight.
 - d. 100 percent passing through 1-inch sieve; soluble salt content of 5 to 10 decisiemens/m.
 - e. Not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings; and as follows:
 - 1) Organic matter content: 50 to 60 percent of dry weight.
 - 2) Feedstock: Agricultural, food, or industrial residuals; biosolids; yard trimmings; or source-separated or compostable mixed solid waste.
- C. Stakes and Guys:
1. Upright and Guy Stakes:
 - a. Wood: Rough-sawn, sound, free of knots, holes, cross grain, and other defects.
 - b. Steel, tapered.
 - c. Aluminum: ASTM B221, alloy 6061-T6.
 - d. 2-inch by 2-inch by length indicated.
 - e. Pointed at one end.
 2. Guy and Tie Wire:
 - a. ASTM A641/A, Class 1.
 - b. Galvanized-steel wire.
 - c. 2-strand, twisted.
 - d. 0.106 inch diameter.
 3. Guy Cable:
 - a. 5-strand, 3/16-inch-diameter.
 - b. Galvanized-steel cable with zinc-coated turnbuckles.
 - c. Minimum of 3 inches long.
 - d. Two 3/8-inch galvanized eyebolts.
 4. Hose Chafing Guard:
 - a. Reinforced rubber or plastic hose at least 1/2 inch in diameter.
 - b. Black.
 - c. Cut to lengths required to protect tree trunks from damage.
 5. Flags:
 - a. Standard surveyor's plastic flagging tape.
 - b. Color: White.
 - c. Size: 6 inches long.

2.04 MISCELLANEOUS PRODUCTS

- A. Antidesiccant:
1. Water-insoluble emulsion, permeable moisture retarder, film forming, for trees and shrubs.
 2. Deliver in original, sealed, and fully labeled containers and mix according to manufacturer's written directions.
- B. Tree-Wrap Tape:
1. Designed to prevent border damage and winter freezing.
 2. 2 layers of crinkled paper cemented together with bituminous material.
 3. 4-inch wide minimum.
 4. Stretch factor of 33 percent.

2.05 SOURCE QUALITY CONTROL

- A. Ship landscape materials with certificates of inspection required by governing authorities.
1. Comply with regulations applicable to landscape materials.
 2. Do not prune prior to delivery unless otherwise approved by Engineer.
 3. Provide protective covering during delivery.
- B. Substitutions:
1. Do not make substitutions.

2. If specified landscape material is not obtainable, submit proof of non-availability to Engineer, together with proposal for use of equivalent material.
- C. Analysis and Standards:
1. Package standard products with manufacturer's certified analysis.
 2. For other materials, provide analysis by recognized laboratory made in accordance with methods established by the Association of Official Agriculture Chemists, wherever applicable.

PART 3 EXECUTION

3.01 PREPARATION

- A. Lay out individual tree and shrub locations and areas for multiple plantings.
- B. Stake locations and outline areas and secure Architect's acceptance before start of planting work, making minor adjustments as may be required.
- C. Protect structures, utilities, sidewalks, pavements, and other facilities, and lawns and existing exterior plants from damage caused by planting operations.
- D. Provide erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.
- E. Apply antidesiccant to trees and shrubs using power spray to provide an adequate film over trunks, branches, stems, twigs, and foliage to protect during digging, handling, and transportation.
- F. If deciduous trees or shrubs are moved in full leaf, spray with antidesiccant at nursery before moving and again 2 weeks after planting.
- G. Excavation:
 1. When conditions detrimental to plant growth are encountered, such as rubble fill, adverse drainage conditions, or obstructions, notify Engineer before planting.
 2. Drainage: Notify Engineer if subsoil conditions evidence unexpected water seepage or retention in tree or shrub pits.
- H. Planting Soil:
 1. Subsoil:
 - a. After subgrade is established and accepted, loosen to depth of minimum 4 inches.
 - b. Remove sticks, stones, roots and rubbish.
 - c. Smooth over to remove ridges and depressions so surface is parallel to finished grade.
 2. Topsoil:
 - a. Before mixing, clean topsoil of roots, plants, sods, stones, clay lumps, and other extraneous materials harmful or toxic to plant growth.
 - b. Do not turn existing vegetation over into soil being prepared for lawns.
 3. Soil Amendments:
 - a. Mix Lime with dry soil prior to mixing of fertilizer; prevent lime from contacting roots of acid-loving plants.
 - b. Apply phosphoric acid fertilizer (other than that constituting a portion of complete fertilizers) directly to subgrade before applying planting soil and tilling.
 - c. Mix specified soil amendments and fertilizers with topsoil at rates specified.
 - d. Delay mixing of fertilizer if planting will not follow placing of planting soil within a few days.
 4. Prepare planting soil in the following proportions:
 - a. 1 part existing soil by volume.
 - b. 1 part topsoil by volume.
 - c. 1 part compost by volume.
 - d. 2.9 pounds per cubic yard of 4-4-4 analysis organic slow-release fertilizer.

- I. Planting Beds:
 - 1. Loosen subgrade of planting bed areas to a minimum depth of 6 inches using a culti-mulcher or similar equipment.
 - 2. Remove stones measuring over 1-1/2 inches in any dimension, sticks, rubbish and other extraneous matter.
 - 3. Apply fertilizer directly to subgrade before loosening.
 - 4. Thoroughly blend planting soil mix.
 - 5. Mix lime with dry soil before mixing fertilizer.
 - 6. Spread mixture of planting soil and soil amendments to depth shown on Drawings, but not less than required to meet finish grades after natural settlement.
 - 7. Place approximately 1/2 of total amount of planting soil required. Work into top of loosened subgrade to create a transition layer, then place remainder of the planting soil.
 - 8. Do not spread if planting soil or subgrade is frozen, muddy, or excessively wet.
 - 9. Finish grading: Grade planting beds to a smooth, uniform surface plane with loose, uniformly fine texture.
 - 10. Roll and rake, remove ridges, and fill depressions to meet finish grades.
 - 11. Restore planting beds if eroded or otherwise disturbed after finish grading and before planting.

- J. Planters:
 - 1. Place not less than 4-inch layer of gravel in bottom of planters.
 - 2. Install filtration/separation fabric and fill with planting soil mixture.
 - 3. Mixture: 1 part topsoil, 1 part coarse sand, 1 part peat, and 3 pounds dolomitic limestone per cubic yard of mix.
 - 4. Place soil in lightly compacted layers to an elevation 1-1/2 inches below top of planter, allowing for natural settlement.

- K. Hanging Baskets:
 - 1. Completely line basket with sheets of sphagnum moss or cocoa mat.
 - 2. Fill with planting soil mixture.
 - 3. Place soil in lightly compacted layers to an elevation 1-1/2 inches below top of basket, allowing for natural settlement.
 - 4. Place pre-selected annuals into baskets in approved pattern.

3.02 PLANTING

- A. Trees and Shrubs to be Transplanted:
 - 1. Excavation of Trees:
 - a. Excavate with hydraulic tree spade.
 - b. Burlap and wire root ball immediately upon excavation.
 - 2. Storage of Trees and Shrubs:
 - a. Stand tree or shrub upright.
 - b. Cover entire root ball with wood chips.
 - c. Entirely soak root ball.
 - d. Keep root ball wet.

- B. Excavation:
 - 1. Excavate pits, beds, and trenches with sides sloped inward.
 - 2. Trim base leaving center area raised slightly to support root ball and assist in drainage.
 - 3. Do not further disturb base.
 - 4. Loosen hard subsoil in bottom of excavation.
 - 5. Bare Root: For bare root trees and shrubs, make excavations at least 12 inches wider than root spread and deep enough to allow for setting of roots on a layer of compacted backfill and with collar set at same grade level as in nursery, but 1 inch below finished grade at site. Allow for 9 inch setting layer of planting soil mixture.
 - 6. Balled and Burlapped: Make excavations at least half again as wide as the ball diameter and equal to the ball depth, plus 3 inch thick setting layer of planting soil mixture for setting of ball on a layer of compacted backfill.
 - 7. Container Grown: Excavate as specified for balled and burlapped stock, adjusted to size of container width and depth.

8. Bulbs: Excavate to a depth 3 times the height of the bulb.
 9. Drain Tile: If required under planted areas, excavate to top of porous backfill over tile.
 10. Subsoil Disposal: Dispose of subsoil removed from planting excavations. Do not mix with planting soil or use as backfill.
 11. Pre-planting Watering: Fill excavations for with water and allow water to percolate away prior to planting.
- C. Planting Trees and Shrubs:
1. Balled and Burlapped:
 - a. Set balled and burlapped (B&B) stock on layer of compacted planting soil mixture, plumb, and in center of pit or trench.
 - b. Place top of ball 1 inch above adjacent finished landscape grades.
 - c. Remove burlap and wire baskets from tops of root balls and partially from sides; retain on bottoms.
 - d. Remove pallets, if any.
 - e. Do not use planting stock if root ball is cracked or broken before or during planting operation.
 2. Bare Root:
 - a. Set bare root stock on cushion of planting soil mixture.
 - b. Spread roots and carefully work backfill around roots by hand.
 - c. Puddle with water until backfill layers are completely saturated.
 - d. Set collar or trunk flare 1 inch below adjacent finish landscape grades.
 - e. Spread out roots without tangling or turning up to surface.
 - f. Cut injured roots clean; do not break.
 3. Container-grown:
 - a. Set container grown stock plumb and in center of pit or trench with top of root ball 1 inch above adjacent finish grades.
 - b. Cut cans on 2 sides with an approved can cutter and carefully remove after partial backfilling so as not to damage root balls.
 4. Fabric Bag-grown:
 - a. Set container grown stock plumb and in center of pit or trench with top of root ball 1 inch above adjacent finish grades.
 - b. Carefully remove root ball from fabric bag without damaging root ball or plant.
 - c. Do not use planting stock if root ball is cracked or broken before or during planting operation.
- D. Backfilling:
1. When trees and shrubs are set, place additional backfill around base and sides of ball.
 2. Work each layer to settle backfill and eliminate voids and air pockets.
 3. When excavation is approximately 2/3 full, water thoroughly before placing remainder of backfill.
 4. Repeat watering until no more is absorbed. Water again after placing final layer of backfill.
- E. Mulching, Pruning, and Protection of Trees and Shrubs:
1. Mulch pits, trenches, and planted areas.
 2. Mulch Placement and Depth: See Drawings.
 3. Work into top of backfill and finish level with adjacent finish grades.
 4. Do not place mulch within 3 inches of trunks or stems.
 5. Prune, thin, and shape trees and shrubs in accordance with standard horticultural practice.
 - a. Prune trees to retain required height and spread.
 - b. Unless otherwise directed by Engineer, do not cut tree leaders.
 - c. Remove only injured or dead branches from flowering trees, if any.
 - d. Prune shrubs to retain natural character.
 - e. Remove and replace excessively pruned or misformed stock resulting from improper pruning.
 6. Wrap tree trunks of 2 inches caliper and larger.
 - a. Start at base of trunk and spiral cover trunk to height of first branches.
 - b. Overlap wrap, exposing half the width, and securely attach.
 - c. Inspect tree trunks for injury, improper pruning and insect infestation, and take corrective measures before wrapping.
 7. Guy and Stake Trees:
 - a. Immediately after planting as needed.

- b. Stake trees of 2- through 5-inch caliper as indicated on Drawings.
 - 1) Stake trees of less than 2-inch caliper only as required to prevent wind tip-out.
 - 2) Set vertical stakes and space to avoid penetrating root balls or root masses.
 - 3) Support trees with 2 strands of tie wire encased in hose sections at contact points with tree trunk.
 - 4) Allow enough slack to avoid rigid restraint of tree.
 - c. Guy and stake trees exceeding 14 feet in height and more than 3 inches in caliper.
 - 1) Anchor guys to pressure-preservative treated deadmen 8 inches in diameter and 48 inches long buried at least 36 inches below grade.
 - 2) Provide turnbuckles for each guy wire and tighten securely.
 - 3) Attach flags to each guy wire, 30 inches above finish grade.
 - 4) Paint turnbuckles with luminescent white paint.
- F. Perennials:
- 1. Space plants as indicated or scheduled, or if not shown or scheduled, not more than 24 inches on center.
 - 2. Dig holes large enough to allow for spreading of roots and backfill with planting soil.
 - 3. Work soil around roots to eliminate air pockets and leave a slight saucer indentation around plants to hold water.
 - 4. Water thoroughly after planting, taking care not to cover crowns of plants with wet soils.
 - 5. Mulch areas between plants; place not less than 2 inches thick.
 - 6. Protect plants from hot sun and wind; remove protection if plants show evidence of recovery from transplanting shock.
- G. Bulbs:
- 1. Planting Pattern: See Drawings.
 - 2. Growing tip to be pointed upward.
 - 3. Set bottom of bulb on compacted grade at depth 3 times height of bulb, but minimum 6 inches.
 - 4. Work soil around roots to eliminate air pockets without disturbing bulbs.
 - 5. Water thoroughly.
- H. Annuals:
- 1. Planting Pattern: See Drawings.
 - 2. Water thoroughly, taking care not to cover crowns of plants with wet soils.
- I. Planting Bed Mulching:
- 1. Install weed-control barriers before mulching according to manufacturer's written instructions.
 - 2. Completely cover area to be mulched, overlapping edges a minimum of 6 inches.
 - 3. Mulch backfilled surfaces of planting beds and other areas indicated with 6-inch average thickness.
 - 4. Finish level with adjacent finish grades.
 - 5. Do not place mulch against plant stems.

3.03 CLEANUP AND PROTECTION

- A. During landscape work, keep pavements clean and work area in an orderly condition.
- B. Begin maintenance immediately after planting.
- C. Disposal:
 - 1. Remove waste and foreign materials, including weeds, stones, soil cores, grass, vegetation, and sod and legally dispose of them off Owner's property.
 - 2. Divert from landfill disposal whenever possible.
 - 3. Topsoil containing foreign materials resulting from Contractor's operations, including oil drippings, fuel spills, shall be disposed of legally.
- D. Protect exterior plants from damage due to landscape operations, operations by other contractors and trades, and others.

E. Maintain protection during installation and maintenance periods.

END OF SECTION

Single, straight, main trunk.
Lower branches may require
removal for height clearance

Remove transit guard

Root flare to be level
with the finished grade

3"-4" of woody mulch:
Shredded or Ground
hardwood bark mulch

Remove wire baskets; or cut top and
fold down in pit after positioned for
backfill planting. Cut and remove or
fold down burlap from upper 1/2
of ball.

Cut and remove all poly ties and burlap !!

Water thoroughly to eliminate air pockets,
and to settle the surrounding soil

Finish Grade

Soil under ball undisturbed
to support root ball
and reduce settling

Break down sides of
hole when backfilling

3 times ball diameter

Backfill: Excavated soil or amended
as specified. Do Not Tamp !!!

2004

CITY OF MADISON
PARKS DIVISION

STANDARD PLANTING
TECHNIQUE FOR TREES
IN TURF AREAS

STANDARD DETAIL DRAWING 2.01

Branching to be full throughout entire tree/shrub as is typical from the species.
Any broken branches to be removed

Single, straight, main trunk.
Lower branches may require removal for height clearance
(when / where applicable / specified)

Root flare to be level with the finished grade

3"-4" of woody mulch:
Shredded or Ground hardwood bark mulch
(over landscape fabric when/where specified)

Remove wire baskets; or cut top and fold down in pit after positioned for backfill planting. Cut and remove or fold down burlap from upper 1/2 of ball.
Cut and remove all poly ties and burlap !!
- or -
Remove Poly Pot and dispose

Water thoroughly to eliminate air pockets, and to settle the surrounding soil

Finish Grade

Soil under ball undisturbed to support root ball and reduce settling

Break down sides of hole when backfilling

3 times ball diameter

Backfill: Excavated soil or amended as specified. Do Not Tamp !!!

2004

CITY OF MADISON
PARKS DIVISION

STANDARD PLANTING
TECHNIQUE FOR
EVERGREENS

STANDARD DETAIL DRAWING 2.03

Branching to be full throughout entire tree/shrub as is typical from the species.
Any broken branches to be removed

Single, straight, main trunk.
Lower branches may require removal for height clearance
(when / where applicable / specified)

3"-4" of woody mulch:
Shredded or Ground
hardwood bark mulch
(over landscape fabric
when/where specified)

Root flare to be level
with the finished grade

Remove wire baskets; or cut top and
fold down in pit after positioned for
backfill planting. Cut and remove or
fold down burlap from upper 1/2
of ball.

Cut and remove all poly ties and burlap !!

- or -

Remove Poly Pot and dispose

Water thoroughly to eliminate air pockets,
and to settle the surrounding soil

Finish Grade

Soil under ball undisturbed
to support root ball
and reduce settling

Break down sides of
hole when backfilling

3 times ball diameter

Backfill: Excavated soil or amended
as specified. Do Not Tamp !!!

2004

CITY OF MADISON
PARKS DIVISION

STANDARD PLANTING
TECHNIQUE FOR SHRUBS

STANDARD DETAIL DRAWING 2.04

SECTION 33 11 00

WATER DISTRIBUTION SYSTEMS

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Water main pipe and fittings.
 - 2. Valves and boxes.
 - 3. Hydrants.
 - 4. Services.
 - 5. Insulation.

- B. Related Sections:
 - 1. Section 31 23 33 - Trench Excavation and Backfill
 - 2. Section 33 05 50 - Surface Facility Restoration

1.02 REFERENCES

- A. ASTM:
 - 1. A126 - Gray Iron Castings for Valves, Flanges, and Pipe Fittings
 - 2. A536 - Ductile Iron Castings
 - 3. B88 - Seamless Copper Water Tube
 - 4. B152 - Copper Sheet, Strip, Plate, Rolled Bar
 - 5. D429 - Tests for Rubber Adhesion to Rigid Surfaces
 - 6. D2842 - Test for Water Absorption of Rigid Cellular Materials
 - 7. D1248 - Polyethylene Plastics Extrusion Materials for Wire and Cable

- B. AWWA:
 - 1. C111 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
 - 2. C150 - Thickness Design of Ductile Iron Pipe
 - 3. C151 - Ductile-Iron Pipe, Centrifugally Cast for Water or other Liquids
 - 4. C153 - Ductile-Iron Compact Fittings for Water Service
 - 5. C502 - Dry-Barrel Fire Hydrants
 - 6. C504 - Rubber-Seated Butterfly Valves
 - 7. C509 - Resilient-Seated Gate Valves for Water Supply Service
 - 8. C515 - Reduced-Wall, Resilient-Seated Gate Valves, for Water Supply Service
 - 9. C600 - Installation of Ductile Iron Water Mains and their Appurtenances
 - 10. C605 - Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water
 - 11. C900 - Polyvinyl Chloride (PVC) Pressure Pipe, 4-inch through 12-inch for Water Distribution

1.03 SUBMITTALS

- A. Submit Certificate of Compliance for products listed under Article 1.04.

- B. Submit proposed method of joint conductivity.

1.04 QUALITY ASSURANCE

- A. Provide Certificates of Compliance from the manufacturer certifying that the following products meet the respective requirements listed in Article 1.02:
 - 1. Watermain piping
 - 2. Valves
 - 3. Hydrants

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Inspection:
 - 1. Inspect all pipe and products during the unloading process.
 - 2. Notify Engineer of any cracked, flawed or otherwise defective products.
 - 3. Remove all products found to be defective by the Engineer from the Site.

- B. Handling and Storage: Handling and storage of products shall be in accordance with Section 2.2 of AWWA C600.

PART 2 PRODUCTS

2.01 WATER MAIN PIPE

- A. Ductile Iron: AWWA C151.

- B. Ductile Iron: AWWA C151

- C. Cement-Mortar Lining: AWWA C104.

- D. Thickness Class: 52.

- E. Joints: Push-On.

- F. Joint Conductivity:
 - 1. Conductive gaskets as manufactured by American Ductile Iron Pipe Co.
 - 2. Field Application Methods:
 - a. Burndy - Thermoweld by Burndy Corp., Norwalk, Connecticut.
 - b. Cadweld by Erico Products Co., Cleveland, Ohio.
 - 3. Copper Jumpers:
 - a. Minimum 1/16-inch by 1/2-inch wide flat copper strip.
 - b. Annealed round copper wire conforming to ASTM B152, Type DHP.
 - 4. Nuts and Bolts: Silicon Bronze.

2.02 FITTINGS

- A. Ductile Iron: AWWA C153.

- B. Cement-Mortar Lining: AWWA C104.

- C. Joints: Mechanical with ASTM F593 and F594 type 304 Stainless Steel bolts and nuts.

2.03 VALVES AND BOXES

- A. Gate Valves:
 - 1. Resilient Seated: AWWA C515.
 - 2. Working Pressure: 200 psi.
 - 3. Ends: Mechanical Joint with ASTM F593 and F594 type 304 Stainless Steel bolts and nuts.
 - 4. Operating Stem: Non-Rising with O-ring Seals.
 - 5. Operating Nut: 2-inch Square, Open Left.
 - 6. Markings to be cast on the bonnet or body:
 - a. Open indicating arrow.
 - b. Manufacturer's name.
 - c. Pressure rating.
 - d. Year of manufacture.
 - e. Size.
 - 7. Type: Kennedy, Mueller, Clow

- B. Butterfly Valves:
 - 1. Rubber Seated: AWWA C504.
 - 2. Class: 150B.
 - 3. Body Type: Mechanical - Joint-End with ASTM F593 and F594 type 304 Stainless Steel bolts and nuts.
 - 4. Disc:
 - a. 316 stainless steel edge
 - b. 3-inch thru 24-inch: ASTM A126 Class B Cast Iron
 - c. 30-inch and larger: ASTM A536 Ductile Iron
 - 5. Seat:
 - a. 3-inch through 20-inch: Bond to body per ASTM D429, Method B.
 - b. 24-inch and larger: Retain in body without use of metal retainers.
 - 6. Operator:
 - a. Traveling nut actuator
 - b. Open left.
 - 7. Markings to be cast on the body:
 - a. Open indicating arrow.
 - b. Manufacturer's name.
 - c. Class.
 - d. Year of manufacture.
 - e. Size.
 - 8. Type: Kennedy, Clow
- C. Boxes:
 - 1. Cast Iron, 5-1/4-inch shaft.
 - 2. Vertical, 3 piece, Buffalo type.
 - 3. Box length to provide for 8 feet of pipe cover.
 - 4. Adjustable to 6 inches up or down from standard box length.

2.04 HYDRANTS

- A. Dry Barrel: AWWA C502.
- B. Waterous Pacer WB67 or equal.
- C. Hose Connections: 2 each at 2-1/2-inch diameter.
- D. Steamer Connection: 1 each at 4-1/2-inch diameter.
- E. Threads: National Standard.
- F. Operating Stem: Open Left with O-ring Seals.
- G. Traffic flange.
- H. Hub: 6-inch Mechanical Joint with ASTM F593 and F594 type 304 Stainless Steel bolts and nuts.
- I. Main Valve Opening: 5-inch diameter.
- J. Barrel Diameter: 5-inch.
- K. Drain to operate only when hydrant is closed.
- L. Bury Depth: 8 feet (ground to bottom of hub).
- M. Minimum Nozzle Height (from flange): 16 inches.
- N. Cap Nuts: Pentagon.

- O. Color: White.
- P. Provide permanent markings which indicate:
 - 1. Manufacturer's name.
 - 2. Year of manufacture.
 - 3. Bury depth.

2.05 SERVICE PIPE

- A. Copper: ASTM B88.
- B. Type: K, Soft.

2.06 CORPORATION STOPS

- A. Type: For 1" Use Mueller H-9971, For 1-2" Use Mueller H09971
 - 1. Inlet: AWWA taper thread.
 - 2. Outlet: Copper flare straight connection.

2.07 CURB STOPS AND BOXES

- A. Valve:
 - 1. Type: Mueller H-15154 Mark II Oriseal, or approved equal.
 - a. Inlet: Copper Service Thread.
 - b. Outlet: Copper Service Thread.
- B. Box:
 - 1. Type: Bingham and Taylor 94F or approved equal.
 - 2. Length: 7 feet.
 - 3. Upper Section Diameter: 2.5
 - 4. Adjustable to 6 inches up or down from specified length.
 - 5. Provide stationary rod and guide ring.

2.08 INSULATION

- A. Rigid, extruded polystyrene board insulation.
- B. Thermal Resistance (R): 5.0.
- C. Thickness: 2-inch.
- D. Board Size: 48-inch by 96-inch.
- E. Compressive Strength: Minimum 25 psi.
- F. Water Absorption in accordance with ASTM D2842: 0.1 percent by volume, maximum.
- G. Edges: Square.

PART 3 EXECUTION

3.01 CONSTRUCTION REQUIREMENTS

- A. Connection to Existing System:
 - 1. Pressure Tap:
 - a. Install tap in location shown on the Drawings.
 - b. Use approved tapping machine designed specifically for tapping under pressure.
 - c. Install tapping sleeve and gate valve as part of assembly.

- d. Install blocking as required.
 - 2. Cut-In Connection:
 - a. Isolate segment of pipe to be cut and drain water from the line.
 - b. Connect tee and sleeve assembly to pipe ends.
 - c. Install blocking as required.
 - 3. Connect to Inplace Fitting:
 - a. Isolate segment of inplace pipe and remove blocking as required.
 - b. Remove plug and drain water from the line.
 - c. Install blocking as required.
- B. Pipe Installation:
- 1. Install pipe at the alignment and grade shown on the Drawings.
 - 2. Provide a minimum of 8 feet of cover over the pipe.
 - 3. Install appurtenances in the locations shown on the Drawings.
 - 4. Remove all dirt and foreign material from the pipe interior prior to installation.
 - 5. See Section 31 23 33 for pipe foundation and backfill procedures.
 - 6. See Section 31 23 33 in case of conflicts with existing pipes.
- C. Valve and Box Installation:
- 1. Verify that subgrade material is adequate to support valve assembly.
 - 2. Install valves with stems vertical and plumb.
 - 3. Install boxes plumb and centered over the valve nut.
 - 4. Verify that box remains plumb and centered during backfill.
 - 5. Adjust box cover to required grade.
- D. Hydrant Installation:
- 1. Verify that subgrade material is adequate to support hydrant.
 - 2. Place thrust block, crushed rock and tar paper in accordance with Drawing details.
 - 3. Install and maintain hydrant in a plumb position.
 - 4. Where groundwater is present, plug drain hole and affix "Pump After Use" tag to the hydrant.
- E. Joint Conductivity:
- 1. Provide electrical bond across all joints between pipes and appurtenances.
 - 2. Install copper jumpers by either shop or field applications.
 - 3. Fasten multiple jumper strips with silicon bronze bolts and nuts.
 - 4. Welding:
 - a. Grind surfaces to be welded to remove coating and oxide and to provide clean metal surface.
 - b. Use metallic-arc process for shop applications.
 - c. Use exothermic process for field applications.
 - d. Refinish welded area with protective coating after connection is made.
- F. Thrust Restraint:
- 1. Install thrust restraints at all bends, tees and plugs.
 - 2. Concrete Blocking:
 - a. Place between the fitting and undisturbed trench wall.
 - b. Minimum thickness: 12 inches.
 - c. Minimum area in square feet shall be in accordance with the following:

Pipe	Tee or Plug	1/4 Bend	1/32 and 1/8 Bend	1/16 Bend
6-inch	2.9	3.1	1.6	0.8
8-inch	3.7	5.3	2.9	1.4
10-inch	5.7	8.1	4.4	2.2
12-inch	8.1	13.4	6.6	3.2
16-inch	15.1	21.4	11.6	5.9
20-inch	23.2	30.2	18.1	9.3
24-inch	33.6	48.5	26.1	13.3

- d. Size blocking based on the larger main.
- e. Verify that bolts are accessible after concrete is poured.
- 3. Timber Blocking:
 - a. Use for temporary blocking only for maximum 8-inch mains.
 - b. Minimum timber size: 4-inch by 4-inch.
- 4. Restrained Joints:
 - a. Submit method and type to Engineer for approval.
 - b. Install in accordance with "Thrust Restraint Design for Ductile Iron Pipe".
- G. Service Installation:
 - 1. Corporation Stops:
 - a. Provide watertight connection with approved tapping machine.
 - b. Install under main pressure.
 - c. Place a double wrap of Teflon tape around the threads prior to installation.
 - 2. Copper Service Pipe:
 - a. Install pipe between corporation stop and curb stop with no joints or unions.
 - b. Bury Depth: 8 feet.
 - c. Provide minimum 1-foot of slack in the pipe to allow for settlement and movement.
 - 3. Curb Stop and Box:
 - a. Install at the location shown on the Drawings.
 - b. Verify that subgrade material is adequate to support the curb box assembly.
 - c. Install boxes plumb and centered over the tee head.
 - d. Verify that box remains plumb and properly aligned during backfill.
 - e. Adjust box cover to required grade.
 - f. Key all curb stops after backfill to ensure proper operation.

3.02 FIELD QUALITY CONTROL

- A. Perform the following tests upon completion of the system and prior to being placed into service:
 - 1. Pressure and Leakage Test:
 - a. Perform pressure and leakage test in accordance with AWWA C600.
 - b. Test Pressure: 150 psi.
 - c. Test Duration: 2 hours.
 - d. Gage Requirements:
 - 1) Size: 4-1/2-inch dial.
 - 2) Range: 0 to 200 psi.
 - 3) Gradation: 2 psi.
 - 4) Accuracy: 1/2 percent.
 - e. Do not allow pressure to vary more than 5 psi during the test.
 - f. Do not allow pressure to vary more than 2 psi during the last hour of the test.
 - g. Allowable Leakage: One-half of the volume allowed by AWWA C600 in accordance with the following:

$$L = \frac{SD\sqrt{P}}{266,400}$$

L = Allowable Leakage in Gallons Per Hour

S = Length of Pipe Tested in Feet

D = Nominal Diameter of Pipe in Inches

P = Average Test Pressure During Test in Pounds/Square Inch (Gage)

- 2. Testing Services:
 - a. Perform separate pressure and leakage test on the services with the corporation stops open.
 - b. Test Pressure: 100 psi.

- c. Allowable Leakage: None.
- d. At Contractor's option, service testing may be done concurrent with main testing.
- 3. Electrical Conductivity Test:
 - a. Perform electrical conductivity test to verify that electrical thawing of the system may be accomplished by Owner.
 - b. Test Parameters:
 - 1) Perform test within 1 week after pressure testing.
 - 2) Perform test after back-filling is completed and while line is at normal operating pressure.
 - 3) Test Current: 350 amperes DC plus or minus 10 percent.
 - 4) Test Duration: 5 minutes.
 - 5) Test between hydrants in segments of convenient length.
 - c. Procedures:
 - 1) Furnish DC current source, cable and all required equipment of adequate capacity to accomplish the test.
 - 2) Clamp cables to hydrant flange bolts.
 - 3) Conduct test with hydrant in the open position and caps on.
 - 4) Measure current continuously throughout the test with a DC ammeter hooked on a cable lead.
 - 5) Start test at minimum current level and increase to test level.
 - 6) Drain hydrant and tighten caps after test.
 - d. Failure and Correction:
 - 1) Failure of a segment shall be determined by current measurements that are insufficient, intermittent or unsteady.
 - 2) Isolate and correct defective contact points as indicated by failed tests.
 - 3) Retest failed segments after correction.

3.03 DISINFECTION

- A. Disinfect all newly installed water mains, appurtenances and services in accordance with AWWA C651.
 - 1. Tablet or Continuous Feed Method:
 - a. Hold chlorine solution in pipe for a minimum period of 24 hours.
 - 1) Initial dosage: 50 ppm minimum.
 - 2) Residual dosage after hold period: 10 ppm minimum.
- B. Flush system within 24 hours after disinfection is completed.
- C. Sampling and Testing:
 - 1. After final flushing, obtain 2 sets of samples taken a minimum of 24 hours apart.
 - 2. Each sample set shall include:
 - a. One sample for every 1,200 feet of main.
 - b. One sample at each dead-end.
 - c. Ensure that 1 sample is obtained from each branch of main.
 - d. Minimum sample required: 2
 - 3. Perform coliform tests on each sample.
 - 4. Rechlorinate if any sample tests positive for coliform.

END OF SECTION

MIN. 24" OR AS REQUIRED BY DRAWINGS OR FIELD CONDITIONS.

RoDon HIGH-VISIBILITY LOCATING DEVICE W/ A BOLT-ON FLAT STEEL MOUNTING BRACKET. STANDARD 5' LENGTH.

FOR MORE DETAILS GO TO RoDonCorp.com

BURY LINE ON HYDRANT SHALL BE AT FINISHED GRADE. DO NOT DISH OUT OR BUILD UP GRADE AROUND HYDRANT TO MEET REQUIREMENT.

18"

GROUND

6 MIL. POLYETHYLENE

VALVE BOX

6'-0" MIN.

4'X4' MIN SIZE, 6 MIL. POLYETHYLENE FILM OR GEOTEXTILE FABRIC.

1" WASHED STONE, MIN. 1/2 CUBIC YARD.

HYDRANT LEAD

6" VALVE

NOTE: RESTRAIN ENTIRE LENGTH OF HYDRANT LEAD FROM THE TEE THROUGH THE VALVE TO THE HYDRANT AS SPECIFIED USING RESTRAINED JOINT FLANGES PER SPECIFICATION 702.6, SEE DRAWING 7.03. JOINT REDRAINTS, PER DRAWING 7.03.

POURED CONCRETE OR SOLID CONCRETE BLOCK TO UNDISTURBED SOIL.

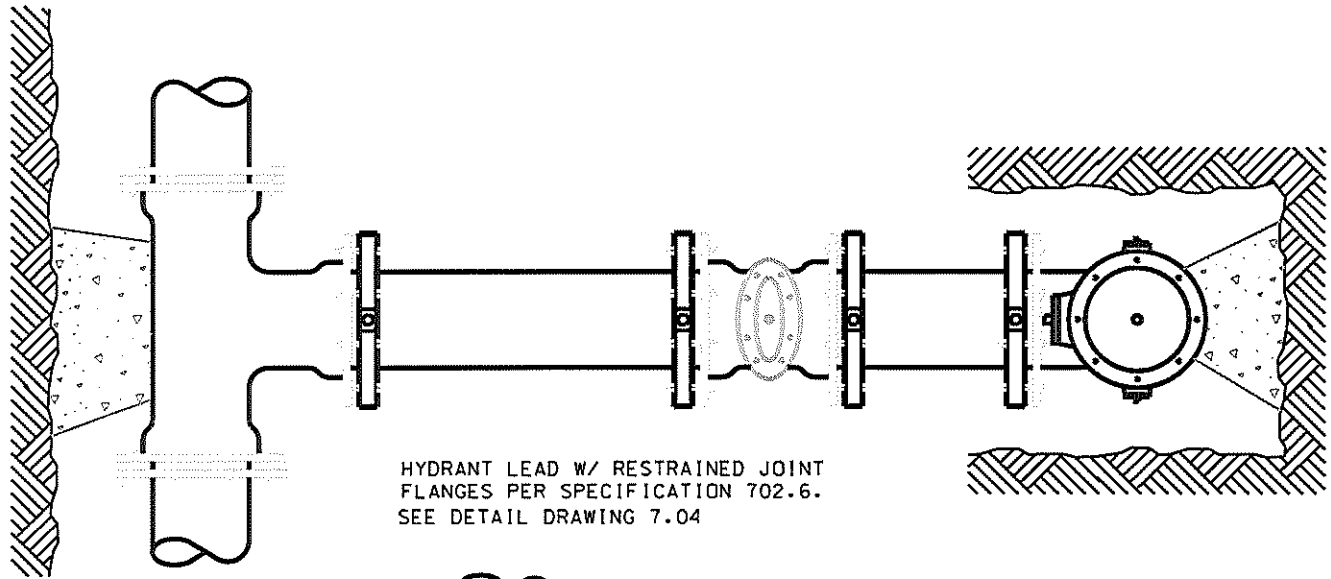
SOLID CONCRETE MASONRY UNIT

CITY OF MADISON
WATER UTILITY

TYPICAL HYDRANT INSTALLATION

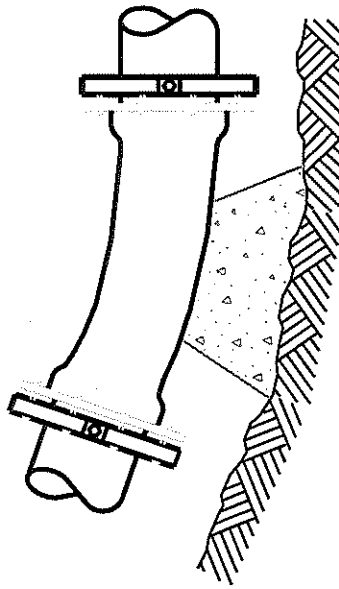
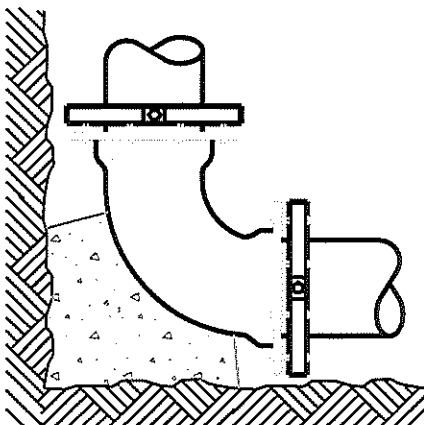
REVISED 12/2009

STANDARD DETAIL DRAWING 7.04

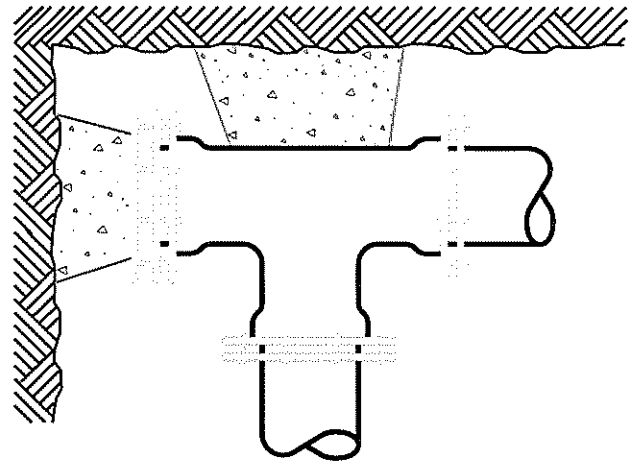


HYDRANT LEAD W/ RESTRAINED JOINT
FLANGES PER SPECIFICATION 702.6.
SEE DETAIL DRAWING 7.04

REQUIRED BEARING AREA PER
MASTER SPECIFICATIONS SECTION 703.



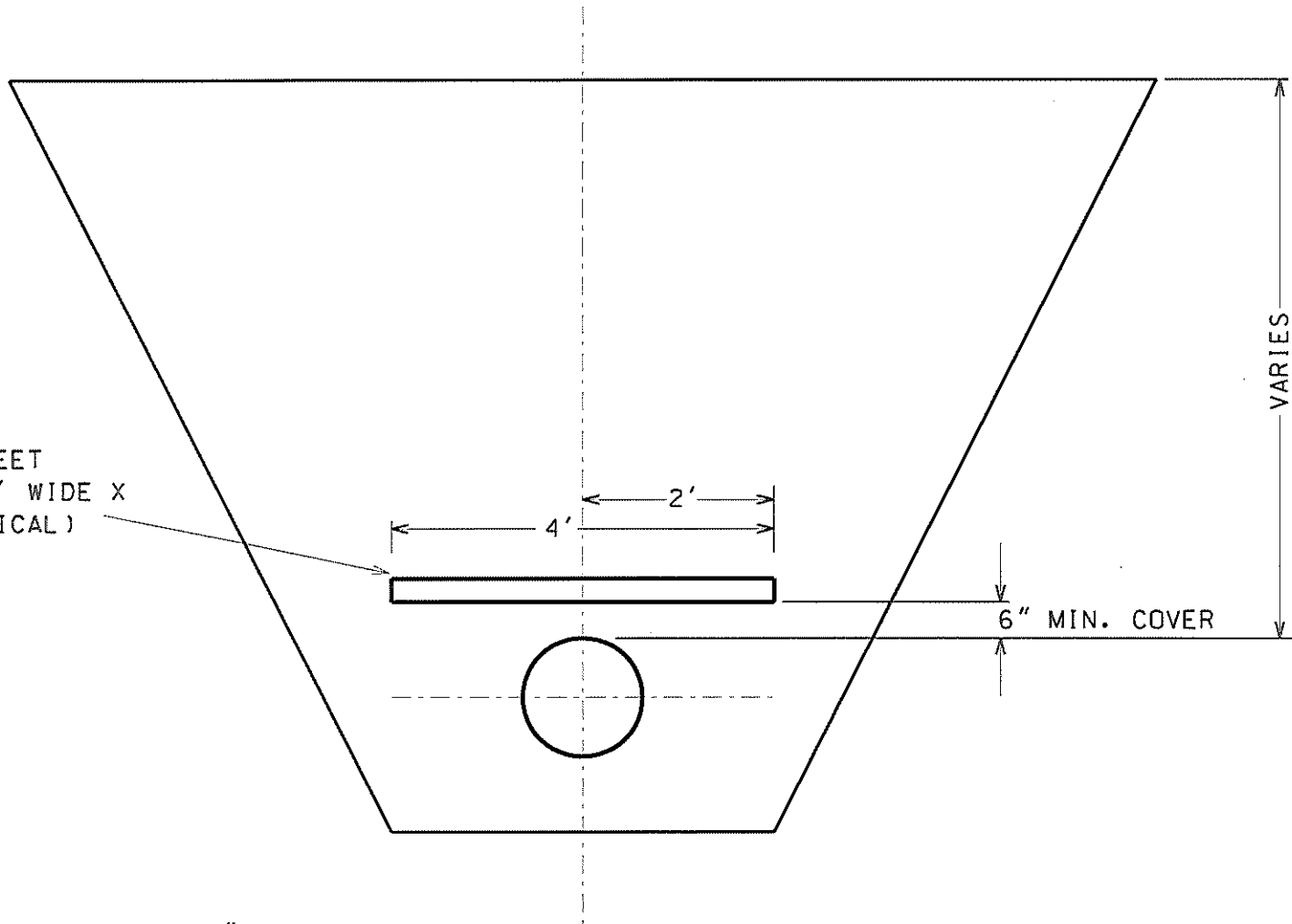
NOTE: ALL PIPES BENDS SHALL HAVE
RESTRAINED JOINT FLANGES PER
SPECIFICATION 702.6. IN
ADDITION TO CONCRETE THRUST
BLOCKING.



DENOTES UNDISTURBED SOIL

DENOTES POURED CONCRETE

CITY OF MADISON WATER UTILITY
STANDARD THRUST BLOCKING
STANDARD DETAIL DRAWING 7.03

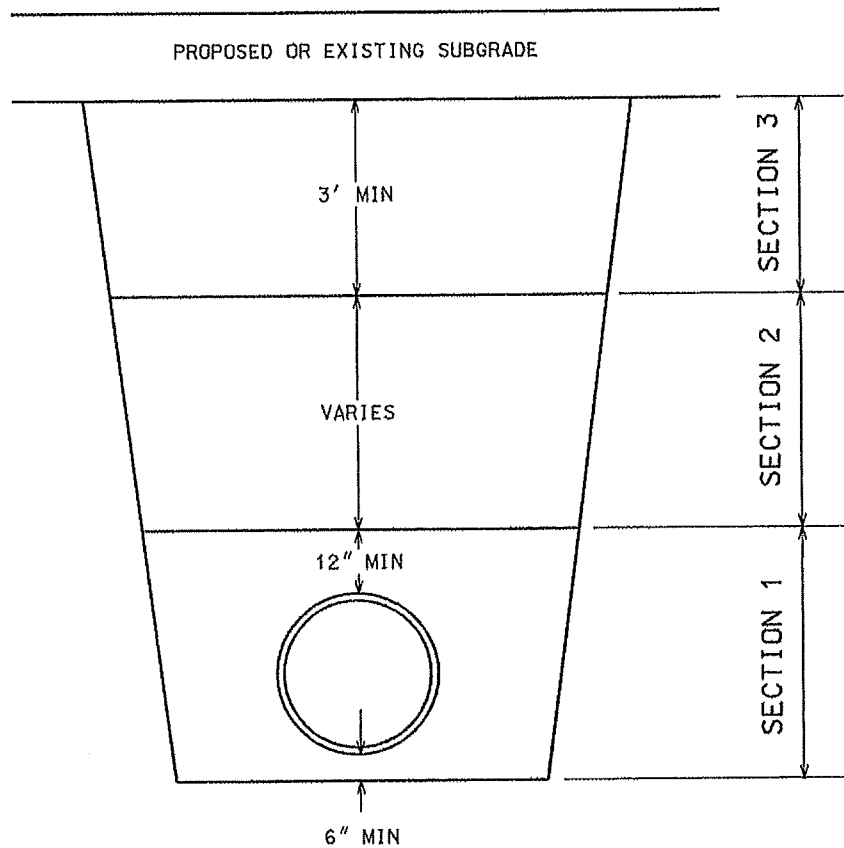


STYROFOAM SHEET
2" THICK X 4' WIDE X
8' LONG (TYPICAL)

NOTES:

- 1) ALL STYROFOAM TO BE 2" HIGH DENSITY POLYSTYRENE BOARD

CITY OF MADISON WATER UTILITY
TYPICAL STYROFOAM INSTALLATION
STANDARD DETAIL DRAWING 7.05



TYPICAL TRENCH COMPACTION

ALL BACKFILL MATERIAL SHALL BE PLACED IN LIFTS NOT TO EXCEED 12" BEFORE COMPACTION UNLESS AUTHORIZED BY THE ENGINEER DUE TO THE CHARACTER OF THE MATERIAL AND THE COMPACTING EQUIPMENT. EACH LIFT SHALL BE MECHANICALLY COMPACTED TO THE REQUIRED DENSITY PRIOR TO PLACING SUCCEEDING LIFTS OF BACKFILL MATERIAL.

IN COLD WEATHER, TRENCHES SHALL BE COMPACTED IN ACCORDANCE WITH THE REQUIREMENTS SPECIFIED IN SECTION 502.1 (e), BACKFILLING EXCAVATIONS AND COMPACTION OF BACKFILL, OF THESE SPECIFICATIONS.

SECTION 1:

MECHANICALLY COMPACTED BEDDING AS REQUIRED BY THE SPECIFICATIONS. COMPACTION ACHIEVED WITH SMALLER PLATE COMPACTOR. FOR ALL PLASTIC PIPE SECTION 1 SHALL BE INSTALLED IN ACCORDANCE WITH S.D.D. 5.2.1A

SECTION 2:

MINIMUM COMPACTION OF 90% MAXIMUM DENSITY. COMPACTION OF BACKFILL WITH BOMAG OR HOE-PAC SHALL NOT BEGIN UNTIL THE DEPTH OF BACKFILL MATERIAL IS TWO FEET ABOVE THE TOP OF PIPE.

SECTION 3:

MINIMUM COMPACTION OF 95% MAXIMUM DENSITY.

2011

CITY OF MADISON
ENGINEERING DIVISION

**TYPICAL
TRENCH
COMPACTION**

STANDARD DETAIL DRAWING 5.2.2

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SECTION 33 16 30

DISINFECTION OF WATER STORAGE FACILITIES

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Disinfection materials.
 - 2. Facility preparation.
 - 3. Application of disinfectant.
 - 4. Disposal of chlorinated water.
 - 5. Sampling and testing for bacteria.

1.02 REFERENCES

- A. AWWA:
 - 1. C652 - Disinfection of Water Storage Facilities

1.03 SUBMITTALS

- A. Post Construction - Contract Close-Out: Submit certified bacteriological and chlorine residual test results.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Sodium Hypochlorite - Liquid
- B. Calcium Hypochlorite - Granular or Tablet

PART 3 EXECUTION

3.01 PREPARATION

- A. Screens:
 - 1. Prior to cleaning, remove all vents and overflow screens.
 - 2. Verify that screens are in satisfactory condition.
 - 3. After cleaning is completed replace all screens.
- B. Cleaning:
 - 1. Remove all materials from the facility interior.
 - 2. Thoroughly clean all interior surfaces using a high pressure water jet. This may be performed coincidental to Method 2 disinfection.
 - 3. Remove all water, dirt and foreign material accumulated in the cleaning operation from the facility.

3.02 APPLICATION

- A. Chlorinate facility in accordance with AWWA C652, Method 3 as follows:
 - 1. Add water and chlorine to the facility in the following amounts:
 - a. Water: Fill to 5 percent of the total storage volume.
 - b. Chlorine: Add to provide a 50 mg/l (available chlorine) solution.
 - 2. Hold the solution in the facility for a minimum of 6 hours.

3. Admit potable water and fill to overflow.
4. Hold facility full for a minimum of 24 hours.
5. Purge highly-chlorinated water from drain piping.
6. Verify that a free-chlorine residual of not less than 2 mg/l is present.
7. Provide acceptable bacteriological testing.
8. Deliver water to distribution system.

B. Disposal of Water:

1. Prior to discharge or purging of chlorinated water, advise Owner of the time, quantity and concentration.
2. If the concentration exceeds 10 mg/l, neutralize in accordance with Appendix B of AWWA C652 prior to discharge.

3.03 FIELD QUALITY CONTROL

A. Provide bacteriological sampling and testing as follows:

1. Obtain samples from sample tap connected to storage facility or outlet piping at 24 hour intervals.
2. Perform coliform and chlorine residual tests on samples by a certified laboratory.
3. Obtain 2 successive negative coliform test results prior to placement of facility in service.
4. Rechlorinate in accordance with 3.02 A if samples test positive for coliform, or if a 2 mg/l residual cannot be maintained.

END OF SECTION

SECTION 33 31 00

SANITARY SEWER SYSTEMS

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Gravity sanitary sewer pipe.
 - 2. Service connections.
 - 3. Service pipe.
 - 4. Riser pipe.

- B. Related Sections:
 - 1. Section 31 23 33 - Trench Excavation and Backfill

1.02 REFERENCES

- A. ANSI:
 - 1. A21.4 - Standard for Cement - Mortar Lining for Ductile Iron Pipe and Fittings
 - 2. A21.11 - Standard for Rubber - Gasket Joints for Ductile Iron Pressure Pipe and Fittings
 - 3. A21.51 - Standard for Ductile Iron Pipe Centrifugally Cast
 - 4. A21.53 - Standard for Ductile Iron Compact Fittings, 3-inch through 16-inch

- B. ASTM:
 - 1. A48 - Specification for Gray Iron Castings
 - 2. A74 - Specification for Cast Iron Soil Pipe and Fittings
 - 3. C76 - Specification for Reinforced Concrete Pipe
 - 4. C361 - Specification for Reinforced Concrete Low Head Pressure Pipe
 - 5. C425 - Specification for Compression Joints for VCP and Fittings
 - 6. C478 - Specification for Precast Reinforced Concrete Manhole
 - 7. C564 - Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings
 - 8. D2321 - Recommended Practice for Installation of Flexible Thermo-plastic Sewer Pipe
 - 9. D3034 - Specification for PVC Sewer Pipe and Fittings
 - 10. F477 - Elastomeric Seals for Joining Plastic Pipe
 - 11. F714 - Specification for PE Sewer Pipe and Fittings
 - 12. C900 - Polyvinyl Chloride (PVC) Pressure Pipe, 4-inch through 12-inch

1.03 SUBMITTALS

- A. Submit Shop Drawings for each manhole.

- B. Quality Assurance/Control Submittals:
 - 1. Submit Certificates of Compliance from manufacturers certifying that materials meet reference specifications listed in Article 1.02.
 - 2. Submit record of service connections weekly to Engineer.

1.04 HANDLING AND DELIVERY OF MATERIALS

- A. Inspect pipe and materials during unloading process and notify Engineer of cracked, flawed or otherwise defective material.

1.05 STAKING

- A. Contractor shall provide necessary staking for all Work under this Section.

1.06 MAINTAINING SEWER SYSTEM

- A. Maintain flow in sanitary sewers on continuous basis while construction is underway.
- B. Plug sewers with inflatable plug. Provide pumps, portable generators, hoses, and related items appurtenant to the Work.
- C. Sewer service lines to individual users may be disconnected for a period not to exceed 2 hours.

PART 2 PRODUCTS

2.01 PIPE AND FITTINGS

- A. Provide the following:

Material	Class	Joint
PVC	AWWA C900	Push On

- B. Provide pipe and fittings of each material type from same manufacturer.
- C. Service Pipe Couplings:
 - 1. Dissimilar Pipe Material Connection:
 - a. Fernco, Inc., 1-piece eccentric series, or approved equal.
 - 2. PVC to PVC Connection:
 - a. J-M Manufacturing Co., Inc., or approved equal.
 - b. PVC Stop or Repair Coupling, Gasket by gasket joint.

PART 3 EXECUTION

3.01 PREPARATION

- A. Line and Grade: Provide means for accurately transferring line and grade from ground surface stakes to working point in trench.
- B. Water Stops: Provide in manholes as required to prevent infiltration into system.

3.02 CONSTRUCTION REQUIREMENTS

- A. Pipe Installation:
 - 1. Comply with ASTM D2321 for PVC installation.
 - 2. Install wye in mainline pipe with Fernco couplings in accordance with City of Madison requirements.
 - 3. Inspect pipe for defects and cracks while suspended before lowering into trench.
 - 4. Place pipe bell at upstream end of pipe length.
 - 5. Install pipe from lower to higher invert elevation at a uniform slope between manholes.
 - 6. Place plug in end of incomplete piping at end of day and when Work stops.
 - 7. Provide watertight plugs at future connection plugs.
 - 8. When water is present in trench, seals are to remain in-place while trench is pumped completely dry.
 - 9. See Section 31 23 33 for pipe foundation and backfill.
 - 10. Maximum Allowable Deviation From Staked Grade:
 - a. Alignment: 0.30 feet.
 - b. Elevation: 0.02 percent.

- B. Service Pipe:
 - 1. Extend pipe to building connection.
 - 2. Install pipe at minimum 1 percent to maximum 2 percent grade.
 - 3. Place gasketed plug at end of pipe or connect to building piping.
 - 4. Maintain a record of each service connection as follows to be submitted to Engineer at the end of each week:
 - a. Type of service connection.
 - b. Distance from downstream manhole.
 - c. Length of riser.

- C. Riser Pipe:
 - 1. Extend riser from service connection at 45-degree angle above horizontal to a point 11 feet below street grade.
 - 2. Install riser pipe against undisturbed trench wall.
 - 3. Place concrete collar around service connection as shown on Drawings.

3.03 FIELD QUALITY CONTROL

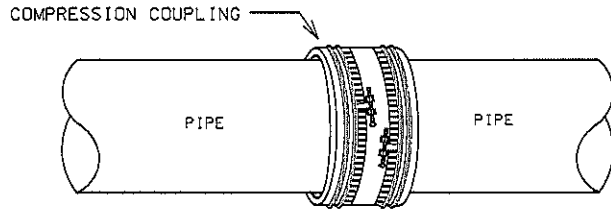
- A. Remove all dirt and foreign material from pipe interior prior to testing.

- B. Perform the following tests upon completion of sewer construction and prior to any external plumbing connections:
 - Tests for all gravity sewers shall be as follows: Pipe will be plugged at its downstream end and water will be placed inside the pipe to a minimum head of 10 feet. Water shall be held for 15 minutes without dropping. No leakage is allowed.

END OF SECTION

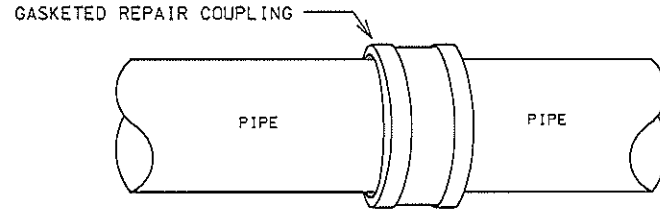
COMPRESSION COUPLING

PIPES WITH DIFFERENT MATERIAL TYPES
PIPES WITH DIFFERENT OUTSIDE DIAMETERS

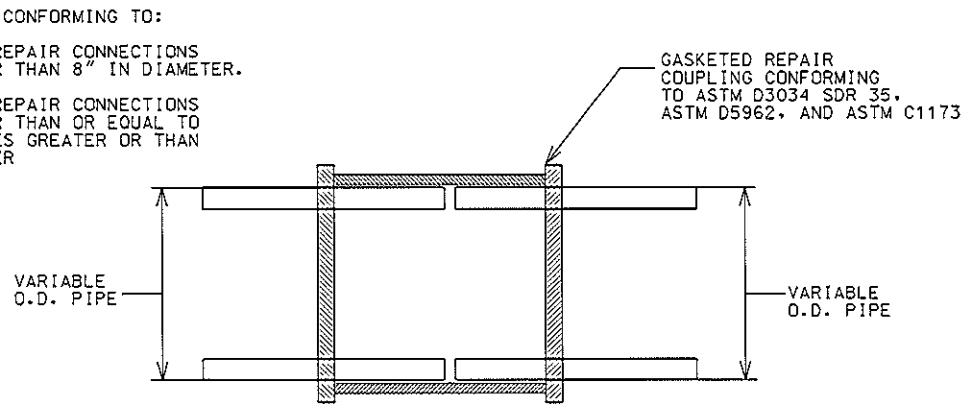
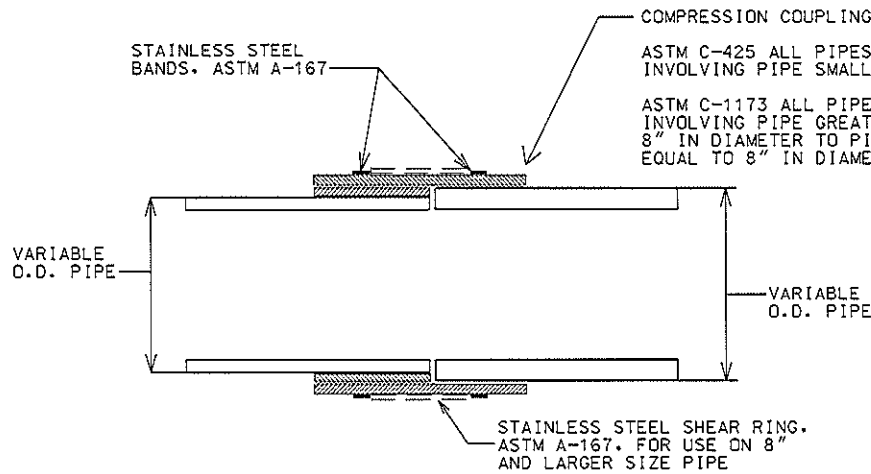


GASKETED REPAIR COUPLING

PVC TO PVC CONNECTION



5.3.3



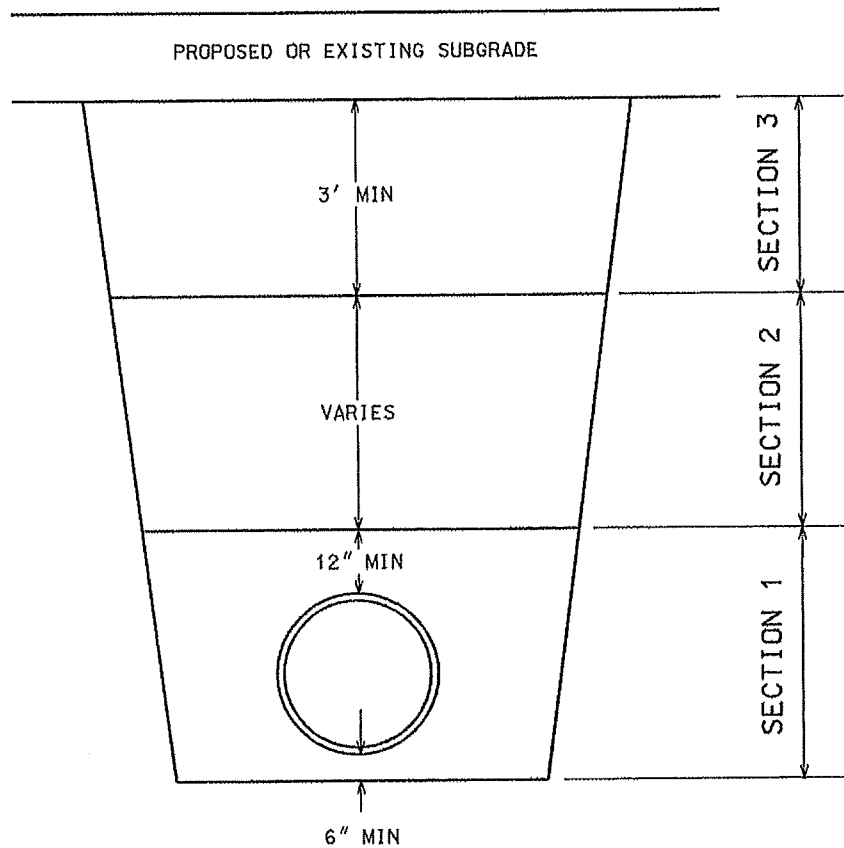
ALL REPAIRS INVOLVING PIPE CONNECTIONS 8" IN DIAMETER TO 8" IN DIAMETER OR LARGER SHALL UTILIZE THE FERNCO RC STRONGBACK OR EQUIVALENT REPAIR COUPLING. (ASTM C1173).

2012

CITY OF MADISON
ENGINEERING DIVISION

COUPLING
DETAILS

STANDARD DETAIL DRAWING 5.3.3



TYPICAL TRENCH COMPACTION

ALL BACKFILL MATERIAL SHALL BE PLACED IN LIFTS NOT TO EXCEED 12" BEFORE COMPACTION UNLESS AUTHORIZED BY THE ENGINEER DUE TO THE CHARACTER OF THE MATERIAL AND THE COMPACTING EQUIPMENT. EACH LIFT SHALL BE MECHANICALLY COMPACTED TO THE REQUIRED DENSITY PRIOR TO PLACING SUCCEEDING LIFTS OF BACKFILL MATERIAL.

IN COLD WEATHER, TRENCHES SHALL BE COMPACTED IN ACCORDANCE WITH THE REQUIREMENTS SPECIFIED IN SECTION 502.1 (e), BACKFILLING EXCAVATIONS AND COMPACTION OF BACKFILL, OF THESE SPECIFICATIONS.

SECTION 1:

MECHANICALLY COMPACTED BEDDING AS REQUIRED BY THE SPECIFICATIONS. COMPACTION ACHIEVED WITH SMALLER PLATE COMPACTOR. FOR ALL PLASTIC PIPE SECTION 1 SHALL BE INSTALLED IN ACCORDANCE WITH S.D.D. 5.2.1A

SECTION 2:

MINIMUM COMPACTION OF 90% MAXIMUM DENSITY. COMPACTION OF BACKFILL WITH BOMAG OR HOE-PAC SHALL NOT BEGIN UNTIL THE DEPTH OF BACKFILL MATERIAL IS TWO FEET ABOVE THE TOP OF PIPE.

SECTION 3:

MINIMUM COMPACTION OF 95% MAXIMUM DENSITY.

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CITY OF MADISON
ENGINEERING DIVISION

**TYPICAL
TRENCH
COMPACTION**

STANDARD DETAIL DRAWING 5.2.2

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SECTION 33 41 00
STORM SEWER SYSTEMS

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Storm sewer pipe.
 - 2. Manholes and appurtenances.
 - 3. Catch basins and appurtenances.
 - 4. Aprons.

- B. Related Sections:
 - 1. Section 31 23 33 - Trench Excavation and Backfill

1.02 REFERENCES

- A. ASTM:
 - 1. A48 - Specification for Gray Iron Castings
 - 2. C76 - Specification for Reinforced Concrete Pipe
 - 3. C361 - Specification for Reinforced Concrete Low Head Pressure Pipe
 - 4. C443 - Specification for Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets
 - 5. C478 - Specification for Precast Reinforced Concrete Manhole

1.03 DELIVERY OF MATERIALS

- A. Inspect all pipe and materials during the unloading process.
- B. Notify Engineer of any cracked, flawed or otherwise defective material.
- C. Remove all materials found to be unsatisfactory by Engineer from the Site.

PART 2 PRODUCTS

2.01 PIPE

- A. Reinforced Concrete:
 - 1. Class IV
 - 2. WisDOT Facilities Development Manual 13-1, Attachment 25.1
 - 3. Formed rubber gasket per ASTM C443.

- B. Provide all pipe from the same manufacturer.

2.02 MANHOLES AND CATCH BASINS

- A. See Drawings for diameter.
- B. Provide gasket joint.
- C. Provide base, cone section or cover slab as shown on Drawing details.

- D. Manhole Steps:
 - 1. Provide 16-inch wide step in accordance with the following:
 - a. Cast aluminum by Modern Metals Foundry (A-12).
 - b. Polypropylene coated steel by M.A. Industries, Inc.
 - c. Cast iron or aluminum alloy by Neenah Foundries (R-1980-I).
- E. Catch Basin Covers/Inlets
 - 1. The following lists of Neenah Foundry castings are acceptable for City construction. Substitutions shall be approved by the Engineer prior to delivery to the job site.
 - a. R-1878-A10G Heavy-duty, four (4) inch high, catchbasin frame with open grate.

PART 3 EXECUTION

3.01 PREPARATION

- A. Line and Grade:
 - 1. Conform to lines, elevations, and grades shown on the Drawings.
 - 2. Provide means for accurately transferring line and grade from ground surface stakes to the working point in the trench.

3.02 CONSTRUCTION REQUIREMENTS

- A. Pipe Installation:
 - 1. Inspect pipe for defects and cracks while suspended before lowering into the trench.
 - a. See Drawings for bedding details.
 - 2. Place pipe bell at upstream end of pipe length.
 - 3. Install pipe from lower to higher invert elevation.
 - 4. See Section 31 23 33 for pipe foundation and backfill procedures.
- B. Manhole and Catch Basin Installation:
 - 1. Place precast base on compacted granular subgrade.
 - 2. Install in accordance with drawing details.
 - 3. Locate steps within 1 inch of vertical alignment and within 1 inch of required vertical spacing.
 - 4. Install concrete adjusting rings to provide final horizontal and vertical adjustment within tolerances.
 - 5. Maximum horizontal tolerance: 3 inches in any direction.
 - 6. Construct watertight to prevent groundwater infiltration.
- C. Apron Installation: Tie aprons to next three pipe sections using galvanized "U" bolt fasteners.

3.03 CLEANING

- A. Remove all dirt and foreign material from the pipe and structure interiors.

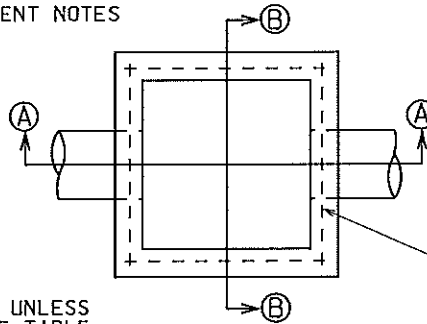
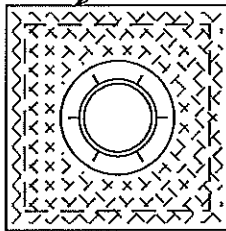
END OF SECTION

SEWER ACCESS STRUCTURES

ROOF REINFORCEMENT NOTES:

- 1) EPOXY COATED REBARS SHALL BE USED IN ALL CASES
- 2) #6 BARS PLACED ON 6" CENTERS FOR 3'X3', 3'X4', 4'X4', 4'X5', 5'X5' STRUCTURES
- 3) #6 BARS PLACED ON 4" CENTERS FOR 6'X5', 6'X6' AND LARGER STRUCTURES
- 4) 3" CLEAR SHALL BE MAINTAINED IN ALL CASES
- 5) ROOF THICKNESS SHALL BE 8" MINIMUM UNLESS SPECIFIED OTHERWISE.

SEE ROOF REINFORCEMENT NOTES

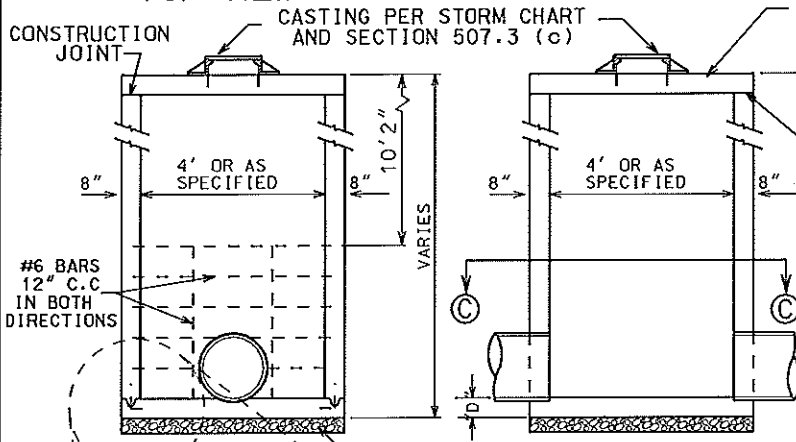


#6 BARS CENTERED IN WALL

NOTE: CASTING TO BE CENTERED UNLESS NOTED IN STORM STRUCTURE TABLE

TOP VIEW

SECTION C-C



ROOF TO BE POURED SEPERATELY FROM WALLS

JOINT TO BE SEALED WITH CONSEAL (CS-102 OR CS-202) DEPENDING ON FIELD TEMPERATURES

CONSTRUCTION JOINT

CASTING PER STORM CHART AND SECTION 507.3 (c)

4' OR AS SPECIFIED

4' OR AS SPECIFIED

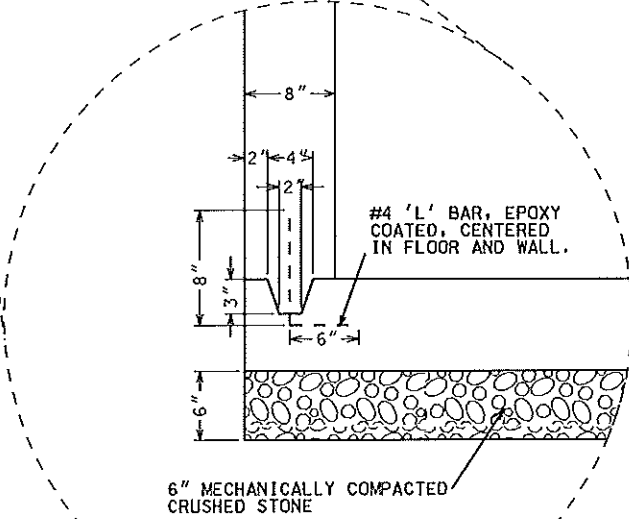
#6 BARS 12" C.C. IN BOTH DIRECTIONS

6" MECHANICALLY COMPACTED CRUSHED STONE

SECTION A-A

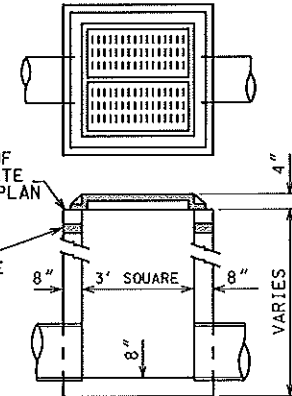
NOTE: THICKNESS OF FLOOR (DIMENSION "D") TO BE 8" UP TO 10' DEPTHS AND 10" FOR GREATER DEPTHS

SECTION B-B



6" MECHANICALLY COMPACTED CRUSHED STONE

3'X3' CATCH BASIN



TOP OF CONCRETE AS PER PLAN

MORTAR CASTING TO GRADE

PRECAST REINFORCED CONCRETE STRUCTURES MAY BE USED IF APPROVED ACCORDING TO ARTICLES 106.3 AND 507.3 (b) OF THE STANDARD SPECIFICATIONS

NEENAH FOUNDRY CASTINGS AS LISTED OR EQUAL. ALL CASTING WITH FLANGE AT BASE. LIGHT DUTY

R-1879-A10G FOR OPEN GRATE

R-1879-A10L FOR SOLID LID

HEAVY DUTY

R-1878-A10G FOR OPEN GRATE

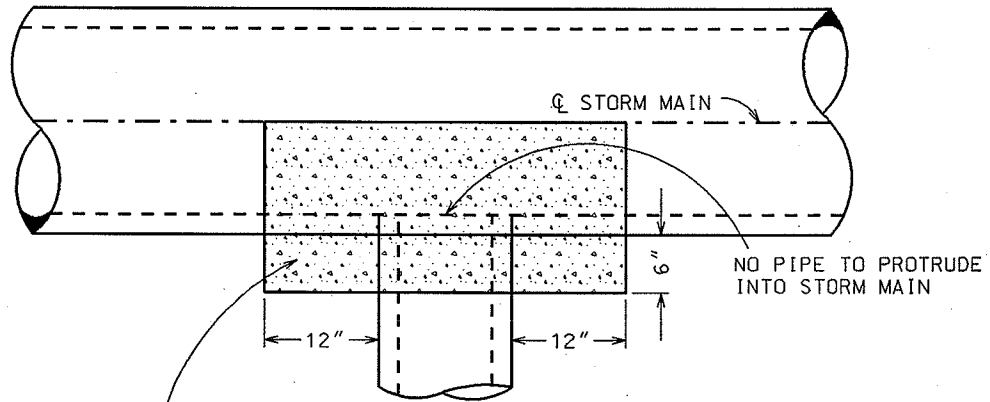
R-1878-A10L FOR SOLID LID

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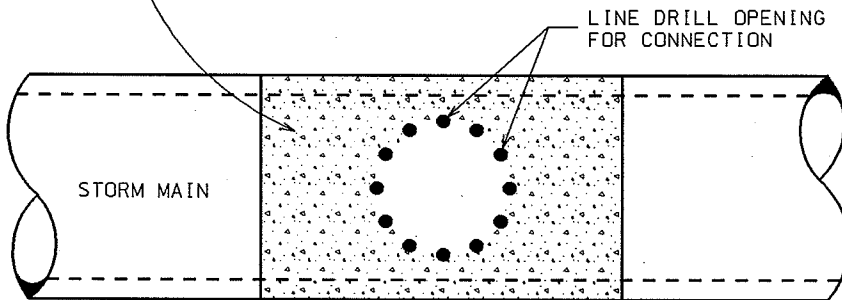
CITY OF MADISON
ENGINEERING DIVISION

STORM SEWER
FIELD POURED SAS
AND CATCH BASINS

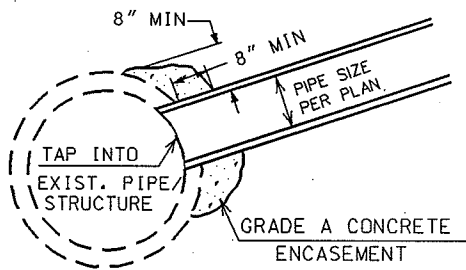
STANDARD DETAIL DRAWING 5.7.3



TOP VIEW



SIDE VIEW



ALTERNATE CONCRETE ENCASEMENT

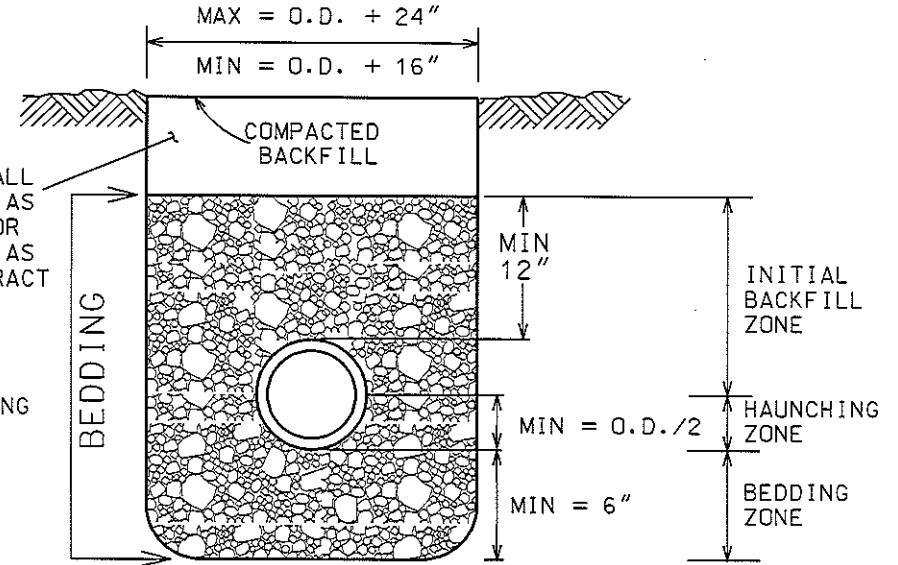
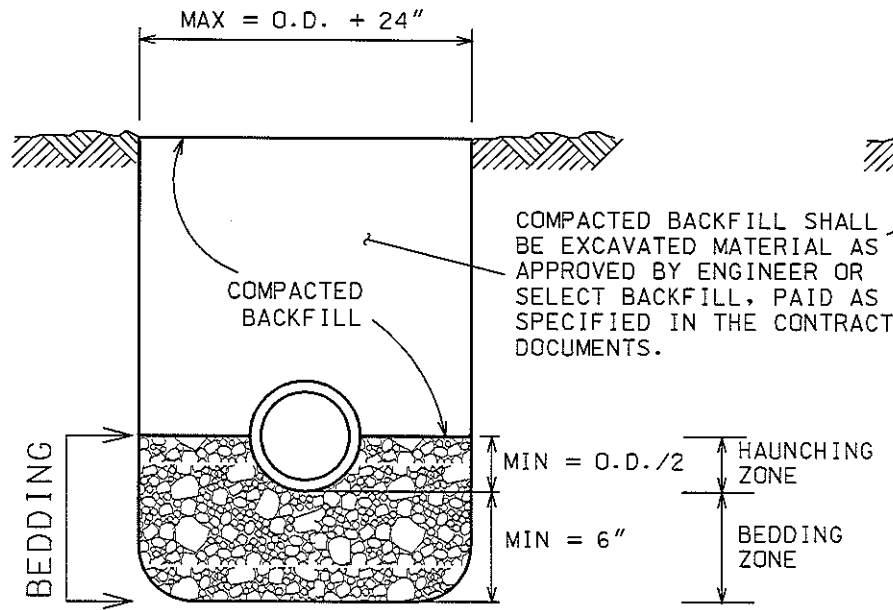
DRAWING NOT TO SCALE


2004


CITY OF MADISON
ENGINEERING DIVISION

STORM SEWER
TAP DETAIL

STANDARD DETAIL DRAWING 5.7.32



 WASHED GRAVEL OR CRUSHED STONE AS SPECIFIED IN SECTION 502.1 (d), BEDDING OF SEWER PIPES

 WASHED GRAVEL, CRUSHED STONE, SAND OR LIMESTONE SCREENINGS FOR PIPE SIZES 10" IN DIAMETER OR LESS. WASHED GRAVEL OR CRUSHED STONE FOR PIPE SIZES OVER 10" IN DIAMETER. AS SPECIFIED IN SECTION 502.1 (d), BEDDING OF SEWER PIPES

BEDDING FOR REINFORCED CONCRETE SEWER PIPES

BEDDING FOR SANITARY SEWER PIPES AS WELL AS METAL, ADS, AND PVC STORM PIPES

NOTES:

UNLESS OTHERWISE SPECIFIED, ALL SANITARY AND STORM SEWER PIPES, INCLUDING LATERALS AND LEADS, SHALL BE INSTALLED WITH THE TYPE OF BEDDING SHOWN FOR THE TYPE AND SIZE OF PIPE INSTALLED.

THE COSTS OF BEDDING SHALL BE INCLUDED IN THE UNIT PRICES BID FOR THE PIPE. FOR RCP, BEDDING INCLUDES THE HAUNCHING & BEDDING ZONES. FOR PLASTIC PIPES, THE BEDDING INCLUDES THE HAUNCHING, BEDDING & INITIAL BACKFILL ZONES. THE BEDDING SHALL BE INSTALLED & COMPACTED IN 6" MAXIMUM LIFTS.

ALL TRENCHES SHALL BE HAND BACKFILLED TO A POINT 12" ABOVE THE TOP OF THE PIPE. ALL BEDDING SHALL BE MECHANICALLY COMPACTED.

PAYMENT SHALL NOT BE MADE FOR BACKFILL WITH EXCAVATED MATERIAL, IF APPROVED. SELECT FILL, IF REQUIRED, SHALL BE PAID PER CONTRACT.

THE MAXIMUM ALLOWABLE TRENCH WIDTH SHALL BE O.D. + 24" AND MINIMUM OF OD + 16" AS SPECIFIED, AND SHALL APPLY FROM THE BOTTOM OF THE TRENCH TO A POINT 12" ABOVE THE TOP OF THE PIPE. WHERE THIS WIDTH IS EXCEEDED, THE CONTRACTOR SHALL FURNISH AND INSTALL A HIGHER TYPE OF BEDDING AT NO EXTRA COST. THE TYPE OF BEDDING SHALL BE DETERMINED BY THE ENGINEER.

O.D. EQUALS THE OUTSIDE DIAMETER OF THE PIPE.

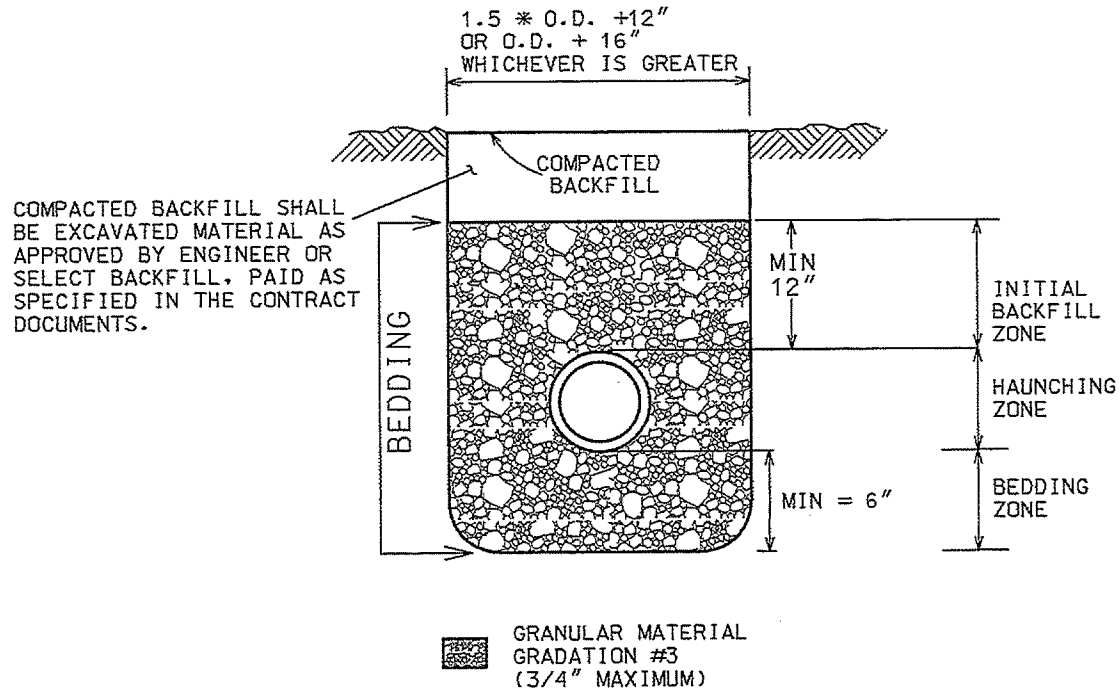
CITY OF MADISON
ENGINEERING DIVISION

PIPE BEDDING AND BACKFILL

STANDARD DETAIL DRAWING 5.2.1

DRAWING NOT TO SCALE

5.2.1A



BEDDING FOR
STORM SEWER PIPE—
SECTION 1 OF S.D.D 5.2.2

NOTES:

UNLESS OTHERWISE SPECIFIED, ALL HDPE SEWER PIPES, INCLUDING LATERALS AND LEADS, SHALL BE INSTALLED WITH THE TYPE OF BEDDING SHOWN FOR THE TYPE AND SIZE OF PIPE INSTALLED.

BEDDING SHALL BE INSTALLED IN ACCORDANCE WITH ASTM D2321

THE COSTS OF BEDDING SHALL BE INCLUDED IN THE UNIT PRICES BID FOR THE PIPE. THE BEDDING INCLUDES THE HAUNCHING, BEDDING & INITIAL BACKFILL ZONES. THE BEDDING SHALL BE INSTALLED & COMPACTED IN 6" MAXIMUM LIFTS.

ALL TRENCHES SHALL BE HAND BACKFILLED TO A POINT 12" ABOVE THE TOP OF THE PIPE. ALL BEDDING SHALL BE MECHANICALLY COMPACTED.

PAYMENT SHALL NOT BE MADE FOR BACKFILL WITH EXCAVATED MATERIAL, IF APPROVED. SELECT FILL, IF REQUIRED, SHALL BE PAID PER CONTRACT.

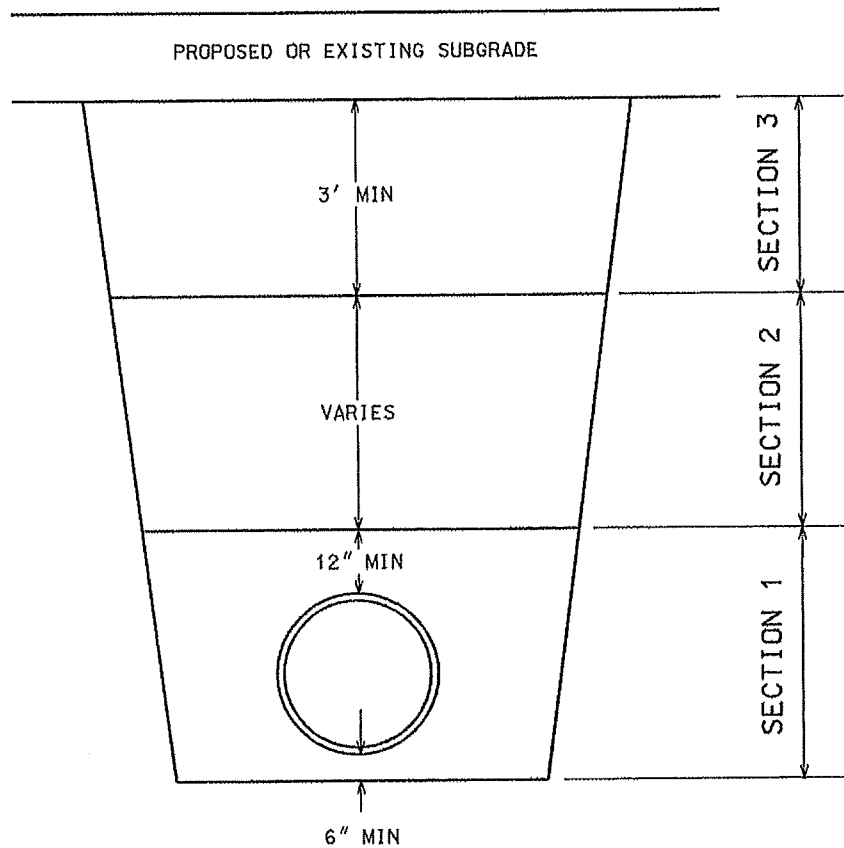
THE MAXIMUM ALLOWABLE TRENCH WIDTH SHALL BE THE MIN SPECIFIED PLUS 12". AND SHALL APPLY FROM THE BOTTOM OF THE TRENCH TO A POINT 12" ABOVE THE TOP OF THE PIPE. WHERE THIS WIDTH IS EXCEEDED, THE CONTRACTOR SHALL FURNISH AND INSTALL A HIGHER TYPE OF BEDDING AT NO EXTRA COST. THE TYPE OF BEDDING SHALL BE DETERMINED BY THE ENGINEER.

O.D. EQUALS THE OUTSIDE DIAMETER OF THE PIPE.

DRAWING NOT TO SCALE

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CITY OF MADISON ENGINEERING DIVISION
STORM PIPE BEDDING AND BACKFILL— SECTION 1 OF S.D.D.5.2.2.
STANDARD DETAIL DRAWING 5.2.1A



TYPICAL TRENCH COMPACTION

ALL BACKFILL MATERIAL SHALL BE PLACED IN LIFTS NOT TO EXCEED 12" BEFORE COMPACTION UNLESS AUTHORIZED BY THE ENGINEER DUE TO THE CHARACTER OF THE MATERIAL AND THE COMPACTING EQUIPMENT. EACH LIFT SHALL BE MECHANICALLY COMPACTED TO THE REQUIRED DENSITY PRIOR TO PLACING SUCCEEDING LIFTS OF BACKFILL MATERIAL.

IN COLD WEATHER, TRENCHES SHALL BE COMPACTED IN ACCORDANCE WITH THE REQUIREMENTS SPECIFIED IN SECTION 502.1 (e), BACKFILLING EXCAVATIONS AND COMPACTION OF BACKFILL, OF THESE SPECIFICATIONS.

SECTION 1:

MECHANICALLY COMPACTED BEDDING AS REQUIRED BY THE SPECIFICATIONS. COMPACTION ACHIEVED WITH SMALLER PLATE COMPACTOR. FOR ALL PLASTIC PIPE SECTION 1 SHALL BE INSTALLED IN ACCORDANCE WITH S.D.D. 5.2.1A

SECTION 2:

MINIMUM COMPACTION OF 90% MAXIMUM DENSITY. COMPACTION OF BACKFILL WITH BOMAG OR HOE-PAC SHALL NOT BEGIN UNTIL THE DEPTH OF BACKFILL MATERIAL IS TWO FEET ABOVE THE TOP OF PIPE.

SECTION 3:

MINIMUM COMPACTION OF 95% MAXIMUM DENSITY.

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CITY OF MADISON
ENGINEERING DIVISION

**TYPICAL
TRENCH
COMPACTION**

STANDARD DETAIL DRAWING 5.2.2

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SECTION 40 23 00

PROCESS PIPING GENERAL PROVISIONS

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. General provisions relating to process piping, valves, and related accessories.
- B. Related Sections:
 - 1. Section 09 91 50 - Shop Painting
 - 2. Section 09 97 20 - Coating Systems for Industrial Facilities
 - 3. Section 40 23 10 - Process Water and Waste Piping
 - 4. Section 40 23 20 - Process Piping Valves
 - 5. Section 40 23 30 - Process Piping Specialties
 - 6. Section 40 23 50 - Process Piping Testing, Adjusting, and Disinfection
 - 7. Section 40 92 13 - Process Regulating Valves
 - 8. Section 40 92 40 - Process Valve Actuators

1.02 REFERENCES

- A. AWWA:
 - 1. C104 - American National Standard for Cement - Mortar Lining for Ductile Iron Pipe and Fittings for Water
 - 2. C110 - American National Standard for Ductile Iron and Gray Iron Fittings, 3-Inches Through 48-Inches for Water and Other Liquids
 - 3. C111 - American National Standard for Rubber Gasket Joints for Ductile Iron and Gray Iron Pressure Pipe and Fittings
 - 4. C115 - American National Standard for Flanged Ductile Iron Pipe with Threaded Flanges
 - 5. C150 - American National Standard for Flanged Ductile Iron Pipe with Threaded Flanges
 - 6. C153 - American National Standard for Ductile Iron Compact Fittings for Water Service
 - 7. C500 - Standard for Gate Valves, for Water and Sewerage Systems
 - 8. C504 - Standard for Rubber Seated Butterfly Valves
 - 9. C508 - Standard for Swing Check Valves for Waterworks Service, 2-Inches Through 24-Inches NPS
 - 10. C509 - Standard for Resilient-Seated Gate Valves for Water Supply Service
 - 11. C512 - Air-Release, Air/Vacuum, and Combination Air Valves for Waterworks Service
 - 12. C540 - Power Actuating Devices for Valves and Sluice Gates
 - 13. C600 - Installation of Ductile-Iron Water Mains and Their Appurtenances
 - 14. C651 - Standard for Disinfecting Water Mains

1.03 SYSTEM DESCRIPTION

- A. Piping System:
 - 1. Provide a complete and fully operational process piping system inclusive of all appurtenances not specifically shown or covered by the Contract Documents but required for complete operation of the process system.
 - 2. Assume full responsibility for any additional costs that may result from unauthorized deviations from the Contract Documents.

1.04 SUBMITTALS

- A. Shop Drawings:
 - 1. Exterior yard piping drawings (minimum scale 1-inch equals 10-feet) with information including:
 - a. Dimensions of piping lengths.

- b. Centerline elevations of piping crossings.
 - c. Acknowledgement of bury depth requirements.
 - d. Details of fittings, tapping locations, thrust blocks, restrained joint segments, harnessed joint segments, hydrants, and related appurtenances.
 - e. Acknowledge designated valve or gate tag numbers, manhole numbers, instrument tag numbers, pipe and line numbers.
 - f. Line slopes and vents.
2. Interior piping drawings (minimum scale 1/8-inch equals 1-foot) with information including:
 - a. Dimensions of piping from column lines or wall surfaces.
 - b. Centerline dimensions of piping.
 - c. Centerline elevation and size of intersecting ductwork, conduit/conduit racks, or other potential interferences requiring coordination.
 - d. Location and type of pipe supports and anchors.
 - e. Locations of valves and valve actuator type.
 - f. Details of fittings, tapping locations, equipment connections, flexible expansion joints, connections to equipment, and related appurtenances.
 - g. Acknowledgement of valve, equipment and instrument tag numbers.
 - h. Provisions for expansion and contraction.
 - i. Line slopes and air release vents.
 3. Schedule of interconnections to existing piping and method of connection.
- B. Test Reports:
1. Copies of pressure test results on all piping systems.
 2. Reports defining results of dielectric testing and corrective action taken.
 3. Disinfection test report.
 4. Notification of time and date of piping pressure tests.
- C. Operation and Maintenance Manuals: See Section 01 78 23.

1.05 QUALITY ASSURANCE

- A. The physical and chemical properties of all materials, design, performance characteristics and methods of construction and installation of all process items shall be in accordance with applicable current editions of the following standards, references, and guidelines.
1. American Water Works Association (AWWA)
 2. American Society for Testing and Materials (ASTM)
 3. American Society of Mechanical Engineers (ASME)
 4. American National Standards Institute (ANSI)
 5. Occupational Safety and Health Act (OSHA)
 6. National Electrical Manufacturers Association (NEMA)
 7. Institute of Electrical and Electronic Engineers (IEEE)
 8. Underwriters Laboratories, Inc. (UL)
 9. The Chlorine Institute
 10. Pipe Fabrication Institute
- B. All materials, equipment and their installation shall comply with the applicable sections of the following current codes:
1. Madison Standard Specifications
 2. WDNR - NR 811
 3. Recommended Standards for Water Works ("10 State Standards"), Great Lakes - Upper Mississippi River Board of State and Provincial Public Health and Environmental Managers.
- C. Provide Certificates of Compliance from the manufacturer certifying that the particular product meets the respective requirements for that item.
- D. All welding shall be performed by ASME certified welders. Submit copies of the welder's certification to the Engineer prior to any welds made.

1.06 DELIVERY, STORAGE AND HANDLING:

- A. Inspection:
 - 1. Inspect all pipe and products as it is received to determine damage and/or missing parts.
 - 2. Notify Engineer of any missing, damaged, or defective products.
 - 3. Remove all products found to be defective by the Engineer from the site.
 - 4. Repair or replace damaged items in accordance with the manufacturer's instructions.
- B. Handling and Storage: Handling and storage of products shall be in accordance with Section 22 of AWWA C600.

1.07 SCHEDULING

- A. Schedule all process work in phases to accommodate the Owner's occupancy and treatment requirements.
- B. Inform the Owner and Engineer at least 48 hours in advance of any service interruption, disruption to construction activities, or to the existing process system operation. Do not proceed until the Owner has granted approval.

PART 2 PRODUCTS

2.01 PROCESS PIPING MATERIALS

- A. Materials used shall be in accordance to the requirements for class and size as specified or shown on the Drawings.
- B. All portions of the process piping system shall be capable of handling stresses that may occur during fabrication, installation, pressure testing and intermittent or continuous operation.

2.02 FINISHES

- A. All piping, fittings, valves and related products and equipment shall be finished, color coded, and labeled in accordance with Section 09 97 20.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Determine locations and dimensions of existing structures, piping, and equipment associated with or potentially interfering with the proper fabrication and installation of proposed work.
- B. Coordinate final length and location of required pipe connections to all process equipment to meet the recommendations and requirements of the equipment manufacturer subject to approval of the Engineer.
- C. No work shall be installed that directly connects to equipment until such time as complete Shop Drawings of said equipment have been reviewed by the Engineer.
- D. Determine and be responsible for the proper locations and character of all hangers, chases, sleeves and other openings in the construction required for all process piping work.
- E. Refer to other drawings for exact locations of partitions, walls, doors, equipment, etc.

3.02 INSTALLATION

- A. Exposed Process Piping, Valves, Supports, and Accessories
 - 1. Provide piping systems in accordance with the manufacturer's instructions and recommendations.
 - 2. Provide ductwork, piping, electrical connections, valves, and appurtenances recommended by the manufacturer for proper operation to complete the operation.
 - 3. Install all process piping systems to facilitate accessibility for maintenance and/or replacement.
 - 4. Protect all work from subsequent construction activity.
 - 5. Inplace components will be salvaged at the discretion of the Owner.
 - a. Remove and deliver salvaged items as directed by Owner.
 - b. Non-salvaged items will become property of the Contractor and promptly removed from the Site.

3.03 CONNECTIONS WITH EXISTING PIPING

- A. Where connection between new and existing work is made, use suitable and proper fittings to suit conditions encountered.
- B. Provide suitable equipment and facilities to dewater, drain, and dispose of liquid removed without damage to adjacent property.
- C. Where connection involves potable water systems, provide disinfection methods as prescribed in these Specifications.

3.04 PROTECTION

- A. When pipe installation is not in progress, keep pipe and fitting openings, including manholes, tightly closed.
- B. Closures shall be suitable to prevent entrance of animals, foreign materials, and extraneous water into the process system.

END OF SECTION

SECTION 40 23 10

PROCESS WATER AND WASTE PIPING

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Process water and waste piping and fitting materials.
 - 2. Installation of process piping and fittings.

- B. Related Sections:
 - 1. Section 09 91 50 - Shop Painting
 - 2. Section 09 97 20 - Coatings for Industrial Facilities
 - 3. Section 40 23 00 - Process Piping General Provisions
 - 4. Section 40 23 20 - Process Piping Valves and Operators
 - 5. Section 40 23 30 - Process Piping Specialties
 - 6. Section 40 23 40 - Process Piping Hangers and Supports
 - 7. Section 40 23 50 - Process Piping Testing, Adjusting, and Disinfection

1.02 REFERENCES

- A. ASTM:
 - 1. D1785 - Specification for PVC Pipe, Schedules 40, 80, and 120
 - 2. D2464 - Specification for Threaded PVC Pipe Fittings, Schedule 80
 - 3. D2467 - Specification for PVC Pipe Fittings, Schedule 80
 - 4. D2564 - Specification for Solvent Cements for PVC Piping Systems

- B. AWWA:
 - 1. C104 - American National Standard for Cement - Mortar Lining for Ductile Iron Pipe and Fittings for Water
 - 2. C110 - Standard for Ductile Iron and Gray Iron Fittings for Water
 - 3. C111 - Standard for Rubber-Gasket Joints for Ductile Iron Pressure Pipe and Fittings
 - 4. C115 - Standard for Flanged Ductile Iron Pipe and Ductile Iron or Gray Iron Threaded Flanges
 - 5. C150 - Standard for Thickness Design of Ductile Iron Pipe
 - 6. C151 - Standard for Ductile Iron Pipe, Centrifugally Cast, for Water
 - 7. C153 - Standard for Ductile Iron Compact Fittings for Water Service
 - 8. C606 - Standard for Grooved and Shouldered Joints

1.03 SUBMITTALS

- A. Submit Shop Drawings for:
 - 1. Location and style of all pipe hangers, supports and anchors.
 - 2. Length of pipe and pipe spools for exposed piping.
 - 3. Detailed piping layout for connection to existing and proposed pipe and equipment.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. DI Pipe and Fittings:
 - 1. American Cast Iron Pipe Co.
 - 2. U.S. Pipe
 - 3. Approved equals per Article 6.05 of the General Conditions

2.02 PIPE

- A. Ductile Iron: AWWA C151.
 - 1. Cement-Mortar Lining: AWWA C104.
 - 2. Thickness Class: 52.
- B. PVC: ASTM D1785.
 - 1. Class 123454-B.
 - 2. Schedule 80.

2.03 FITTINGS

- A. Ductile Iron: AWWA C153.
 - 1. Cement-Mortar Lining: AWWA C104.
 - 2. Joints:
 - a. Flanged: AWWA C110.
 - b. Mechanical: AWWA C111.
- B. PVC: Schedule 80.
 - 1. Threaded: ASTM D2464.
 - 2. Socket: ASTM D2467.
 - a. Solvent Cement: ASTM D2564.

2.04 ANCHOR BOLTS AND NUTS

- A. Interior Fittings: Zinc coated steel.
- B. Submerged and Buried Fittings: 304 stainless steel.

2.05 COATINGS

- A. Encased or Buried Pipe:
 - 1. Asphaltic coating per AWWA C151.
 - 2. Minimum Thickness: 1 mil.
- B. Interior Pipe:
 - 1. 2-component shop prime.
 - 2. Final coat per Section 09 97 20.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Provide piping in accordance with Section 40 23 00 and as shown on the Contract Drawings.
- B. Install vertical piping runs plumb and horizontal runs parallel with structure wall unless otherwise noted on the Drawings.
- C. Alignment for piping smaller than 4 inches may not be shown on Drawings. Install with clearance and allowance for:
 - 1. Expansion and contraction.
 - 2. Operation and access to equipment, doors, windows, hoists, and moving equipment.
 - 3. Headroom and walking space for working areas and aisles.
 - 4. System drainage and air removal.
- D. Provide full force gaskets on all systems.
- E. Fit flange joints so contact faces bear uniformly on gasket. Ensure uniform bolt stress when tightened.

- F. Bolts shall not extend more than 0.5-inch beyond the nut for all applications.
- G. Provide hangers and supports in accordance with Section 40 23 40.

END OF SECTION

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SECTION 40 23 20

PROCESS PIPING VALVES

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Process piping valves and accessories.
- B. Related Sections:
 - 1. Section 09 91 50 - Shop Painting
 - 2. Section 09 97 20 - Coatings for Industrial Facilities
 - 3. Section 40 23 00 - Process Piping General Provisions
 - 4. Section 40 23 10 - Process Water and Waste Piping
 - 5. Section 40 23 40 - Process Piping Hangers and Supports
 - 6. Section 40 23 50 - Process Piping Testing, Adjusting, and Disinfection
 - 7. Section 40 92 40 - Process Valve Actuators
 - 8. Section 40 95 26 - Process Instrumentation Piping

1.02 REFERENCES

- A. AWWA:
 - 1. C504 - Rubber-Seated Butterfly Valves
 - 2. C508 - Swing-Check Valves for Waterworks Service, 2-Inch Through 24-Inch
 - 3. C509 - Standard for Resilient-Seated Gate Valves for Water Supply Service
 - 4. C511 - Reduced-Pressure Principle Backflow Prevention Assembly
 - 5. C512 - Air Release, Air/Vacuum, and Combination Air Valves for Waterworks Service

1.03 SUBMITTALS

- A. Catalog data, net weight, and assembly drawings.
- B. Affidavit of Compliance per AWWA standards.

PART 2 PRODUCTS

2.01 MANUFACTURED UNITS

- A. Provide valves of the same size, joint type, and body material as the corresponding piping, unless otherwise indicated.
- B. Provide valves of the same type from the same manufacturer.

2.02 GATE VALVES (3-INCH OR LARGER)

- A. Gate Valves (3-inch or larger):
 - 1. Valves shall be resilient seated gate valves conforming to the latest revision of AWWA standard C-509.
 - 2. Valves shall be non-rising stem, opening by turning stem left and provided with a handwheel, unless otherwise shown or specified, and the word "open" and an arrow cast in the metal to indicate direction to open.
 - 3. The wedge shall be cast iron completely encapsulated, except for guide and stem nut areas, with polyurethane rubber.

4. The polyurethane sealing rubber shall be permanently bonded to the cast iron wedge to meet ASTM tests for rubber to metal bond ASTM D429.
5. Stem shall be cast bronze with integral collars in full compliance with AWWA standards. The stem stuffing box shall be the o-ring seal type with two o-rings located above the thrust collar. The two o-rings shall be replaceable with valve fully open and subjected to full rated working pressure.
6. Provide two low torque thrust bearings located above and below the stem collar. The stem nut shall be independent of wedge and shall be made of solid bronze.
7. There shall be a smooth unobstructed waterway free of all pockets, cavities and depressions in the seat area.
8. The body and bonnet shall be coated with on the interior and exterior with fusion bonded epoxy.
9. Each valve shall have manufacturer's name, size, pressure rating, and year in which manufactured cast on the body.
10. Prior to shipment from factory, each valve shall be tested by hydrostatic pressure equal to twice the specified working pressure.
11. Approved Manufacturers: Clow, American, Mueller, M&H, or approved equal.

2.03 BUTTERFLY VALVES (3-INCH THROUGH 24-INCH)

1. Butterfly valves 3-inch through 24-inch shall have flanged ends and meet or exceed the requirements of AWWA C504 Class 150B and MSS SP-67.
2. Valve body shall be ASTM A126 Class B cast iron.
3. Disc:
 - a. **3-inc to 20-inch Valve Disc:** The disc shall be a lens-shaped design to afford minimal pressure drop and line turbulence. Materials of construction shall be: **8-inch to 20-inch** ASTM A126, Class B cast iron disc with a stainless steel Type 316 edge
4. Valve stem shall be 304 stainless steel and shall be supported on upper and lower nylon bearings.
5. Seat and stem seals shall be acrylonitrile-butadiene.
6. The seat shall be compression molded in the body and shall conform to ASTM D429 test standards.
7. Operators
 - a. Handwheel operators shall be provided for all 6-inch and larger butterfly valves. Valves with centerlines more than 6 feet above the floor shall be equipped with chain wheels and chains. Handwheel operators (geared actuators) shall be furnished with a 2-inch AWWA nut, cast iron handwheel. Handwheels shall have a maximum diameter of 12 inches. The operator shall be capable of throttling the valve in any position and holding this position under all operating conditions. The unit shall be of the worm screw or traveling nut type, totally enclosed, operating in a lubricant. Exterior position indication shall be provided. Maximum handwheel or chainwheel pull shall be 80 pounds at the rim.
 - b. All butterfly valves shall be provided with position indicators.
 - c. Provide electric or pneumatic actuators where shown on the drawings in accordance with the Pneumatic Actuators article of this section or Section 40 92 43.
8. All process butterfly valves throughout the treatment facility shall be by the same manufacturer.
 - a. In-plant butterfly valves shall be DeZurik BAW. No substitutes.

2.04 SWING-CHECK VALVES

- A. Swing Check Valves (Air Cushioned)
 1. The swing check valve shall be constructed with heavy cast iron or cast steel body with a bronze or stainless steel seat ring, a non-corrosive shaft for attachment of weight and lever, and complete non-corrosive trim cushion chamber. Body shall have minimum 175 psi pressure rating and shall be provided with ANSI standard 125-pound flanges.
 2. Valve shall absolutely prevent the return of water, soil, or gas back through the valve when the inlet pressure decreases below the deliver pressure. The valve must be tight seating, and must be cushioned in operation. The seat ring must be renewable.
 3. The cushion chamber shall be of bronze construction and the shock absorption by air. The cushion chamber shall be attached to the side of the valve body externally and so constructed with a piston operating in a chamber that will effectively permit the valve to be operated without

- any hammering action. The cushion chamber shall be arranged that the closing will be adjustable to meet the service requirements.
4. The valve disc shall be convex and of cast iron or cast steel and shall be suspended from a non-corrosive shaft which will pass through a stuffing box and be connected to the cushion chamber on the outside of the valve.
 5. All material and workmanship shall be first class throughout and the purchaser reserves the right to inspect this valve before shipment.
 6. Air cushioned swing check valves shall be Golden Anderson Figure No. 250-D, or APCO Series 250.

2.05 AIR RELIEF VALVES

- A. AWWA C512.
- B. Body, Cover, and Baffle: Cast or ductile iron.
- C. Fasteners, Internal Linkage, Internal Parts, Float, and Float Guide: Stainless steel.
- D. Elastomers: Buna-N.
- E. Provide with inlet shut-off ball valve.
- F. Extend discharge lines to 18 inches above floor.
- G. Provide pipe saddle as required to allow adequate thread depth.
- H. Venting Rates: Within manufacturer's recommendations.
- I. Air Release Valves:
 1. Size valves based on flow rates and pressures.
 2. Acceptable Manufacturers/Models:
 - a. APCO Series 200.
 - b. Val-Matic Models 38, 45, and 50.
 - c. Approved equal.
- J. Air Release/Vacuum Breaker Valves:
 1. Size valves based on flow rates and pressures.
 2. Provide adjustable throttling device to regulate air flow rate.
 3. Acceptable Manufacturers/Models:
 - a. APCO Series 140.
 - b. Val-Matic Models 100, 101, and 102.
 - c. Approved equal.

2.06 SAMPLE TAPS

- A. Body:
 1. Material: Brass.
 2. One piece, angle pattern, globe valve.
 3. Integral MPT pipe connection.
 4. Hex nut.
 5. Smooth interval passageway to discourage bacterial growth.
- B. Seat Seal: Rubber.
- C. Operating Knob: Round, minimum 1.25-inch diameter, plastic or metal, replaceable.
- D. Acceptable Manufacturers:
 1. Conbraco.
 2. Approved equal.

2.07 SOLENOID VALVES

- A. Minimum Working Pressure: 150 psi.
- B. Screwed ends.
- C. Body Material:
 - 1. Water, Air, or Gas Service: Brass or bronze.
 - a. Trim and spring: Stainless steel.
 - b. Seals: Teflon.
 - 2. Corrosive Environment: Stainless steel.
 - 3. Chemical and Corrosive Fluid Service: Teflon.
- D. Electrical:
 - 1. Enclosure: NEMA, Type 1.
 - 2. Coil Ratings: Continuous duty.
- E. Acceptable Manufacturers/Models:
 - 1. General Duty:
 - a. Automatic Switch Co. (ASCO) Model - Red Hot.
 - b. Skinner Valve Division/Honeywell Model - Lancer.
 - c. Magnatrol Valve Corp.
 - d. Approved equal.
 - 2. Corrosive Fluid Duty:
 - a. Valcor Engineering Corp.
 - b. +GF+Plastic Systems, Inc
 - c. Approved equal.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Inspect all material and equipment as it is received to determine damage and/or missing parts. Repair or replace damaged items in accordance with the manufacturer's instructions.

3.02 INSTALLATION AND TESTING

- A. Each item or system shall be furnished complete and installed as shown on the drawings and in accordance with the manufacturer's recommendations, instructions and directions. The complete installation shall function properly and reflect a high work quality.
- B. Refer to related sections of this specification for additional installation and testing requirements and information. Tests shall be conducted after all valves are installed.

3.03 PAINTING

- A. The exterior of all valves, operators, and accessories, unless otherwise described, shall be painted as specified under Section 09 91 00. Valves shall be painted to match the color of the adjacent piping.

3.04 OPERATOR TRAINING

- A. Provide minimum of 1 hour of operator training, for each type of actuator function (electric or pneumatic) included in the Project. Schedule training at Owner's convenience, after system is operational.

3.05 PARTIAL VALVE SCHEDULE

- A. The following valve schedule has been included in this specification section for the purposes of conveying information regarding operator requirements for some of the butterfly valves to be installed as part of this project. The list is not intended to be complete. All of the manually actuated valves, as well as the air release and air and vacuum valves, have been intentionally kept off the list.

END OF SECTION

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SECTION 40 23 30

PROCESS PIPING SPECIALTIES

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Miscellaneous process piping items.
- B. Related Sections:
 - 1. Section 40 23 00 - Process Piping General Provisions
 - 2. Section 40 23 10 - Process Water and Waste Piping

1.02 REFERENCES

- A. ASTM:
 - 1. C534 - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form
 - 2. E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2005
 - 3. E96 - Standard Test Methods for Water Vapor Transmission of Materials; 2000
- B. NFPA:
 - 1. 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials; 2006
- C. UL:
 - 1. 723 - Standard for Test for Surface Burning Characteristics of Building Materials, 2003

1.03 SUBMITTALS

- A. Submit Product Data which includes the following for each item furnished:
 - 1. Manufacturer and model.
 - 2. Component materials.
 - 3. Dimensions.
- B. Seal Installation Through Fire-rated Wall, Roof, or Floor:
 - 1. Provide Engineer and Code Official with 2 copies each of proposed firestop system for each pipe penetration.
 - 2. System information shall include:
 - a. UL system numbers.
 - b. F and T ratings.
 - c. Detailed drawing.
 - d. Manufacturer name.
 - e. Installation procedure.
 - f. List of components.

PART 2 PRODUCTS

2.01 EXPANSION JOINTS

- A. EPDM or Teflon single-filled arch spool type.
- B. Full face steel flanges.
- C. Temperature Range: 40 to 100 degrees F.

- D. Design for UV exposure.
- E. Maximum Working Pressure: 125 psi.
- F. Furnish tie rods, limiter sleeves, and retaining brackets where indicated on Drawings.
- G. Acceptable Manufacturers:
 - 1. Proco Products, Inc.
 - 2. Mercer Ruber Co.
 - 3. Red Valve Co., Inc.
 - 4. Approved equals.

2.02 PRESSURE GAGES AND COCKS

- A. Pressure Gage:
 - 1. Size: 4-1/2 inch dial.
 - 2. Range: 0-160 psi, unless shown on Drawings.
 - 3. Graduation: 2 psi.
 - 4. Accuracy: 1/2 percent.
 - 5. Movement: Heavy-duty stainless steel.
 - 6. Case: Fiberglass Reinforced Polypropylene.
 - 7. Mounting: Direct (stem).
 - 8. Connection: 1/4-inch NPT, bottom.
 - 9. Glycerin - filled.
 - 10. Manufacturer: Weksler AY04, Trerice No. 500-X Series, Ashcroft Duragauge, or approved equal.
- B. Isolation Cock:
 - 1. Ball valve.
 - 2. Suitable to 200 psi.
 - 3. 1/4-inch NPT male and female connections.

2.03 PIPE COUPLINGS

- A. Sleeve type.
- B. Furnish to match pipe being coupled.
 - 1. Size.
 - 2. Material.
 - 3. Pressure.
 - 4. Service of pipe.
- C. Acceptable Manufacturers/Models:
 - 1. Dresser, Style 38.
 - 2. Smith Blair, Type 411.
 - 3. Approved equal.

2.04 FLANGED ADAPTERS

- A. Furnish to match the pipe being connected:
 - 1. Size.
 - 2. Material.
 - 3. Pressure.
 - 4. Service of pipe.
- B. Acceptable Manufacturers/Models:
 - 1. EBBA Iron Series 2100 Megaflange.
 - 2. Dresser, Style 127.

3. Smith Blair, Type 911.
4. Approved equal.

2.05 PIPE SLEEVES

- A. Material: Steel Pipe.
 1. Furnish zinc-coated steel pipe in the following installations:
 - a. Masonry walls and floor.
 - b. Fire-rated gypboard partitions.
 - c. Masonry or steel deck roofs.
 2. Furnish zinc-coated sheet steel in the following installation:
 - a. Non fire-rated gypboard partitions.
- B. Size:
 1. Minimum: 2 nominal pipe sizes larger than respective pipe.
- C. Acceptable Manufacturers/Models:
 1. American Cast Iron Pipe, Model A-01770.
 2. Approved equal.

2.06 SEALS

- A. Furnish positive hydrostatic pipe link seal.
 1. Sealing Element: Synthetic rubber material expanded by tightening of zinc galvanized plate carbon bolts.
- B. Acceptable Manufacturers:
 1. Thunderline Corp.
 2. Approved equal.

2.07 WALL PIPES

- A. Material: Ductile iron.
- B. Size and End Connections: Match adjacent pipe.
- C. Furnish with welded or integrally-cast waterstop collar.
- D. Acceptable Manufacturers:
 1. Clow Pipe.
 2. American Cast Iron Pipe.
 3. Approved equal.

PART 3 EXECUTION

3.01 INSTALLATION

- A. General:
 1. Install all items in accordance with manufacturer's recommendations.
 2. Install items only where indicated on the Drawings.
 3. Installation at other location only with prior approved by the Engineer.
- B. Pipe Sleeves:
 1. Sleeve each pipe individually.
 2. Floor Installation: Extend sleeve 2 inches above finished floor.
 3. Roof Installation:
 - a. Extend sleeve from 4 inches below to 12 inches above roof deck.
 - b. Furnish with welded attachment brackets.

- c. Furnish with weather skirt for each sleeve.
- 4. Provide continuously welded waterstop collar on sleeves set in masonry or concrete.

C. Seals:

- 1. Installation through fire-rated wall, floor, or roof.
- 2. Seal annular space between piping and sleeve with approved brand fire barrier caulk or putty.

END OF SECTION

SECTION 40 23 50

PROCESS PIPING TESTING, ADJUSTING, AND DISINFECTION

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Hydrostatic leak testing.
 - 2. Process equipment testing and adjusting.
 - 3. Process system disinfection.
- B. Related Sections:
 - 1. Section 40 23 00 - Process Piping General Provisions
 - 2. Section 40 23 10 - Process Piping Water and Waste Piping

1.02 REFERENCES

- A. AWWA:
 - 1. C651 - Disinfecting Water Mains
 - 2. C653 - Disinfection of Water Treatment Plants

1.03 SUBMITTALS

- A. Submit copies of the following test results:
 - 1. Field quality control.
 - 2. Start-up.
 - 3. Disinfection.

1.04 SCHEDULING AND SEQUENCING

- A. Perform leakage testing prior to the application of coatings or insulation on the piping.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.01 PREPARATION

- A. Isolate all piping and equipment from potable water systems.
- B. Remove foreign materials from the piping and equipment by means of flushing or other appropriate methods.
- C. Install taps in pipe as required to expel air prior to hydrostatic testing.

3.02 FIELD QUALITY CONTROL

- A. Leakage Testing:
 - 1. Perform hydrostatic leakage testing on all process piping and equipment as follows:
 - a. Test pressure:
 - 1) Ductile iron pipe: 100 psi.
 - 2) Steel pipe: 100 psi.
 - 3) PVC pipe: 100 psi.
 - b. Test duration: 1 hour.
 - c. Allowable pressure drop: None.
 - 2. If pressure drop is detected, determine and correct source of leakage.
 - 3. Re-test until satisfactory results are obtained.
- B. Manufacturer's Field Service:
 - 1. Inspect, calibrate, and adjust process equipment and systems prior to start-up.
 - 2. Supervise placement of equipment and systems into operation.
 - 3. Perform final inspection and adjustment to ensure proper operation of the system.

3.03 DISINFECTION

- A. Perform disinfection of all process piping and equipment in accordance with the following:
 - 1. AWWA C651.
 - 2. AWWA C653.
- B. Hold chlorine solution in pipe for a minimum of 24 hours.
 - 1. Initial Dosage: 50 ppm minimum.
 - 2. Residual Dosage After Hold Period: 10 ppm minimum.
- C. Operate all valves and other equipment during disinfection to ensure complete coverage.
- D. Flush system with potable water within 24 hours after disinfection is completed.
- E. After flushing, obtain 2 sets of samples taken a minimum of 24 hours apart.
 - 1. Take sample sets from various representative areas of the piping.
 - 2. Minimum Samples Required: 2.
- F. Perform coliform and chlorine residual tests on each sample.
- G. Rechlorinate if any samples test positive for coliform.
- H. After satisfactory test results are achieved, the piping may be connected to the potable water system.

END OF SECTION

SECTION 40 91 20

PROCESS PRESSURE GAGES

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes pressure gages for discharge piping.
- B. Related Sections:
 - 1. Section 40 23 30 - Process Piping Specialties

1.02 REFERENCES

- A. ANSI:
 - 1. B40.1, Grade 2A - Gages, Pressure, and Vacuum Indicating Dial Type - Elastic Element

1.03 SUBMITTALS

- A. Product Data
- B. Manufacturer's Instructions for Installation

1.04 PROJECT CONDITIONS

- A. Drawings do not purport to show actual field dimensions, but are intended only to establish location and scope of Work. Field-verify dimensions and assume full responsibility for their accuracy.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Weksler Instruments Corporation, Model AY4.
- B. Trefice No., Model 500-X Series.
- C. Ashcroft, Model Duragauge.
- D. "Or equal" models submitted and approved in accordance with Article 11 of the Instructions to Bidders and General Condition 6.05.A.1.

2.02 EQUIPMENT

- A. Gages:
 - 1. Well Pump
 - a. Size: 4-1/2-inch dial.
 - b. One (1) Pump Discharge Gage, Range: 0 - 60 psi.
 - c. Graduation: 1 psi.
 - d. Accuracy: 1/2 percent.
 - e. Movement: Heavy-duty stainless steel.
 - f. Case: Fiberglass Reinforced Polypropylene.
 - g. Mounting: Direct (stem).
 - h. Connection: 1/4 -inch NPT, bottom.

2. Booster Pump
 - a. Size: 4-1/2-inch dial.
 - b. Two (2) Pump Discharge Gages, Range: 0 - 160 psi.
 - c. Two (2) Pump Suction Gages, Range : 30 inches HG to 15 psi.
 - d. Graduation: 1 psi.
 - e. Accuracy: 1/2 percent.
 - f. Movement: Heavy-duty stainless steel.
 - g. Case: Fiberglass Reinforced Polypropylene.
 - h. Mounting: Direct (stem).
 - i. Connection: 1/4 -inch NPT, bottom.
 - j. Glycerine - filled.
 - k. Bourdon Tube and Socket Material: Stainless Steel, 316

B. Valves:

1. Ball Valve.
2. Bronze.
3. Suitable to 200 psi.
4. 1/4-inch NPT male and female connections.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Mount gages vertical and plumb horizontally in the locations shown on the Drawings.
- B. Mount gages in accordance with the manufacturer's recommendations for installation.
- C. Provide ball valve with each gage installation.
- D. Provide diaphragm seal with each gage installation.

END OF SECTION

SECTION 40 92 13

PROCESS REGULATING VALVES

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Hydraulically operated valves for the control of flow and pressure.
- B. Related Sections:
 - 1. Section 40 23 00 - Process Piping General Provisions
 - 2. Section 40 23 20 - Process Piping Valves

1.02 REFERENCES

- A. ANSI:
 - 1. B2.1 - Standard Specification for Naval Brass Rod, Bar, and Shapes
 - 2. B16.1 - Cast Copper Alloy Solder Joint Pressure Fittings
- B. ASTM:
 - 1. A536 - Standard Specification for Ductile Iron Castings
- C. AWWA:
 - 1. C550 - Protective Interior Coatings for Valves and Hydrants

1.03 SUBMITTALS

- A. Product Data.
- B. Shop Drawings showing valve size and dimensions.
- C. Manufacturer's instructions for installation.

1.04 WARRANTY

- A. Provided by valve manufacturer.
- B. Warrants against defects in workmanship and materials.
- C. Period: 3 years from the agreed upon date of Substantial Completion of the contract.
- D. Apply to all units provided.
- E. Provide in published form.

PART 2 PRODUCTS

2.01 COMBINATION RATE-OF-FLOW CONTROL VALVE

- A. Features:
 - 1. Cla-Val Model 49-05 or approved equal.
 - 2. Rate of flow control.
 - 3. Pressure reducing.

4. Back pressure sustaining.
 5. Design Flow Rate: 2100 gpm.
 6. Adjustable Flow Range: 1800 to 2500 gpm of continuous flow.
- B. Accessories:
1. Wye-type strainer external to body in pilot system.
 2. Isolating petcocks and valve position indicator.
 3. Check feature.
 4. Pressure reducing and back pressure sustaining control.
 5. Adjustable range pilot control and orifice plate assembly.
 6. Epoxy coatings inside and out.
- C. See Drawings for size and location.

PART 3 EXECUTION

3.01 FIELD QUALITY CONTROL

- A. Manufacturer's Field Services:
1. Provide minimum of 2 hours of qualified representative to perform the following:
 - a. Inspect installation.
 - b. Perform field testing.
 - c. Supervise start-up.
 - d. Provide final adjustments.

3.02 DEMONSTRATION

- A. Operator Training:
1. Provide qualified representative to perform the following:
 - a. After equipment is operational, provide minimum of 2 hours of operator training to Owner's personnel.

END OF SECTION

SECTION 40 92 40

PROCESS VALVE ACTUATORS

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Electric and pneumatic power-actuating devices for process valves.
- B. Related Sections:
 - 1. Section 09 91 50 - Shop Painting
 - 2. Section 40 23 20 - Process Piping Valves
 - 3. Section 40 90 00 - Instrumentation and Control for Process Systems

1.02 REFERENCES

- A. AWWA:
 - 1. C540 - Power-Actuating Devices for Valves and Sluice Gates

1.03 DESIGN REQUIREMENTS

- A. Features:
 - 1. Ensure that the motor runs with the correct rotation for the required direction of travel without regard of the connection sequence of the power supply.
 - 2. The following shall be completed without removal of the actuator covers:
 - a. Setting of the torque levels and position limits.
 - b. Configuration of the indication contacts.
- B. Sizing: Size actuator to ensure valve closure at the differential pressure at each location.
 - 1. Verify differential pressures at each location prior to ordering.
 - 2. Coordinate with valve manufacturer to ensure proper sizing for each valve model and size.
- C. Commissioning Tools:
 - 1. Provide with each actuator.
 - 2. Shall not form an integral part of the actuator.
 - 3. Shall meet enclosure protection and certification levels of the actuator.
 - 4. Shall be removable for secure storage/authorized release.
 - 5. Ensure protection of configured actuator settings by a means independent of access to the commissioning tool.

1.04 PERFORMANCE REQUIREMENTS

- A. Electrical:
 - 1. Operate on a minimum 460 volt, 3 phase, 60 Hz power supply.
 - 2. Incorporate the following:
 - a. Motor integral reversing starter.
 - b. Local control facilities and terminals for remote control.
 - c. Indication connections housed within a self-contained sealed enclosure.
- B. Environmental:
 - 1. Enclosure: NEMA 4X/6P
 - 2. Capable of functioning in an ambient temperature range of 32 degrees F to 100 degrees F.
 - 3. Capable of functioning in relative humidity up to 100 percent.

- C. Operating Speed:
 - 1. Speed of Operation 25 Seconds
- D. The safety margin of motor power available for seating and unseating the valve shall be sufficient to ensure torque switch trip at maximum valve torque with the supply voltage 10 percent below normal.

1.05 SUBMITTALS

- A. Product Data: Submit Product Data for each type of actuator provided.
- B. Shop Drawings: Submit scaled Shop Drawings for each size and type of actuator provided.
- C. Quality Assurance:
 - 1. A list of actuators to be provided for each application which includes:
 - a. Torque capabilities.
 - b. Operating torques.
 - 1) Seating.
 - 2) Unseating.
 - 2. Certificates of performance testing.
- D. Close-out:
 - 1. System start-up reports.
 - 2. Operation and maintenance manuals.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. 8" Butterfly Valves: Auma Model SQ10.2 – No Substitutes
- B. 12" Butterfly Valves: Auma Model SQ12.2 – No Substitutes

2.02 COMPONENTS

- A. Enclosure:
 - 1. Features:
 - a. O-ring seals.
 - b. Watertight to NEMA 4X/6
 - c. All electric actuators shall conform to the applicable requirements of AWWA Standards C540 and C504. Actuators shall contain a motor, gearing, manual over-ride, sixteen contact limit switch, torque switch, drive coupling, integral motor controls, position feedback transmitter (Modulating Service) and a mechanical dial position indicator.
 - d. Inner watertight and dustproof O-ring seal between terminal compartment and internal electrical elements of the actuator.
 - 2. Protect motor and all internal components from moisture and dust when terminal cover is removed for cabling.
 - 3. External Fasteners:
 - a. Material: Stainless steel. In order to prevent the loss of fasteners during commissioning or maintenance, the limit switch and terminal compartments shall have captured bolts.
- B. Motor:
 - 1. The motor shall be specifically designed for actuator service. The motor will be of the induction type with class F insulation and protected by means of thermal switches imbedded in the motor windings. Motor enclosure will be totally enclosed, non-ventilated. Motors will be capable of operating on 480 volt - 3 phase - 60 hertz power. The motor shall have a plug and socket connector for ease of maintenance. No grease or oil will be permitted in the motor compartment.

2. Time rating at 104 degrees F and minimum load of 33 percent of maximum valve torque shall be the longer of the following:
 - a. 15 minutes.
 - b. Twice the valve stroking time.
 3. Electrical and mechanical disconnection of the motor shall be accomplished without draining lubricant from the gearcase.
- C. Motor Protection Features:
1. Motor shall de-energize in the event of a stall when attempting to unseat a jammed valve.
 2. Sense motor temperature by means of a thermostat.
 3. Thermostat shall de-energize motor in case of overheating.
 4. Lost phase protection.
- D. Gearing:
1. All gearing shall be grease lubricated and designed to withstand the full stall torque of the motor. Oil lubrication is not acceptable.
 2. Suitable for operation at any angle.
 3. Drive gearing and components:
 - a. Metal construction.
 - b. Include lost-motion hammer blow feature.
 4. For rising spindle valves:
 - a. Hollow output shaft to accept rising stem.
 - b. Incorporate ball or roller-type thrust bearings at the base of the actuator.
 - c. Provide for opening of gearcase for inspection or disassembly without releasing the stem thrust or removing valve from service.
- E. Hand Operation:
1. Provide handwheel for emergency operation.
 2. Features:
 - a. Engage by lever mechanism when motor is de-clutched.
 - b. Automatically restore drive to power when motor starts.
 - c. Handwheel or selection level to remain in place on restoration of motor drive.
 - d. Lockable hand/auto selection lever in either position.
 - e. Selection of hand operation while actuator is running.
 - f. Start actuator motor while selection lever is locked in hand.
 3. Handwheel Drive: Mechanically independent of motor drive.
 4. Handwheel gearing to permit emergency manual operation in reasonable time.
 5. Provide valve closure by clockwise handwheel operation.
- F. Drive Bushing:
1. Easily detachable for machining to accommodate valve stem or gearbox input shaft.
 2. Position bushing in detachable actuator base.
 3. Thrust Bearings Housed in Separate Base: Sealed for life of actuator.
- G. Torque Sensing:
1. Mechanically operated torque switches shall be furnished at each end of travel. Torque switches will trip when the valve load exceeds the torque switch setting. The torque switch adjustment device must be calibrated directly in engineering units of torque.
 2. Torque sensing by means of motor current is not acceptable.
- H. Remote Valve Position/Actuator Status Indication:
1. Contacts:
 - a. Provide 4 contacts which can be selected to indicate any position of the valve.
 - b. Provide for selection of a normally closed or open contact form.
 - c. Contacts shall maintain and update position indication during handwheel operation when all external power to the actuator is isolated.
 - d. Contacts: Rated at 5 A, 250V AC, 30V DC.

- I. Local Position Indicator:
 1. Include mechanical dial position indicator with display from fully open to fully closed
 2. Include position indicator lights:
 - a. Red: Open.
 - b. Green: Closed.
 - c. Amber: Fault.
 3. Provide for orientation of the display through increments of 90 degrees.

2.03 ACCESSORIES

- A. Supply each actuator with a start-up kit.
 1. Content:
 - a. Installation manual.
 - b. Electrical wiring diagram.
 - c. Cover seals to make good any site losses during the commissioning period.
 - d. Supply sufficient tools to enable set up and adjustment during valve/ actuator installation, testing, and commissioning.
 - e. The manufacturer shall have an authorized field service agent and facility capable of local repairs and 24 hour on-site response time. The supplier/ local service agent shall provide a letter from the motor manufacturer certifying them to perform warranty and repair work on behalf of AUMA actuators and the letter shall be included in the final IOM manual provided to the owner and submitted to the engineer for approval.

2.04 FABRICATION

- A. Integral Starter and Transformer:
 1. The following shall be integral with the actuator and suitably housed to prevent breathing and condensation.
 - a. Reversing starter.
 - b. Control transformer.
 - c. Local controls.
 2. Starter:
 - a. Capable of 300 starts per hour.
 - b. Rated appropriate to motor size.
 3. Control Supply Transformer:
 - a. Fed from 2 of the incoming 3 phases.
 - b. Overload protected.
 - c. Include necessary tapings.
 - d. Rated to provide power for the following functions:
 - 1) Energization of the contactor coils.
 - 2) 24V DC output where required for remote controls.
 - 3) Supply for all internal electrical circuits.
- B. Integral Local Control and Control Mode Selector:
 1. Incorporate local controls for Open/Close/Stop functions.
 2. Mode Selector Switch:
 - a. Local/Stop/Remote functions.
 - b. Lockable in any one of the following positions:
 - 1) Local control only.
 - 2) Stop (no electrical operation).
 - 3) Remote control plus local stop only.
 3. Capable of selecting maintained or non-maintained local control.
 4. Arrange local controls so that direction of travel can be reversed with stopping the actuator.
 5. Provide for orientation of local controls through 90 degree increments.

- C. Control Facilities:
 - 1. Provide wiring and terminals for the following control functions:
 - a. Open and external interlocks to inhibit local and remote valve opening and/or closing control. Configure the interlocks to be active in remote control only.
 - b. Remote controls fed from an internal 24V DC supply and/or from an external supply, to be suitable for any one or more of the following methods of control:
 - 1) Open, Close, and Stop control.
 - 2) Open and Close maintained or "push to run" (inching) control.
 - 3) Overriding Emergency Shut-down to Close (or Open) valve from a normally closed or open contact.
- D. Monitoring Facilities:
 - 1. Provide facilities for monitoring operation and availability as follows:
 - a. Actuator shall be furnished with monitor relay (to signal fault conditions such as thermal switch trip, torque switch tripped in mid-travel, wrong phase sequence or phase failure).
 - 2. Contact shall be provided for indication of actuator operation in local control mode.
 - 3. When required, provide indication of Thermostat trip and Remote selected as discreet signals.
- E. Wiring and Terminals:
 - 1. Internal Wiring:
 - a. Tropical grade PVC insulated stranded cable.
 - b. Size for control and 3-phase power.
 - c. Clearly identify wire at each end.
 - d. All wiring shall be terminated at a plug and socket connector. The electrical connection shall be plug and socket, double sealed integral to the actuator.
 - 2. Separate terminal compartment from inner electrical components of the actuator by means of watertight seal.
 - a. Provide minimum 3 threaded cable entries with provisions for 1 additional.
 - 3. Contain all actuator wiring within the main enclosure for physical and environmental protection.
 - a. External conduit connections between components are not acceptable.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install equipment and accessories in accordance with manufacturer's instructions.

3.02 FIELD QUALITY CONTROL

- A. The manufacturer or duly appointed representative shall provide the following services:
 - 1. After installation and prior to start-up:
 - a. Inspect all installations.
 - b. Perform necessary adjustments and modifications.
 - 2. During start-up operations: Supervise initial start-up.
 - 3. Post start-up:
 - a. Make all final adjustments.
 - b. Provide minimum of 4 hours of operation and maintenance training for Owner's personnel.

END OF SECTION

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SECTION 40 95 26

PROCESS INSTRUMENTATION PIPING

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Process instrumentation piping and fitting materials for pneumatically controlled valves, pneumatic filter control panels, and air diaphragm pumps.
- B. Related Sections:
 - 1. Section 40 23 00 - Process Piping General Provisions
 - 2. Section 40 23 20 - Process Piping Valves
 - 3. Section 40 23 30 - Process Piping Specialties
 - 4. Section 40 23 40 - Process Piping Hangers and Supports

PART 2 PRODUCTS

2.01 PIPES AND FITTINGS

- A. Instrumentation Air Piping:
 - 1. Inside Above Floor:
 - a. Type L, hard drawn seamless copper tubing.
 - b. Wrought copper solder fittings.
 - c. Join using 95-5 solder.
 - d. Short connections to fixtures and equipments: Type K, soft drawn copper tubing.
 - 2. Underground Piping:
 - a. Type K, soft drawn copper tubing.
 - b. No joints permitted.

2.02 UNIONS

- A. For Copper Tubing:
 - 1. Soldered ground joint union.
 - 2. Chase 402, or equal.

2.03 VALVES

- A. Acceptable Manufacturers:
 - 1. Apollo
 - 2. Nibco-Scott
 - 3. Milwaukee
 - 4. Watts
 - 5. Hammond
 - 6. Crane
 - 7. Stockham
 - 8. Powell
 - 9. Jenkins
 - 10. Lunkenheimer
 - 11. DeZurik
 - 12. Grinnell
 - 13. Demco

- B. For Service Pipe:
 - 1. Solder End Ball Valve:
 - a. 300 psi WOG.
 - b. Bronze, 2-piece body.
 - c. Stainless steel ball.
 - d. Extended stem to allow for insulation.
 - e. Lever handle.
 - f. Teflon seats and seal.
 - g. Nibco S580, Apollo 70-200 Series, or equal.
 - 2. Check Valve:
 - a. Screwed lift check.
 - b. 300 psi WOG.
 - c. Bronze body and trim.
 - d. 300 degree F composition disc.
 - e. Stockham B322, Crane 27, or equal.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Provide support system for piping in accordance with Section 40 23 40.
- B. Connections to Miscellaneous Equipment:
 - 1. Install connections to equipment, piping, and valves on service mains or branches.
 - 2. Allow for variations in connections and locations as required for each piece of equipment.

3.02 FIELD QUALITY CONTROL

- A. Pressure Test: Perform pressure test on instrumentation air piping prior to insulating or concealing and connecting to equipment.
- B. Perform air test on piping:
 - 1. Pressure: 50 psig.
 - 2. Duration: 24 hours.
 - 3. Allowable Pressure Drop: None.

END OF SECTION

SECTION 43 21 13

HORIZONTAL SPLIT CASE CENTRIFUGAL PUMPS

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes the furnishing and installation of horizontal split case centrifugal pumps complete with discharge head, motor, mounting bases, anchor bolts, and appurtenances necessary for satisfactory operation.
- B. Related Sections:
 - 1. Section 26 29 24 - Variable Frequency Drives

1.02 PERFORMANCE REQUIREMENTS

- A. Liquid Temperature Range: 40-70 degrees F.
- B. Meet or exceed the operating condition requirements listed at the end of this section.

1.03 SUBMITTALS

- A. Product Data:
 - 1. Preliminary characteristic performance curves.
 - 2. List of pump components and materials.
- B. Shop Drawings:
 - 1. Pump schematic.
 - 2. Component sizes and dimensions.
- C. Test Reports: Certified factory H.I. performance test results for pumps to be provided prior to shipping. The Certified H.I. performance tests shall show the reduced speed operating points listed below.
- D. Manufacturers Operation and Maintenance Instructions.
- E. Close-out:
 - 1. Performance test results from installed units.
 - 2. Provide within 7 days of field testing.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Fairbanks Morse (Pentair), Kansas City, KS.

2.02 EQUIPMENT

- A. General Requirements
 - 1. Pump shall meet requirements for NSF/ANSI 61 Drinking Water System – Health Effects, and certified to be Lead-Free in accordance with NSF/ANSI 372.

- B. Provide one horizontal, flexible coupled, split-case, single stage, centrifugal type pump mounted with the motor on a common rigid steel frame base.
1. Capacity of pump: 2,100 gpm when operating against a total head of 245 feet at a maximum nominal speed of 1,800 rpm.
 2. Provide pump to meet rotation shown on drawings.
 3. Available net positive suction head at worst case design is 25 feet with normal available net positive suction head at 33feet.
 4. Equip pump with single mechanical seals with adequate flushing (either with internal or through external brass ¼" piping) GR 4140 carbon steel shaft, 316 stainless steel sleeves, bronze impeller with renewable wear rings, bronze or cast iron wear rings, and grease lubricated ball bearings.
 5. Provide 1/4-inch NPT gauge taps on suction and discharge flange openings.
 6. Provide a one piece bent form steel base plate, with provisions for anchoring to concrete base and grouting in place.
 7. Provide with manufacturer's prime coat paint on all metallic surfaces to accept an exterior non-immersion, Tnemec System Series 1075 Endura- Shield final coat, with Omnithane and Hi-build Epoxy 1st and 2nd coats.
 8. Connect pump to motor with a flexible coupling.
 - a. Acceptable manufacturer: Woods Sure-Flex, or equal.
 9. Provide OSHA approved coupling guard
- C. Operating Conditions:

	Flow (gpm)	TDH (feet)	Minimum Efficiency (%)
Minimum Shut-off Head	0	326	-
Design Condition	2100	245	82
Design Condition	2100	215	82

- D. Provide continuous duty rated motor with inverter duty grade insulation system, suitable to use with a VFD and meeting NEMA MG-1 Part 31, with sealed grease lubricated bearings, copper wound for 480 volt, 3 phase, 60 Hertz A.C., with Class F non-hygroscopic insulation for 40 degree C temperature rise over 40 degree C. ambient temperature, and a service factor of 1.15. Efficiency rating shall be premium efficient. Provide 3 normally closed over-temperature switches embedded in the windings.
1. Motor to be TEFC design with 120 volt space heater
 2. Provide motor with manufacturer's prime and final coatings with no field painting required.
 3. Provide adequate horsepower to be non-overloading throughout the pump capacity head curve, minimum 200 hp
 4. Acceptable motor manufacturers: US Motors

2.03 WARRANTY

- A. Provide two year warranty against defective equipment in compliance with pertinent provisions of Supplementary Conditions

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install pump in accordance with manufacturer's recommendations.

3.02 FIELD QUALITY CONTROL

- A. Field Testing:
1. Conduct test of the pumping equipment in the presence of the Engineer and in accordance with the Test Code of the Standards of the Hydraulic Institute for Centrifugal Pumps.

2. Testing Period: One hour minimum, or longer as may be required to determine compliance with the specifications.
3. Provide all power, gauges, measurement devices, and other apparatus required for the testing.
4. Remove all testing equipment upon completion of testing.
5. Provide copies of all test data and results to Owner and Engineer.
6. Resulting pump capacities shall be within 5 percent of the previously supplied certified curves.
7. Replace pumping equipment which fails to meet the specified requirements.

- B. Manufacturer's Field Services: Check pumps and motors for alignment after installation and prior to field testing.

3.03 DISINFECTION

- A. Disinfect all water contact surfaces prior to placement in service.
- B. Disinfectant: 200 ppm chlorine solution or dusting chlorine compound per AWWA C654.

3.04 DEMONSTRATION

- A. Provide minimum of 4 hours of operator training after pumps are in service.

END OF SECTION

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SECTION 44 44 15

GAS CHLORINATION SYSTEM

PART 1 GENERAL

1.01 SUMMARY

- A. Furnish and install gas chlorination system.

1.02 SYSTEM DESCRIPTION

- A. Design Requirements:
 - 1. Provide for the conveyance of chlorine gas under vacuum from the vacuum regulators to the ejector-check valve assemblies via automatic flow proportioned control.
 - 2. Entire system can be vacuum checked in the field.
 - 3. Equipped as follows:
 - a. Cylinder-mounted regulator.
 - b. Latching Type Switchover System.
 - c. Automatic valve.
 - d. 6-inch Remote meter panel.
 - e. Ejector assembly.
 - f. Chlorine gas detector.
 - g. Chlorine booster pump.
 - h. Motor.
 - i. Insect screen.
 - j. Signage.

1.03 SUBMITTALS

- A. Refer to Section 01 33 00.
- B. Submit Shop Drawings indicating system schematics, equipment locations, details, and control schematics.
- C. Product Data: Submit Product Data indicating chemical treatment methods, chemicals, and equipment; manufacturer's installation instructions.
- D. Submit reports in accordance with Section 01 75 00:
 - 1. Report indicating start-up of treatment system is completed and operating properly.
 - 2. Report indicating analysis of system water after treatment.
 - 3. Report indicating analysis of fluoride residuals measured immediately after each injecting point and post filtration.
- E. Operation and Maintenance Manuals: Prior to start-up, furnish operation and maintenance manuals in accordance with Section 01 77 00.

1.04 WARRANTY

- A. All equipment, unless otherwise stated, shall be warranted by the manufacturer for 1 year from the date of start-up. Chlorinator shall include a 3-year warranty and a lifetime warranty shall be included on the diaphragm, body bolts, springs (2), inlet adapter and vent plug.

1.05 QUALITY ASSURANCE

- A. Single Source Responsibility: All components to be provided by 1 supplier.

- B. Qualifications:
 - 1. Manufacturer/supplier shall have minimum 5 years documented experience in the manufacture and installation of gas chlorination systems.
 - 2. Manufacturer/supplier shall maintain full-time service staff.
- C. Regulatory Requirements: Materials and equipment provided in this Section shall comply with the recommended practices and standards for the Chlorine Institute, Inc.

PART 2 PRODUCTS

2.01 MANUFACTURED SYSTEMS

- A. Acceptable Manufacturers:
 - 1. Chlorination system equal to Chemical Injection Technologies Superior Model CL-16-100, no equal. The system shall be purchased through Energenecs of Cedarburg, WI (Steve Berggruen, Phone: 262-387-1333)

2.02 COMPONENT FABRICATION

- A. Vacuum Regulators:
 - 1. Number required: 2.
 - 2. Mount directly on gas valve via positive yoke type gasket connection.
 - 3. Provide vacuum control by spring opposed diaphragm regulator that closes tight upon loss of vacuum.
 - 4. Equip as follows:
 - a. Gravity actuated, loss of gas indicator.
 - b. 100 pounds/day gas flow meter.
 - c. Gas direction indicator.
 - 5. Pressure relief:
 - a. Pressure relief valve, spring-loaded, diaphragm actuated.
 - b. Vent gas at vent relief valve.
- B. Latching Style Switchover System:
 - 1. Provide 1 latching style switchover system, wall-mount.
 - 2. Capacity: 100 pounds/day.
 - 3. Vacuum operated switching from empty to full source.
 - 4. Manual reset required.
 - 5. Operated by spring-loaded toggle.
 - 6. Preset at factory.
- C. Ejector/Check Assembly:
 - 1. Discharge gas/ejector water solution to point of application.
 - 2. Equip with standard dual check valves to prevent backup into regulators.
 - 3. Automatic gas flow shut-off upon loss of water.
 - 4. Maximum feed rate: 100 pounds/day.
 - 5. Teflon diaphragm as secondary check valve.
- D. Ball Valve Main Connection: Provide one 3/4-inch Mueller thread corporation stop with solution tube.
- E. Scale:
 - 1. Quantity: 1.
 - 2. Electronic Type.
 - 3. Platform: Non-corrosive molded fiberglass reinforced thermoplastic.
 - 4. Provide for two 150-pound cylinders.
 - 5. Load cell: Electronic, stainless steel.
 - 6. 4-20 mA Output

7. 3-1/2 digit LCD display
8. NEMA 4X, UL approved enclosure
9. Scaleton Model 2350 dual cylinder scale.

F. Chlorine Gas Detector:

1. Controller:
 - a. Multichannel Gas Monitoring System
 - b. Inputs: analog 4-20 mA
 - c. Common Alarm Relays: Two 5A at 240 VAC
 - d. Discrete Alarm Relays: Six 5A at 240 VAC
 - e. Display: 128 x 64 pixel graphic LCD with backlight displays bar graphs, six discrete LEDs, indicate alarm status for three alarms per channel
 - f. Power Supply: 100 to 240 VAC or 24 VDC
 - g. Enclosure: NEMA 4X wall mount
 - h. Scott series 7200 plus controller
2. Transmitter with integral sensor:
 - a. Display: 3.5 digit LCD; 0 to 100% concentration bargraph
 - b. Output: 4-20 mA
 - c. Transmitter Enclosure: NEMA-4X Noryl plastic with stainless steel screws
 - d. Power: 10 to 28 VDC 2-wire loop power,
 - e. Sensor Type: electrochemical micro-redox.
 - f. Measuring range: 0 to 5 ppm.
 - g. Scott Freedom Series 5020 with Rock Solid Sensor

G. Chlorine Analyzer

1. Type: Colorimetric DPD method using DPD indicator and buffer solution
2. Range: 0 to 5 mg/L free or total residual chlorine
3. Cycle Time: 2.5 minutes
4. Accuracy: $\pm 5\%$ or ± 0.03 mg/L (ppm) as Cl_2 , whichever is greater
5. Output: One (1) 4-20 mA with an output span programmable over any portion of the 0 to 5 mg/L range.
6. Alarm Relays: two (2) SPDT relay with contacts rated for 5A resistive load at 230 V AC
7. Power: 100 - 115/230 VAC, 2.5A
8. Display: LCD, 3-1/2 inch digit measurement readout and six-character alphanumeric scrolling text line
9. Light Source: Class 1 LED (light emitting diode) with a peak wavelength of 520 nm; 50,000 hours estimated minimum life
10. Enclosure: ABS plastic two clear polycarbonate windows, IP62-rated with the gasketed door latched.
11. Hach Model CL17 Chlorine Analyzer
12. Accessories
 - a. One (1) month additional supply of free chlorine reagents
 - b. Provide pressure reducing valve as required to meet manufacturer's maximum pressure requirements.
 - c. One (1) sample conditioning kit.

H. Emergency Shut Off System

1. Scope:
 - a. Provide 1 emergency shut-off system for two (2) 150 pound chlorine cylinders.
 - b. The emergency shut off systems shall be comprised of up to four (2) electrically-driven actuators that act directly on four (2) cylinder valve stems.
 - c. The actuators shall mount upon the cylinder or ton container valve and yoke assemblies by means of a clamping mechanism and a valve stem coupling so as to be removable during cylinder changes.
 - d. Each actuator shall deliver 50 feet per pound of closing torque to the valve stem upon receipt of a shutdown signal.
 - e. Each actuator shall be powered only in the closing direction with provision for manual override in either the OPEN or CLOSED direction.

- f. Power for each actuator shall be supplied by an uninterruptable 12V battery power supply and control system.
- 2. Actuator Design:
 - a. Each actuator shaft shall couple to the valve stem and provide an extension through the actuator such that a standard chlorine wrench may be applied to the extension to manually operate the valve while the actuator is in place.
- 3. Actuator Components:
 - a. Motor Driver: Power shall be provided by 12V DC electric motors acting through a gear reduction system.
 - b. Clutch and Shaft: Constructed of materials suitable for the chlorine environment.
 - c. Valve Stem Coupling: The element that couples the driven shaft to the valve stem shall be designed to accommodate slight misalignment of the actuator shaft with the axis of the valve stem without restricting rotation.
 - d. Clamp/Frame:
 - 1) The clamping mechanism for yoke mounting shall require no tools for installation on the valve and valve yoke.
 - 2) Adapters shall be provided to unitize the actuator with regulator clamping systems commonly used in the industry.
 - 3) All clamp and frame components shall be coated with fusion bonded polyester for corrosion resistance.
 - e. Sealing Devices:
 - 1) Shaft entrances to the actuator mechanism shall be sealed with double "O" ring seals of Viton and/or Teflon.
 - 2) The motor canister and main enclosure will be sealed with static, Viton "O" ring seals.
- 4. Control Panel Design:
 - a. The controller shall be contained within a single electrical enclosure of NEMA 4X rating.
 - b. All cables, connectors, switches and fittings shall be of a similar rating to resist the chemical environment.
 - c. The actuators shall have a dedicated power source (battery) and microprocessor controller. Electrical power shall be delivered to each actuator by means a flexible cable.
 - d. Control panel:
 - 1) Indicator lights to display the status of key system elements.
 - 2) Accept signals from sources such as gas detectors, remote station alarms, seismic or fire sensors.
 - 3) Manual switches to trigger each actuator to automatically close each cylinder or ton container valve connected to the system.
 - 4) Capable of accepting input signals to initiate either simultaneous or independent operation of each actuator and valve.
- 5. Control Panel Components:
 - a. Control Circuitry:
 - 1) An electronic circuit board in the control panel shall contain a microprocessor programmed to precisely control the valve closing cycle and the torque applied to the valve stem.
 - 2) The panel shall be controlled by wires using quick connectors to digital terminals of the SCADA PLC.
 - b. Battery and Charger:
 - 1) The battery shall be of the gel-cell, lead-acid type rated at 7 ampere-hours.
 - 2) The charging system shall provide a variable controlled charge current that is temperature compensated to optimize battery performance and service life.
 - c. Status Lights:
 - 1) The control panel enclosure shall have a membrane panel in the front cover where the operator may observe the status lights.
 - 2) Provide status lights for each respective system are as follows:
 - a) Charge Power
 - b) Armed/Ready
 - c) Battery Low

- d. Input Signals:
 - 1) The control panel shall contain a DIN rail to accept multiple incoming signals for either simultaneous or individual actuator operation.
 - 2) External signals shall consist of a "NORMALLY OPEN or NORMALLY CLOSED" dry contact, to initiate the actuator.
 - e. Output Signal:
 - 1) After initiation of the actuator, the control system shall provide a high voltage output signal (5.0-amp at 115V DC/AC) and a low voltage output signal (0.2-amp at 24V DC/AC) to indicate actuator initiation and/or completion.
 - 2) These output signals may, in turn, be employed to trigger other relays or alarms.
 - f. Testing: Mount a "TEST" button externally on the control panel to provide a full cycle test of each individual actuator.
- 6. Power Requirements: 115 V AC
 - 7. Furnish one spare battery.
 - 8. Emergency shut-off system shall be Halogen Gemini System, manufactured by Halogen Valve Systems, Inc., or prior approved equal.

2.03 ACCESSORIES

- A. Tubing, Vacuum and Testing: Polyethylene.
- B. Wall Bracket for spare cylinder storage, capable of securing two 150-pound cylinders.
- C. Valves, PVC piping and conduits, and fittings as required for complete installation.
- D. Insect screen.
- E. Signage:
 - 1. Text: "Danger Chlorine".
 - 2. Aluminum with stenciled painted lettering.
 - 3. Finish: Backed-on enamel.
- F. Plastic bottle of ammonia hydroxide for leak detection.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install equipment and accessories in accordance with manufacturers' instructions.
- B. Install vent lines from the regulators to the building exterior.
- C. Install insect screen on exterior end of vent line.
- D. Install "Danger Chlorine" sign on chemical room door exterior.

3.02 FIELD QUALITY CONTROL

- A. Manufacturer's Field Services:
 - 1. Inspect and approve final system installation prior to start-up.
 - 2. Provide minimum 2 man-days and 2 trips to site for supervision of installation, start-up, and operator training.
 - 3. Provide 1 hour/month for further instruction on maintenance and system operation for the first year of operation.

END OF SECTION

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SECTION 44 44 39

FLUORIDE FEED EQUIPMENT

PART 1 GENERAL

1.01 SUMMARY

- A. Furnish and install complete chemical feed system for injecting fluoride.

1.02 REFERENCES

- A. WDNR NR 811
- B. Recommended Standards for Water Works "Ten State Standards", 1997 Edition
- C. NSF - NSF International, Ann Arbor, MI

1.03 SUBMITTALS

- A. Refer to Section 01 33 00.
- B. Shop Drawings: Indicate system schematics, equipment locations, details, and control schematics.
- C. Product Data: Submit manufacturer's Product Data indicating chemical treatment methods, chemicals, and equipment, installation and maintenance instructions.
- D. Submit reports in accordance with Section 01 75 00 and include:
 - 1. Report indicating start-up of treatment system is completed and operating properly.
 - 2. Report indicating analysis of system water after treatment.
 - 3. Report indicating analysis of fluoride residuals measured immediately after each injecting point and post filtration.
- E. Operation and Maintenance Manuals: Prior to start-up, furnish operation and maintenance manuals in accordance with Section 01 78 23.

1.04 DEFINITIONS

- A. PVC: Polyvinyl chloride.
- B. NPT: National pipe thread.

1.05 QUALITY ASSURANCE

- A. Single Source Responsibility: Provide equipment by one (1) supplier.
- B. Regulatory Requirements: Materials and equipment provided in this Section shall comply with the recommended practices and standards of NSF International.

1.06 WARRANTY

- A. All equipment, unless otherwise stated, shall be warranted by the manufacturer for 1 year from the date of start-up.

PART 2 PRODUCTS

2.01 GENERAL

- A. Use common components to the greatest degree possible to simplify spare parts inventory and service.

2.02 TANKS

- A. Description:
 - 1. Quantity: one (1).
 - 2. Size: 160-gallon, diameter 31 inches maximum.
 - 3. Type: "Shoulder" top, allowing the cover to be smaller than main part of tank.
 - 4. Material: Polyethylene, complying with NSF requirements and compatible with intended chemical.
 - 5. Construction: 1-piece seamless construction with ultraviolet inhibitor capable of storing liquid chemicals up to a specific gravity of 1.90.
 - 6. Calibration: 1-gallon increments.
- B. Equip as follows:
 - 1. 1-1/2-inch PVC dip leg with suction tubing and foot valve strainer inside tank.
 - 2. 1-1/2-inch NPT bulkhead and threaded PVC plug for a fill fitting.
 - 3. 3/4-inch NPT bulkhead for venting the tank.
 - 4. Metering pump pressure relief return(s).

2.03 FEED PUMPS

- A. Description:
 - 1. Type: Electronic diaphragm variety, utilizing a stroke length and separate speed adjustment system to adjust feed rate.
 - 2. Product: Pulsafeeder, Pulsatron MP Series.
 - 3. Control: Flow paced with a 4-20 mA input signal.
 - 4. Quantity: one (1).
 - 5. Capacity: The pump shall have a capacity of 44 gpd at 100 psi.
 - 6. 120 VAC, single phase, 60 Hz.
 - 7. UL listed.
 - 8. Equip with:
 - a. Spare parts kit including the entire head assembly and liquid end assembly.
 - b. Thermal protection with auto reset, include indicator lights, bleed valve assembly, panel-mounted circuit breaker, stroke lock.
 - c. 100:1 turndown.
 - d. 5-function valve that provides pressure relief, back pressure, anti-siphon, air bleed, and discharge drain.

2.04 SCALES

- A. Description:
 - 1. Quantity: one (1)
 - 2. Type: Electronic 1000 pound capacity chemical scale
 - 3. Product: Force Flow Model 36-DR10LP chem-scale
 - 4. Platform: Non-corrosive and resistant to moisture, chemicals, abrasion, impact, and UV light.
 - 5. Indicator: Force Flow Model Solo G2
 - a. 110 VAC
 - b. NEMA 4X Enclosure
 - c. 6 digit numeric display
 - d. 4 to 20 mA Output

2.05 ACCESSORIES

- A. Wall Bracket: Provide ABS plastic wall shelves for the pumps

- B. Tubing and Fitting: Provide all required tubing and fittings for a complete installation, including injection fittings, main connections, and suction strainers.
- C. Safety Equipment: Provide one (1) set of chemical handling equipment including goggles, apron, and rubber gloves.
- D. Ball Valve Main Connection: Provide one (1) 3/4-inch Mueller thread corporation stop with solution tube.
- E. Provide one (1) centrifugal blower as specified in Section 23 34 23 – 2.3 Centrifugal Blowers

PART 3 EXECUTION

3.01 INSTALLATION

- A. Comply with manufacturer's Product Data, including installation instructions and details.
- B. Gears: Lubricate gearing by revolving through lubricating oil reservoir. Ample volume shall be provided for the oil to act both as a lubricant and a coolant.
- C. Provide oil seals at all shafts.
- D. Housings shall be dust and moisture-tight and have an easy means of filling, draining and checking oil level.
- E. Separate drive motors from gear reducer.
- F. Connect output shaft of the motor to the input of the gear reducer with a shear pin or torque overload type coupling to protect against overload.
- G. Connections to existing facility piping and modifications to or relocation of existing piping required for proper installation of new equipment, shall be pursued on a continuous basis and coordinated with Engineer so as to cause minimum shut-down time in existing facility.
- H. Anchor bolts: Set by template and protect from misalignment.
- I. Place equipment on foundations level, shimmed, bolted down, and grouted with a non-shrinking grout.
- J. Provide at least one (1) day of installation supervision by the manufacturer's representative.

3.02 FIELD QUALITY CONTROL

- A. Manufacturer's Field Services:
 1. Inspect and approve the completed installation, make all necessary adjustments, corrections, or modifications prior to start-up.
 2. After start-up is authorized by Engineer, furnish a qualified representative to inspect the completed installation, to supervise the system's initial start-up, and to train the operating personnel in operation and equipment maintenance.
 3. At least one (1) day shall be reserved for start-up and adjustment. See Section 01 75 00.
 4. After equipment has been placed into operation, make all final adjustments for the proper operation of the equipment.

3.03 OPERATOR TRAINING

- A. Provide a minimum of 4 hours of operator training at Owner's convenience after equipment is operational.

- B. Ensure plant personnel are sufficiently trained and thoroughly acquainted with operations and maintenance materials to operate all components of the system.

END OF SECTION

SECTION E: BIDDERS ACKNOWLEDGEMENT

**UNIT WELL12 UPGRADE AND CONVERSION TO A TWO ZONE WELL
CONTRACT NO. 7498**

Bidder must state a Unit Price and Total Bid for each item. The Total Bid for each item must be the product of quantity, by Unit Price. The Grand Total must be the sum of the Total Bids for the various items. In case of multiplication errors or addition errors, the Grand Total with corrected multiplication and/or addition shall determine the Grand Total bid for each contract. The Unit Price and Total Bid must be entered numerically in the spaces provided. All words and numbers shall be written in ink.

1. The undersigned having familiarized himself/herself with the Contract documents, including Advertisement for Bids, Instructions to Bidders, Form of Proposal, City of Madison Standard Specifications for Public Works Construction - 2015 Edition thereto, Form of Agreement, Form of Bond, and Addenda issued and attached to the plans and specifications on file in the office of the City Engineer, hereby proposes to provide and furnish all the labor, materials, tools, and expendable equipment necessary to perform and complete in a workmanlike manner the specified construction on this project for the City of Madison; all in accordance with the plans and specifications as prepared by the City Engineer, including Addenda to the Contract Nos. _____ through _____ issued thereto, at the prices for said work as contained in this proposal. (Electronic bids submittals shall acknowledge addendum under Section E and shall not acknowledge here)
2. If awarded the Contract, we will initiate action within seven (7) days after notification or in accordance with the date specified in the contract to begin work and will proceed with diligence to bring the project to full completion within the number of work days allowed in the Contract or by the calendar date stated in the Contract.
3. The undersigned Bidder or Contractor certifies that he/she is not a party to any contract, combination in form of trust or otherwise, or conspiracy in restraint of trade or commerce or any other violation of the anti-trust laws of the State of Wisconsin or of the United States, with respect to this bid or contract or otherwise.
4. I hereby certify that I have met the Bid Bond Requirements as specified in Section 102.5. *(IF BID BOND IS USED, IT SHALL BE SUBMITTED ON THE FORMS PROVIDED BY THE CITY. FAILURE TO DO SO MAY RESULT IN REJECTION OF THE BID).*
5. I hereby certify that all statements herein are made on behalf of _____ (name of corporation, partnership, or person submitting bid) a corporation organized and existing under the laws of the State of _____ a partnership consisting of _____; an individual trading as _____; of the City of _____ State of _____; that I have examined and carefully prepared this Proposal, from the plans and specifications and have checked the same in detail before submitting this Proposal; that I have fully authority to make such statements and submit this Proposal in (its, their) behalf; and that the said statements are true and correct.

SIGNATURE

TITLE, IF ANY

Sworn and subscribed to before me this _____ day of _____, 20_____.

(Notary Public or other officer authorized to administer oaths)

My Commission Expires _____

Bidders shall not add any conditions or qualifying statements to this Proposal.

SECTION F: DISCLOSURE OF OWNERSHIP & BEST VALUE CONTRACTING

UNIT WELL 12 UPGRADE AND CONVERSION TO A TWO ZONE WELL CONTRACT NO. 7498

State of Wisconsin
Department of Workforce Development
Equal Rights Division
Labor Standards Bureau

Disclosure of Ownership

<p>Notice required under Section 15.04(1)(m), Wisconsin Statutes. The statutory authority for the use of this form is prescribed in Sections 66.0903(12)(d) and 103.49(7)(d), Wisconsin Statutes. The use of this form is mandatory. The penalty for failing to complete this form is prescribed in Section 103.005(12), Wisconsin Statutes. Personal information you provide may be used for secondary purposes.</p>			
<p>(1) On the date a contractor submits a bid to or completes negotiations with a state agency or local governmental unit, on a project subject to Section 66.0903 or 103.49, Wisconsin Statutes, the contractor shall disclose to such state agency or local governmental unit the name of any "other construction business", which the contractor, or a shareholder, officer or partner of the contractor, owns or has owned within the preceding three (3) years.</p> <p>(2) The term "other construction business" means any business engaged in the erection, construction, remodeling, repairing, demolition, altering or painting and decorating of buildings, structures or facilities. It also means any business engaged in supplying mineral aggregate, or hauling excavated material or spoil as provided by Sections 66.0903(3), 103.49(2) and 103.50(2), Wisconsin Statutes.</p> <p>(3) This form must ONLY be filed, with the state agency or local governmental unit that will be awarding the contract, if both (A) and (B) are met.</p> <p>(A) The contractor, or a shareholder, officer or partner of the contractor:</p> <p style="margin-left: 20px;">(1) Owns at least a 25% interest in the "other construction business", indicated below, on the date the contractor submits a bid or completes negotiations.</p> <p style="margin-left: 20px;">(2) Or has owned at least a 25% interest in the "other construction business" at any time within the preceding three (3) years.</p> <p>(B) The Wisconsin Department of Workforce Development (DWD) has determined that the "other construction business" has failed to pay the prevailing wage rate or time and one-half the required hourly basic rate of pay, for hours worked in excess of the prevailing hours of labor, to any employee at any time within the preceding three (3) years.</p>			
Other Construction Business			
Not Applicable <input type="checkbox"/>			
Name of Business			
Street Address or P O Box	City	State	Zip Code
Name of Business			
Street Address or P O Box	City	State	Zip Code
Name of Business			
Street Address or P O Box	City	State	Zip Code
<p>I hereby state under penalty of perjury that the information, contained in this document, is true and accurate according to my knowledge and belief.</p>			
Print the Name of Authorized Officer			
Signature of Authorized Officer		Date Signed	
Name of Corporation, Partnership or Sole Proprietorship			
Street Address or P O Box	City	State	Zip Code

If you have any questions call (608) 266-0028

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Best Value Contracting

1. The Contractor shall indicate the non-apprenticeable trades used on this contract.

2. Madison General Ordinance (M.G.O.), 33.07(7), does provide for some exemptions from the active apprentice requirement. Apprenticeable trades are those trades considered apprenticeable by the State of Wisconsin. Please check applicable box if you are seeking an exemption.

- Contractor has a total skilled workforce of four or less individuals in all apprenticeable trades combined.
- No available trade training program; The Contractor has been rejected by the only available trade training program, or there is no trade training program within 90 miles.
- Contractor is not using an apprentice due to having a journey worker on layoff status, provided the journey worker was employed by the contractor in the past six months.
- First-time Contractor on City of Madison Public Works contract requests a onetime exemption but intends to comply on all future contracts and is taking steps typical of a "good faith" effort.
- Contractor has been in business less than one year.
- Contractor doesn't have enough journeyman trade workers to qualify for a trade training program in that respective trade

3. The Contractor shall indicate on the following section which apprenticeable trades are to be used on this contract. Compliance with active apprenticeship, to the extent required by M.G.O. 33.07(7), shall be satisfied by documentation from an applicable trade training body; an apprenticeship contract with the Wisconsin Department of Workforce Development or a similar agency in another state; or the U.S Department of Labor. This documentation is required prior to the Contractor beginning work on the project site.

- The Contractor has reviewed the list and shall not use any apprenticeable trades on this project.

LIST APPRENTICABLE TRADES (check all that apply to your work to be performed on this contract)

- BRICKLAYER
- CARPENTER
- CEMENT MASON / CONCRETE FINISHER
- CEMENT MASON (HEAVY HIGHWAY)
- CONSTRUCTION CRAFT LABORER
- DATA COMMUNICATION INSTALLER
- ELECTRICIAN
- ENVIRONMENTAL SYSTEMS TECHNICIAN / HVAC SERVICE TECH/HVAC INSTALL / SERVICE
- GLAZIER
- HEAVY EQUIPMENT OPERATOR / OPERATING ENGINEER
- INSULATION WORKER (HEAT & FROST)
- IRON WORKER
- IRON WORKER (ASSEMBLER, METAL BLDGS)
- PAINTER & DECORATOR
- PLASTERER
- PLUMBER
- RESIDENTIAL ELECTRICIAN
- ROOFER & WATER PROOFER
- SHEET METAL WORKER
- SPRINKLER FITTER
- STEAMFITTER
- STEAMFITTER (REFRIGERATION)
- STEAMFITTER (SERVICE)
- TAPER & FINISHER
- TELECOMMUNICATIONS (VOICE, DATA & VIDEO) INSTALLER-TECHNICIAN
- TILE SETTER

SECTION G: BID BOND

KNOW ALL MEN BY THESE PRESENT, THAT _____ (a corporation of the State of _____) (individual), (partnership), hereinafter referred to as the "Principal") and _____, a corporation of the State of _____ (hereinafter referred to as the "Surety") and licensed to do business in the State of Wisconsin, are held and firmly bound unto the City of Madison, (hereinafter referred to as the "Obligee"), in the sum of five per cent (5%) of the amount of the total bid or bids of the Principal herein accepted by the Obligee, for the payment of which the Principal and the Surety bind themselves, their heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

The conditions of this obligation are such that, whereas the Principal has submitted, to the City of Madison a certain bid, including the related alternate, and substitute bids attached hereto and hereby made a part hereof, to enter into a contract in writing for the construction of:

UNIT 12 UPGRADE AND CONVERSION TO A TWO ZONE WELL CONTRACT NO. 7498

1. If said bid is rejected by the Obligee, then this obligation shall be void.
2. If said bid is accepted by the Obligee and the Principal shall execute and deliver a contract in the form specified by the Obligee (properly completed in accordance with said bid) and shall furnish a bond for his/her faithful performance of said contract, and for the payment of all persons performing labor or furnishing materials in connection therewith, and shall in all other respects perform the agreement created by the acceptance of said bid, then this obligation shall be void.

If said bid is accepted by the Obligee and the Principal shall fail to execute and deliver the contract and the performance and payment bond noted in 2. above executed by this Surety, or other Surety approved by the City of Madison, all within the time specified or any extension thereof, the Principal and Surety agree jointly and severally to forfeit to the Obligee as liquidated damages the sum mentioned above, it being understood that the liability of the Surety for any and all claims hereunder shall in no event exceed the sum of this obligation as stated, and it is further understood that the Principal and Surety reserve the right to recover from the Obligee that portion of the forfeited sum which exceed the actual liquidated damages incurred by the Obligee.

The Surety, for value received, hereby stipulates and agrees that the obligations of said Surety and its bond shall be in no way impaired or affected by an extension of the time within which the Obligee may accept such bid, and said Surety does hereby waive notice of any such extension.

IN WITNESS WHEREOF, the Principal and the Surety have hereunto set their hands and seals, and such of them as are corporations have caused their corporate seals to be hereto affixed and these presents to be signed by their proper officers, on the day and year set forth below.

Seal

Principal Date

By:

Name of Surety

By:

Date

This certifies that I have been duly licensed as an agent for the above company in Wisconsin under License No. _____ for the year _____, and appointed as attorney in fact with authority to execute this bid bond and the payment and performance bond referred to above, which power of attorney has not been revoked.

Date

Agent

Address

City, State and Zip Code

Telephone Number

NOTE TO SURETY & PRINCIPAL

The bid submitted which this bond guarantees shall be rejected if the following instrument is not attached to this bond:

Power of Attorney showing that the agent of Surety is currently authorized to execute bonds on behalf of the Surety, and in the amounts referenced above.

Certificate of Biennial Bid Bond

TIME PERIOD - VALID (FROM/TO)
NAME OF SURETY
NAME OF CONTRACTOR
CERTIFICATE HOLDER <p style="text-align: center;">City of Madison, Wisconsin</p>

This is to certify that a biennial bid bond issued by the above-named Surety is currently on file with the City of Madison.

This certificate is issued as a matter of information and conveys no rights upon the certificate holder and does not amend, extend or alter the coverage of the biennial bid bond.

Cancellation: Should the above policy be cancelled before the expiration date, the issuing Surety will give thirty (30) days written notice to the certificate holder indicated above.

Signature of Authorized Contractor Representative

Date

SECTION H: AGREEMENT

THIS AGREEMENT made this _____ day of _____ in the year Two Thousand and Fifteen between _____ hereinafter called the Contractor, and the City of Madison, Wisconsin, hereinafter called the City.

WHEREAS, the Common Council of the said City of Madison under the provisions of a resolution adopted _____, and by virtue of authority vested in the said Council, has awarded to the Contractor the work of performing certain construction.

NOW, THEREFORE, the Contractor and the City, for the consideration hereinafter named, agree as follows:

1. **Scope of Work.** The Contractor shall, perform the construction, execution and completion of the following listed complete work or improvement in full compliance with the Plans, Specifications, Standard Specifications, Supplemental Specifications, Special Provisions and contract; perform all items of work covered or stipulated in the proposal; perform all altered or extra work; and shall furnish, unless otherwise provided in the contract, all materials, implements, machinery, equipment, tools, supplies, transportation, and labor necessary to the prosecution and completion of the work or improvements:

UNIT WELL 12 UPGRADE AND CONVERSION TO A TWO ZONE WELL CONTRACT NO. 7498

2. **Completion Date/Contract Time.** Construction work must begin within seven (7) calendar days after the date appearing on mailed written notice to do so shall have been sent to the Contractor and shall be carried on at a rate so as to secure full completion SEE SPECIAL PROVISIONS, the rate of progress and the time of completion being essential conditions of this Agreement.
3. **Contract Price.** The City shall pay to the Contractor at the times, in the manner and on the conditions set forth in said specifications, the sum of _____ (\$ _____) Dollars being the amount bid by such Contractor and which was awarded to him/her as provided by law.
4. **Wage Rates for Employees of Public Works Contractors**

General and Authorization. The Contractor shall compensate its employees at the prevailing wage rate in accordance with section 66.0903, Wis. Stats., DWD 290 of the Wisconsin Administrative Code and as hereinafter provided unless otherwise noted in Section D: Special Provisions, Subsection 102.10 – Minimum Rate of Wage Scale.

“Public Works” shall include building or work involving the erection, construction, remodeling, repairing or demolition of buildings, parking lots, highways, streets, bridges, sidewalks, street lighting, traffic signals, sanitary sewers, water mains and appurtenances, storm sewers, and the grading and landscaping of public lands.

“Building or work” includes construction activity as distinguished from manufacturing, furnishing of materials, or servicing and maintenance work, except for the delivery of mineral aggregate such as sand, gravel, bituminous asphaltic concrete or stone which is incorporated into the work under contract with the City by depositing the material directly in final place from transporting vehicle.

“Erection, construction, remodeling, repairing” means all types of work done on a particular building or work at the site thereof in the construction or development of the project, including without limitation, erecting, construction, remodeling, repairing, altering, painting, and decorating, the transporting of materials and supplies to or from the building or work done by the employees of the Contractor, Subcontractor, or Agent thereof, and the manufacturing or furnishing of

materials, articles, supplies or equipment on the site of the building or work, by persons employed by the Contractor, Subcontractor, or Agent thereof.

"Employees working on the project" means laborers, workers, and mechanics employed directly upon the site of work.

"Laborers, Workers, and Mechanics" include pre-apprentices, helpers, trainees, learners and properly registered and indentured apprentices but exclude clerical, supervisory, and other personnel not performing manual labor.

Establishment of Wage Rates. The Department of Public Works shall periodically obtain a current schedule of prevailing wage rates from DWD. The schedule shall be used to establish the City of Madison Prevailing Wage Rate Schedule for Public Works Construction (prevailing wage rate). The Department of Public Works may include known increases to the prevailing wage rate which can be documented and are to occur on a future specific date. The prevailing wage rate shall be included in public works contracts subsequently negotiated or solicited by the City. Except for known increases contained within the schedule, the prevailing wage rate shall not change during the contract. The approved wage rate is attached hereto.

Workforce Profile. The Contractor shall, at the time of signature of the contract, notify the City Engineer in writing of the names and classifications of all the employees of the Contractor, Subcontractors, and Agents proposed for the work. In the alternative, the Contractor shall submit in writing the classifications of all the employees of the Contractor, Subcontractors and Agents and the total number of hours estimated in each classification for the work. This workforce profile(s) shall be reviewed by the City Engineer who may, within ten (10) days, object to the workforce profile(s) as not being reflective of that which would be required for the work. The Contractor may request that the workforce profile, or a portion of the workforce profile, be submitted after the signature of the contract but at least ten (10) days prior to the work commencing. Any costs or time loss resulting from modifications to the workforce profile as a result of the City Engineer's objections shall be the responsibility of the Contractor.

Payrolls and Records. The Contractor shall keep weekly payroll records setting forth the name, address, telephone number, classification, wage rate and fringe benefit package of all the employees who work on the contract, including the employees of the Contractor's subcontractors and agents. Such weekly payroll records must include the required information for all City contracts and all other contracts on which the employee worked during the week in which the employee worked on the contract. The Contractor shall also keep records of the individual time each employee worked on the project and for each day of the project. Such records shall also set forth the total number of hours of overtime credited to each such employee for each day and week and the amount of overtime pay received in that week. The records shall set forth the full weekly wages earned by each employee and the actual hourly wage paid to the employee.

The Contractor shall submit the weekly payroll records, including the records of the Contractor's subcontractors and agents, to the City Engineer for every week that work is being done on the contract. The submittal shall be within twenty-one (21) calendar days of the end of the Contractor's weekly pay period.

Employees shall receive the full amounts accrued at the time of the payment, computed at rates not less than those stated in the prevailing wage rate and each employee's rate shall be determined by the work that is done within the trade or occupation classification which should be properly assigned to the employee.

An employee's classification shall not be changed to a classification of a lesser rate during the contract. If, during the term of the contract, an employee works in a higher pay classification than the one which was previously properly assigned to the employee, then that employee shall be considered to be in the higher pay classification for the balance of the contract, receive the appropriate higher rate of pay, and she/he shall not receive a lesser rate during the balance of the

contract. For purposes of clarification, it is noted that there is a distinct difference between working in a different classification with higher pay and doing work within a classification that has varying rates of pay which are determined by the type of work that is done within the classification. For example, the classification "Operating Engineer" provides for different rates of pay for various classes of work and the Employer shall compensate an employee classified as an "Operating Engineer" based on the highest class of work that is done in one day. Therefore, an "Operating Engineer's" rate may vary on a day to day basis depending on the type of work that is done, but it will never be less than the base rate of an "Operating Engineer". Also, as a matter of clarification, it is recognized that an employee may work in a higher paying classification merely by chance and without prior intention, calculation or design. If such is the case and the performance of the work is truly incidental and the occurrence is infrequent, inconsequential and does not serve to undermine the single classification principle herein, then it may not be required that the employee be considered to be in the higher pay classification and receive the higher rate of pay for the duration of the contract. However, the Contractor is not precluded or prevented from paying the higher rate for the limited time that an employee performs work that is outside of the employee's proper classification.

Questions regarding an employee's classification, rate of pay or rate of pay within a classification, shall be resolved by reference to the established practice that predominates in the industry and on which the trade or occupation rate/classification is based. Rate of pay and classification disputes shall be resolved by relying upon practices established by collective bargaining agreements and guidelines used in such determination by appropriate recognized trade unions operating within the City of Madison.

The Contractor, its Subcontractors and Agents shall submit to interrogation regarding compliance with the provisions of this ordinance.

Mulcting of the employees by the Contractor, Subcontractor, and Agents on Public Works contracts, such as by kickbacks or other devices, is prohibited. The normal rate of wage of the employees of the Contractor, Subcontractor, and Agents shall not be reduced or otherwise diminished as a result of payment of the prevailing wage rate on a public works contract.

Hourly contributions. Hourly contributions shall be determined in accordance with the prevailing wage rate and with DWD. 290.01(10), Wis. Admin. Code.

Apprentices and Subjourney persons. Apprentices and sub journeypersons performing work on the project shall be compensated in accordance with the prevailing wage rate and with DWD 290.02, and 290.025, respectively, Wis. Admin. Code.

Straight Time Wages. The Contractor may pay straight time wages as determined by the prevailing wage rate and DWD 290.04, Wis. Admin. Code.

Overtime Wages. The Contractor shall pay overtime wages as required by the prevailing wage rate and DWD 290.05, Wis. Admin. Code.

Posting of Wage Rates and Hours. A clearly legible copy of the prevailing wage rate, together with the provisions of Sec. 66.0903(10)(a) and (11)(a), Wis. Stats., shall be kept posted in at least one conspicuous and easily accessible place at the project site by the Contractor and such notice shall remain posted during the full time any laborers, workers or mechanics are employed on the contract.

Evidence of Compliance by Contractor. Upon completion of the contract, the Contractor shall file with the Department of Public Works an affidavit stating:

- a. That the Contractor has complied fully with the provisions and requirements of Sec. 66.0903(3), Wis. Stats., and Chapter DWD 290, Wis. Admin. Code; the Contractor has received evidence of compliance from each of the agents and subcontractors; and the

names and addresses of all of the subcontractors and agents who worked on the contract.

- b. That full and accurate records have been kept, which clearly indicate the name and trade or occupation of every laborer, worker or mechanic employed by the Contractor in connection with work on the project. The records shall show the number of hours worked by each employee and the actual wages paid therefore; where these records will be kept and the name, address and telephone number of the person who will be responsible for keeping them. The records shall be retained and made available for a period of at least three (3) years following the completion of the project of public works and shall not be removed without prior notification to the municipality.

Evidence of Compliance by Agent and Subcontractor. Each agent and subcontractor shall file with the Contractor, upon completion of their portion of the work on the contract an affidavit stating that all the provisions of Sec. 66.0903(3), Wis. Stats., have been fully complied with and that full and accurate records have been kept, which clearly indicate the name and trade or occupation of every laborer, worker or mechanic employed by the Contractor in connection with work on the project. The records shall show the number of hours worked by each employee and the actual wages paid therefore; where these records shall be kept and the name, address and telephone number of the person who shall be responsible for keeping them. The records shall be retained and made available for a period of at least three (3) years following the completion of the project of public works and shall not be removed without prior notification to the municipality.

Failure to Comply with the Prevailing Wage Rate. If the Contractor fails to comply with the prevailing wage rate, she/he shall be in default on the contract. In addition, if DWD finds that a contractor or subcontractor violated the prevailing wage law, DWD will assess liquidated damages of 100% of the wages owed to employees.

Establishment of Wage Rates. The Department of Public Works shall periodically obtain a current schedule of prevailing wage rates from DWD. The schedule shall be used to establish the City of Madison Prevailing Wage Rate Schedule for Public Works Construction (prevailing wage rate). The Department of Public Works may include known increases to the prevailing wage rate which can be documented and are to occur on a future specific date. The prevailing wage rate shall be included in public works contracts subsequently negotiated or solicited by the City. Except for known increases contained within the schedule, the prevailing wage rate shall not change during the contract. The approved wage rate and DWD prevailing wage requirements are attached hereto as Sec. I of the contract.

5. **Affirmative Action.** In the performance of the services under this Agreement the Contractor agrees not to discriminate against any employee or applicant because of race, religion, marital status, age, color, sex, disability, national origin or ancestry, income level or source of income, arrest record or conviction record, less than honorable discharge, physical appearance, sexual orientation, gender identity, political beliefs, or student status. The Contractor further agrees not to discriminate against any subcontractor or person who offers to subcontract on this contract because of race, religion, color, age, disability, sex, sexual orientation, gender identity or national origin.

The Contractor agrees that within thirty (30) days after the effective date of this agreement, the Contractor will provide to the City Affirmative Action Division certain workforce utilization statistics, using a form to be furnished by the City.

If the contract is still in effect, or if the City enters into a new agreement with the Contractor, within one year after the date on which the form was required to be provided, the Contractor will provide updated workforce information using a second form, also to be furnished by the City. The second form will be submitted to the City Affirmative Action Division no later than one year after the date on which the first form was required to be provided.

The Contractor further agrees that, for at least twelve (12) months after the effective date of this contract, it will notify the City Affirmative Action Division of each of its job openings at facilities in Dane County for which applicants not already employees of the Contractor are to be considered. The notice will include a job description, classification, qualifications and application procedures and deadlines. The Contractor agrees to interview and consider candidates referred by the Affirmative Action Division if the candidate meets the minimum qualification standards established by the Contractor, and if the referral is timely. A referral is timely if it is received by the Contractor on or before the date started in the notice.

Articles of Agreement

Article I

The Contractor shall take affirmative action in accordance with the provisions of this contract to insure that applicants are employed, and that employees are treated during employment without regard to race, religion, color, age, marital status, disability, sex, sexual orientation, gender identity or national origin and that the employer shall provide harassment free work environment for the realization of the potential of each employee. Such action shall include, but not be limited to, the following: employment, upgrading, demotion or transfer, recruitment or recruitment advertising, layoff or termination, rates of pay or other forms of compensation and selection for training including apprenticeship insofar as it is within the control of the Contractor. The Contractor agrees to post in conspicuous places available to employees and applicants notices to be provided by the City setting out the provisions of the nondiscrimination clauses in this contract.

Article II

The Contractor shall in all solicitations or advertisements for employees placed by or on behalf of the Contractors state that all qualified or qualifiable applicants will be employed without regard to race, religion, color, age, marital status, disability, sex, sexual orientation, gender identity or national origin.

Article III

The Contractor shall send to each labor union or representative of workers with which it has a collective bargaining agreement or other contract or understanding a notice to be provided by the City advising the labor union or worker's representative of the Contractor's equal employment opportunity and affirmative action commitments. Such notices shall be posted in conspicuous places available to employees and applicants for employment.

Article V

The Contractor agrees that it will comply with all provisions of the Affirmative Action Ordinance of the City of Madison, including the contract compliance requirements. The Contractor agrees to submit the model affirmative action plan for public works contractors in a form approved by the Affirmative Action Division Manager.

Article VI

The Contractor will maintain records as required by Section 39.02(9)(f) of the Madison General Ordinances and will provide the City Affirmative Action Division with access to such records and to persons who have relevant and necessary information, as provided in Section 39.02(9)(f). The City agrees to keep all such records confidential, except to the extent that public inspection is required by law.

Article VII

In the event of the Contractor's or subcontractor's failure to comply with the Equal Employment Opportunity and Affirmative Action Provisions of this contract or Section 39.03 and 39.02 of the Madison General Ordinances, it is agreed that the City at its option may do any or all of the following:

1. Cancel, terminate or suspend this Contract in whole or in part.
2. Declare the Contractor ineligible for further City contracts until the Affirmative Action requirements are met.
3. Recover on behalf of the City from the prime Contractor 0.5 percent of the contract award price for each week that such party fails or refuses to comply, in the nature of liquidated damages, but not to exceed a total of five percent (5%) of the contract price, or five thousand dollars (\$5,000), whichever is less. Under public works contracts, if a subcontractor is in noncompliance, the City may recover liquidated damages from the prime Contractor in the manner described above. The preceding sentence shall not be construed to prohibit a prime Contractor from recovering the amount of such damage from the non-complying subcontractor.

Article VIII

The Contractor shall include the above provisions of this contract in every subcontract so that such provisions will be binding upon each subcontractor. The Contractor shall take such action with respect to any subcontractor as necessary to enforce such provisions, including sanctions provided for noncompliance.

Article IX

The Contractor shall allow the maximum feasible opportunity to small business enterprises to compete for any subcontracts entered into pursuant to this contract. (In federally funded contracts the terms "DBE, MBE and WBE" shall be substituted for the term "small business" in this Article.)

6. Substance Abuse Prevention Program Required. Prior to commencing work on the Contract, the Contractor, and any Subcontractor, shall have in place a written program for the prevention of substance abuse among its employees as required under Wis. Stat. Sec. 103.503.

**UNIT WELL 12 UPGRADE AND CONVERSION TO A TWO ZONE WELL
CONTRACT NO. 7498**

IN WITNESS WHEREOF, the Contractor has hereunto set his/her hand and seal and the City has caused these presents to be sealed with its corporate seal and to be subscribed by its Mayor and City Clerk the day and year first above written.

Countersigned:

	Company Name
Witness	Date
Witness	Date
Witness	Date
Witness	Date

CITY OF MADISON, WISCONSIN

Provisions have been made to pay the liability that will accrue under this contract.

Approved as to form:

Finance Director	City Attorney
Signed this _____ day of _____, 20_____	
Witness	Date
Witness	Date
Witness	Date
Witness	Date

SECTION I: PAYMENT AND PERFORMANCE BOND

KNOW ALL MEN BY THESE PRESENTS, that we _____
as principal, _____ and

Company of _____ as surety, are held and firmly bound unto the City of
Madison, Wisconsin, in the sum of _____ (\$_____) Dollars, lawful money of the
United States, for the payment of which sum to the City of Madison, we hereby bind ourselves and our
respective executors and administrators firmly by these presents.

The condition of this Bond is such that if the above bounden shall on his/her part fully and faithfully
perform all of the terms of the Contract entered into between him/herself and the City of Madison for the
construction of:

**UNIT WELL 12 UPGRADE AND CONVERSION TO A TWO ZONE WELL
CONTRACT NO. 7498**

in Madison, Wisconsin, and shall pay all claims for labor performed and material furnished in the
prosecution of said work, and save the City harmless from all claims for damages because of negligence
in the prosecution of said work, and shall save harmless the said City from all claims for compensation
(under Chapter 102, Wisconsin Statutes) of employees and employees of subcontractor, then this Bond is
to be void, otherwise of full force, virtue and effect.

Signed and sealed this _____ day of _____

Countersigned:

Company Name (Principal)

Witness

President Seal

Secretary

Approved as to form:

Surety Seal

Salary Employee Commission

City Attorney

By _____
Attorney-in-Fact

This certifies that I have been duly licensed as an agent for the above company in Wisconsin under
License No. _____ for the year 20_____, and appointed as attorney-in-fact with
authority to execute this payment and performance bond which power of attorney has not been revoked.

Date

Agent Signature

SECTION J: PREVAILING WAGE RATES

PREVAILING WAGE RATE DETERMINATION

Issued by the State of Wisconsin
Department of Workforce Development
Pursuant to s. 66.0903, Wis. Stats.
Issued On: 1/7/2015

DETERMINATION NUMBER: 201500014

EXPIRATION DATE: Prime Contracts MUST Be Awarded or Negotiated On Or Before 12/31/2015. If NOT, You MUST Reapply.

PROJECT NAME: ALL PUBLIC WORKS PROJECTS UNDER SEC. 66.0903, STATS-CITY OF MADISON

PROJECT LOCATION: MADISON CITY, DANE COUNTY, WI

CONTRACTING AGENCY: CITY OF MADISON - ENGINEERING

CLASSIFICATION:	Contractors are responsible for correctly classifying their workers. Either call the Department of Workforce Development (DWD) with trade or classification questions or consult DWD's Dictionary of Occupational Classifications & Work Descriptions on the DWD website at: dwd.wisconsin.gov/er/prevailing_wage_rate/Dictionary/dictionary_main.htm .
OVERTIME:	<p>Time and one-half must be paid for all hours worked:</p> <ul style="list-style-type: none">- over 10 hours per day on prevailing wage projects- over 40 hours per calendar week- Saturday and Sunday- on all of the following holidays: January 1; the last Monday in May; July 4; the 1st Monday in September; the 4th Thursday in November; December 25;- The day before if January 1, July 4 or December 25 falls on a Saturday;- The day following if January 1, July 4 or December 25 falls on a Sunday. <p>Apply the time and one-half overtime calculation to whichever is higher between the Hourly Basic Rate listed on this project determination or the employee's regular hourly rate of pay. Add any applicable Premium or DOT Premium to the Hourly Basic Rate before calculating overtime.</p> <p>A DOT Premium (discussed below) may supersede this time and one-half requirement.</p>
FUTURE INCREASE:	When a specific trade or occupation requires a future increase, you MUST add the full hourly increase to the "TOTAL" on the effective date(s) indicated for the specific trade or occupation.
PREMIUM PAY:	If indicated for a specific trade or occupation, the full amount of such pay MUST be added to the "HOURLY BASIC RATE OF PAY" indicated for such trade or occupation, whenever such pay is applicable.
DOT PREMIUM:	This premium only applies to highway and bridge projects owned by the Wisconsin Department of Transportation and to the project type heading "Airport Pavement or State Highway Construction." DO NOT apply the premium calculation under any other project type on this determination.
APPRENTICES:	Pay apprentices a percentage of the applicable journey person's hourly basic rate of pay and hourly fringe benefit contributions specified in this determination. Obtain the appropriate percentage from each apprentice's contract or indenture.
SUBJOURNEY:	Subjourney wage rates may be available for some of the trades or occupations indicated below with the exception of laborers, truck drivers and heavy equipment operators. Any employer interested in using a subjourney classification on this project MUST complete Form ERD-10880 and request the applicable wage rate from the Department of Workforce Development PRIOR to using the subjourney worker on this project.

This document **MUST BE POSTED** by the **CONTRACTING AGENCY** in at least one conspicuous and easily accessible place **on the site of the project**. A local governmental unit may post this document at the place normally used to post public notices if there is no common site on the project. This document **MUST** remain posted during the entire time any worker is employed on the project and **MUST** be physically incorporated into the specifications and all contracts and subcontracts. If you have any questions, please write to the Equal Rights Division, Labor Standards Bureau, P.O. Box 8928, Madison, Wisconsin 53708 or call (608) 266-6861.

The following statutory provisions apply to local governmental unit projects of public works and are set forth below pursuant to the requirements of s. 66.0903(8), Stats.

s. 66.0903 (1) (f) & s. 103.49 (1) (c) "PREVAILING HOURS OF LABOR" for any trade or occupation in any area means 10 hours per day and 40 hours per week and may not include any hours worked on a Saturday or Sunday or on any of the following holidays:

1. January 1.
2. The last Monday in May.
3. July 4.
4. The first Monday in September.
5. The 4th Thursday in November.
6. December 25.
7. The day before if January 1, July 4 or December 25 falls on a Saturday.
8. The day following if January 1, July 4 or December 25 falls on a Sunday.

s. 66.0903 (10) RECORDS; INSPECTION; ENFORCEMENT.

(a) Each contractor, subcontractor, or contractor's or subcontractor's agent performing work on a project of public works that is subject to this section shall keep full and accurate records clearly indicating the name and trade or occupation of every person performing the work described in sub. (4) and an accurate record of the number of hours worked by each of those persons and the actual wages paid for the hours worked.

s. 66.0903 (11) LIABILITY AND PENALTIES.

(a) 1. Any contractor, subcontractor, or contractor's or subcontractor's agent who fails to pay the prevailing wage rate determined by the department under sub. (3) or who pays less than 1.5 times the hourly basic rate of pay for all hours worked in excess of the prevailing hours of labor is liable to any affected employee in the amount of his or her unpaid wages or his or her unpaid overtime compensation and in an additional amount as liquidated damages as provided under subd. 2., 3., whichever is applicable.

2. If the department determines upon inspection under sub. (10) (b) or (c) that a contractor, subcontractor, or contractor's or subcontractor's agent has failed to pay the prevailing wage rate determined by the department under sub. (3) or has paid less than 1.5 times the hourly basic rate of pay for all hours worked in excess of the prevailing hours of labor, the department shall order the contractor to pay to any affected employee the amount of his or her unpaid wages or his or her unpaid overtime compensation and an additional amount equal to 100 percent of the amount of those unpaid wages or that unpaid overtime compensation as liquidated damages within a period specified by the department in the order.

3. In addition to or in lieu of recovering the liability specified in subd. 1. as provided in subd. 2., any employee for and in behalf of that employee and other employees similarly situated may commence an action to recover that liability in any court of competent jurisdiction. If the court finds that a contractor, subcontractor, or contractor's or subcontractor's agent has failed to pay the prevailing wage rate determined by the department under sub. (3) or has paid less than 1.5 times the hourly basic rate of pay for all hours worked in excess of the prevailing hours of labor, the court shall order the contractor, subcontractor, or agent to pay to any affected employee the amount of his or her unpaid wages or his or her unpaid overtime compensation and an additional amount equal to 100 percent of the amount of those unpaid wages or that unpaid overtime compensation as liquidated damages.

5. No employee may be a party plaintiff to an action under subd. 3. unless the employee consents in writing to become a party and the consent is filed in the court in which the action is brought. Notwithstanding s. 814.04 (1), the court shall, in addition to any judgment awarded to the plaintiff, allow reasonable attorney fees and costs to be paid by the defendant.

BUILDING OR HEAVY CONSTRUCTION

Includes sheltered enclosures with walk-in access for the purpose of housing persons, employees, machinery, equipment or supplies and non-sheltered work such as canals, dams, dikes, reservoirs, storage tanks, etc. A sheltered enclosure need not be "habitable" in order to be considered a building. The installation of machinery and/or equipment, both above and below grade level, does not change a project's character as a building. On-site grading, utility work and landscaping are included within this definition. Residential buildings of four (4) stories or less, agricultural buildings, parking lots and driveways are NOT included within this definition.

SKILLED TRADES

Fringe Benefits Must Be Paid On <u>All</u> Hours Worked		HOURLY BASIC RATE OF PAY	HOURLY FRINGE BENEFITS	TOTAL
CODE	TRADE OR OCCUPATION	\$	\$	\$
101	Acoustic Ceiling Tile Installer Future Increase(s): Add \$1.42/hr on 6/1/2015; Add \$1.42/hr on 6/1/2016.	32.72	16.00	48.72
102	Boilermaker Future Increase(s): Add \$1.50/hr. on 01/01/2016	33.35	28.24	61.59
103	Bricklayer, Blocklayer or Stonemason Future Increase(s): Add \$1.40 on 06/01/2015; Add \$1.45 on 06/06/2016 Premium Increase(s): DOT PREMIUM: Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day.	32.82	18.66	51.48
104	Cabinet Installer Future Increase(s): Add \$1.42/hr on 6/1/2015; Add \$1.42/hr on 6/1/2016.	32.72	16.00	48.72
105	Carpenter Future Increase(s): Add \$1.42/hr on 6/1/2015; Add \$1.42/hr on 6/1/2016. Premium Increase(s): DOT PREMIUM: Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day.	32.72	16.00	48.72
106	Carpet Layer or Soft Floor Coverer Future Increase(s): Add \$1.42/hr on 6/1/2015; Add \$1.42/hr on 6/1/2016.	32.72	16.00	48.72
107	Cement Finisher	31.98	12.04	44.02
108	Drywall Taper or Finisher	26.05	18.23	44.28
109	Electrician Future Increase(s): Add \$1.20/hr on 6/1/15; Add \$1.25/hr on 6/1/16. Premium Increase(s): DOT PREMIUM: Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day.	34.82	19.67	54.49
110	Elevator Constructor	43.84	27.09	70.93

Fringe Benefits Must Be Paid On <u>All</u> Hours Worked		HOURLY BASIC RATE OF PAY	HOURLY FRINGE BENEFITS	TOTAL
CODE	TRADE OR OCCUPATION	\$	\$	\$
111	Fence Erector	18.00	6.09	24.09
112	Fire Sprinkler Fitter	36.79	18.81	55.60
113	Glazier Future Increase(s): Add \$.75/hr eff. 06/01/2015; Add \$.90/hr eff. 06/01/2016	37.07	14.42	51.49
114	Heat or Frost Insulator	33.43	25.81	59.24
115	Insulator (Batt or Blown) Future Increase(s): Add \$1.42/hr on 6/1/2015; Add \$1.42/hr on 6/1/2016.	32.72	16.00	48.72
116	Ironworker	31.50	20.01	51.51
117	Lather	31.40	15.90	47.30
118	Line Constructor (Electrical)	39.50	17.73	57.23
119	Marble Finisher	16.25	2.32	18.57
120	Marble Mason	32.09	18.04	50.13
121	Metal Building Erector	19.05	8.08	27.13
122	Millwright Future Increase(s): Add \$1.47/hr on 6/1/2015; Add \$1.47/hr on 6/1/2016.	34.44	16.07	50.51
123	Overhead Door Installer	27.46	1.98	29.44
124	Painter	25.75	16.60	42.35
125	Pavement Marking Operator	30.10	17.34	47.44
126	Piledriver Future Increase(s): Add \$1.50/hr on 6/1/2015; Add \$1.60/hr on 6/1/2016. Premium Increase(s): Add \$.65/hr for Piledriver Loftsman; Add \$.75/hr for Sheet Piling Loftsman. DOT PREMIUM: Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day.	30.11	26.51	56.62
127	Pipeline Fuser or Welder (Gas or Utility)	30.83	20.89	51.72
129	Plasterer Future Increase(s): Add \$1.56 on 06/01/2015; Add \$1.61 on 06/01/2016; Add \$1.66 on 06/01/2017	32.65	19.36	52.01
130	Plumber Future Increase(s): Add \$1.80 on 6/1/15	37.57	17.47	55.04

Fringe Benefits Must Be Paid On <u>All</u> Hours Worked		HOURLY BASIC RATE OF PAY	HOURLY FRINGE BENEFITS	TOTAL
CODE	TRADE OR OCCUPATION	\$	\$	\$
132	Refrigeration Mechanic Future Increase(s): Add \$1.80 on 6/1/15	44.20	18.26	62.46
133	Rofer or Waterproofofer	29.40	11.31	40.71
134	Sheet Metal Worker	34.45	22.54	56.99
135	Steamfitter Future Increase(s): Add \$1.80/hr on 6/1/15.	44.20	18.26	62.46
137	Teledata Technician or Installer Premium Increase(s): DOT PREMIUM: Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day.	22.50	12.74	35.24
138	Temperature Control Installer	42.95	15.04	57.99
139	Terrazzo Finisher	16.25	2.32	18.57
140	Terrazzo Mechanic	31.18	17.35	48.53
141	Tile Finisher	23.85	17.18	41.03
142	Tile Setter	29.81	17.18	46.99
143	Tuckpointer, Caulker or Cleaner	23.60	7.10	30.70
144	Underwater Diver (Except on Great Lakes)	35.40	15.90	51.30
146	Well Driller or Pump Installer	25.32	15.65	40.97
147	Siding Installer	36.17	19.44	55.61
150	Heavy Equipment Operator - ELECTRICAL LINE CONSTRUCTION ONLY	30.16	15.11	45.27
151	Light Equipment Operator -ELECTRICAL LINE CONSTRUCTION ONLY	31.60	26.76	58.36
152	Heavy Truck Driver - ELECTRICAL LINE CONSTRUCTION ONLY	27.65	14.49	42.14
153	Light Truck Driver - ELECTRICAL LINE CONSTRUCTION ONLY	27.83	15.01	42.84
154	Groundman - ELECTRICAL LINE CONSTRUCTION ONLY	21.90	9.83	31.73

TRUCK DRIVERS

Fringe Benefits Must Be Paid On <u>All</u> Hours Worked		HOURLY BASIC RATE OF PAY	HOURLY FRINGE BENEFITS	TOTAL
CODE	TRADE OR OCCUPATION	\$	\$	\$
201	Single Axle or Two Axle	32.89	18.96	51.85
203	Three or More Axle	18.00	21.99	39.99

Fringe Benefits Must Be Paid On <u>All</u> Hours Worked		HOURLY BASIC RATE OF PAY	HOURLY FRINGE BENEFITS	TOTAL
CODE	TRADE OR OCCUPATION	\$	\$	\$
204	Articulated, Euclid, Dumptor, Off Road Material Hauler Future Increase(s): Add \$1.60/hr on 6/2/2015; Add \$1.60/hr on 6/3/2016.	33.69	19.78	53.47
205	Pavement Marking Vehicle	20.85	11.02	31.87
207	Truck Mechanic	18.00	21.99	39.99

LABORERS

Fringe Benefits Must Be Paid On <u>All</u> Hours Worked		HOURLY BASIC RATE OF PAY	HOURLY FRINGE BENEFITS	TOTAL
CODE	TRADE OR OCCUPATION	\$	\$	\$
301	General Laborer Future Increase(s): Add \$1.35/hr eff. 06/01/2015; Add \$1.25/hr eff. 06/06/2016 Premium Increase(s): Add \$1.00/hr for certified welder; Add \$.25/hr for mason tender	24.97	15.12	40.09
302	Asbestos Abatement Worker	18.00	9.58	27.58
303	Landscaper	18.75	10.26	29.01
310	Gas or Utility Pipeline Laborer (Other Than Sewer and Water)	21.55	14.14	35.69
311	Fiber Optic Laborer (Outside, Other Than Concrete Encased) Premium Increase(s): DOT PREMIUMS: Pay two times the hourly basic rate on New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day.	18.82	14.16	32.98
314	Railroad Track Laborer	14.50	5.29	19.79
315	Final Construction Clean-Up Worker Future Increase(s): Add \$1.35/hr eff. 06/01/2015; Add \$1.25/hr eff. 06/06/2016	24.97	15.12	40.09

**HEAVY EQUIPMENT OPERATORS
SITE PREPARATION, UTILITY OR LANDSCAPING WORK ONLY**

Fringe Benefits Must Be Paid On <u>All</u> Hours Worked				
CODE	TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY	HOURLY FRINGE BENEFITS	TOTAL
		\$	\$	\$
501	Air Track, Rotary or Percussion Drilling Machine &/or Hammers, Blaster; Asphalt Milling Machine; Boring Machine (Directional, Horizontal or Vertical); Backhoe (Track Type) Having a Mfgr's Rated Capacity of 130,000 Lbs. or Over; Backhoe (Track Type) Having a Mfgr's Rated Capacity of Under 130,000 Lbs., Backhoe (Mini, 15,000 Lbs. & Under); Bulldozer or Endloader (Over 40 hp); Compactor (Self-Propelled 85 Ft Total Drum Width & Over, or Tractor Mounted, Towed & Light Equipment); Concrete Batch Plant, Batch Hopper; Concrete Breaker (Large, Auto, Vibratory/Sonic, Manual or Remote); Crane, Shovel, Dragline, Clamshells; Forklift (Machinery Moving or Steel Erection, 25 Ft & Over); Gradall (Cruz-Aire Type); Grader or Motor Patrol; Master Mechanic; Mechanic or Welder; Robotic Tool Carrier (With or Without Attachments); Scraper (Self Propelled or Tractor Drawn) 5 cu yds or More Capacity; Tractor or Truck Mounted Hydraulic Backhoe; Tractor or Truck Mounted Hydraulic Crane (10 Tons or Under); Tractor (Scraper, Dozer, Pusher, Loader); Trencher (Wheel Type or Chain Type Having Over 8 Inch Bucket). Future Increase(s): Add \$1.60/hr on 6/2/2015; Add \$1.60/hr on 6/3/2016.	33.69	19.78	53.47
502	Backfiller; Broom or Sweeper; Bulldozer or Endloader (Under 40 hp); Environmental Burner; Forestry Equipment, Timbco, Tree Shear, Tub Grinder, Processor; Jeep Digger; Screed (Milling Machine); Skid Rig; Straddle Carrier or Travel Lift; Stump Chipper; Trencher (Wheel Type or Chain Type Having 8 Inch Bucket & Under). Future Increase(s): Add \$1.60/hr on 6/2/2015; Add \$1.60/hr on 6/3/2016.	33.69	19.78	53.47
503	Air Compressor (&/or 400 CFM or Over); Augers (Vertical & Horizontal); Compactor (Self-Propelled 84 Ft Total Drum Width & Under, or Tractor Mounted, Towed & Light Equipment); Crusher, Screening or Wash Plant; Farm or Industrial Type Tractor; Forklift; Generator (&/or 150 KW or Over); Greaser; High Pressure Utility Locating Machine (Daylighting Machine); Mulcher; Oiler; Post Hole Digger or Driver; Pump (3 Inch or Over) or Well Points; Refrigeration Plant or Freeze Machine; Rock, Stone Breaker; Skid Steer Loader (With or Without Attachments); Vibratory Hammer or Extractor, Power Pack. Future Increase(s): Add \$1.60/hr on 6/2/2015; Add \$1.60/hr on 6/3/2016.	31.62	19.78	51.40
504	Work Performed on the Great Lakes Including Diver; Wet Tender or Hydraulic Dredge Engineer.	41.65	21.71	63.36
505	Work Performed on the Great Lakes Including Crane or Backhoe Operator; Assistant Hydraulic Dredge Engineer; Hydraulic Dredge Leverman or Diver's Tender; Mechanic or Welder; 70 Ton & Over Tug Operator. Premium Increase(s): Add \$.50/hr for Friction Crane, Lattice Boom or Crane Certification (CCO).	41.65	21.71	63.36

Fringe Benefits Must Be Paid On <u>All</u> Hours Worked				
CODE	TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY	HOURLY FRINGE BENEFITS	TOTAL
		\$	\$	\$
506	Work Performed on the Great Lakes Including Deck Equipment Operator or Machineryman (Maintains Cranes Over 50 Tons or Backhoes 115,000 Lbs. or More); Tug, Launch or Loader, Dozer or Like Equipment When Operated on a Barge, Breakwater Wall, Slip, Dock or Scow, Deck Machinery.	35.72	17.85	53.57
507	Work Performed on the Great Lakes Including Deck Equipment Operator, Machineryman or Fireman (Operates 4 Units or More or Maintains Cranes 50 Tons or Under or Backhoes 115,000 Lbs. or Under); Deck Hand, Deck Engineer or Assistant Tug Operator; Off Road Trucks - Great Lakes ONLY.	35.46	20.40	55.86

**HEAVY EQUIPMENT OPERATORS
EXCLUDING SITE PREPARATION, UTILITY, PAVING LANDSCAPING WORK**

Fringe Benefits Must Be Paid On <u>All</u> Hours Worked				
CODE	TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY	HOURLY FRINGE BENEFITS	TOTAL
		\$	\$	\$
508	Boring Machine (Directional); Crane, Tower Crane, Pedestal Tower or Derrick, With or Without Attachments, With a Lifting Capacity of Over 100 Tons, Self-Erecting Tower Crane With a Lifting Capacity of Over 4,000 Lbs., Crane With Boom Dollies; Crane, Tower Crane, Pedestal Tower or Derrick, With Boom, Leads &/or Jib Lengths Measuring 176 Ft or Over; Master Mechanic. Future Increase(s): Add \$1.60/hr on 6/2/2015; Add \$1.60/hr on 6/3/2016. Premium Increase(s): Add \$.50/hr for >200 Ton; Add \$1/hr at 300 Ton; Add \$1.50/hr at 400 Ton; Add \$2/hr at 500 Ton & Over.	36.67	19.78	56.45
509	Backhoe (Track Type) Having a Mfgr's Rated Capacity of 130,000 Lbs. or Over; Boring Machine (Horizontal or Vertical); Caisson Rig; Crane, Tower Crane, Portable Tower, Pedestal Tower or Derrick, With or Without Attachments, With a Lifting Capacity of 100 Tons or Under, Self-Erecting Tower Crane With A Lifting Capacity Of 4,000 Lbs. & Under; Crane, Tower Crane, Portable Tower, Pedestal Tower or Derrick, With Boom, Leads &/or Jib Lengths Measuring 175 Ft or Under; Pile Driver; Versi Lifts, Tri-Lifts & Gantrys (20,000 Lbs. & Over). Future Increase(s): Add \$1.60/hr on 6/2/2015; Add \$1.60/hr on 6/3/2016. Premium Increase(s): Add \$.25/hr for all >45 Ton lifting capacity cranes.	35.42	19.78	55.20
510	Backhoe (Track Type) Having a Mfgr.'s Rated Capacity of Under 130,000 Lbs., Backhoe (Mini, 15,000 Lbs. & Under); Concrete Bump Cutter, Grinder, Planing or Grooving Machine; Concrete Laser/Screed; Concrete Paver (Slipform); Concrete Pump (Over 46 Meter), Concrete Conveyor (Rotec or Bidwell Type); Concrete Slipform Placer Curb & Gutter Machine; Concrete Spreader & Distributor; Dredge (NOT Performing Work on the Great Lakes); Forklift (Machinery Moving or Steel Erection, 25 Ft & Over); Gradall (Cruz-Aire Type); Hydro-Blaster (10,000 PSI or Over); Milling Machine; Skid Rig; Traveling Crane (Bridge Type). Future Increase(s): Add \$1.60/hr on 6/2/2015; Add \$1.60/hr on 6/3/2016.	34.22	19.78	54.00

Fringe Benefits Must Be Paid On <u>All</u> Hours Worked		HOURLY BASIC RATE OF PAY	HOURLY FRINGE BENEFITS	TOTAL
CODE	TRADE OR OCCUPATION	\$	\$	\$
511	Air, Track, Rotary or Percussion Drilling Machine &/or Hammers, Blaster; Bulldozer or Endloader (Over 40 hp); Compactor (Self-Propelled 85 Ft Total Drum Width & Over, or Tractor Mounted, Towed & Light Equipment); Concrete Pump (46 Meter & Under), Concrete Conveyor (Rotec or Bidwell Type); Crane (Carry Deck, Mini) or Truck Mounted Hydraulic Crane (10 Tons or Under); Environmental Burner; Gantrys (Under 20,000 Lbs.); Grader or Motor Patrol; High Pressure Utility Locating Machine (Daylighting Machine); Manhoist; Material or Stack Hoist; Mechanic or Welder; Railroad Track Rail Leveling Machine, Tie Placer, Extractor, Tamper, Stone Leveler or Rehabilitation Equipment; Roller (Over 5 Ton); Scraper (Self Propelled or Tractor Drawn) 5 cu yd or More Capacity; Screed (Milling Machine); Sideboom; Straddle Carrier or Travel Lift; Tining or Curing Machine; Tractor (Scraper, Dozer, Pusher, Loader); Tractor or Truck Mounted Hydraulic Backhoe; Tractor or Truck Mounted Hydraulic Crane (10 Tons or Under); Trencher (Wheel Type or Chain Type Having Over 8-Inch Bucket). Future Increase(s): Add \$1.60/hr on 6/2/2015; Add \$1.60/hr on 6/3/2016.	33.69	19.78	53.47
512	Backfiller; Broom or Sweeper; Bulldozer or Endloader (Under 40 hp); Compactor (Self-Propelled 84 Ft Total Drum Width & Under, or Tractor Mounted, Towed & Light Equipment); Concrete Batch Plant, Batch Hopper; Concrete Breaker (Large, Auto, Vibratory/Sonic, Manual or Remote); Concrete Conveyor System; Concrete Finishing Machine (Road Type); Fireman (Pile Driver & Derrick NOT Performing Work on the Great Lakes); Grout Pump; Hoist (Tugger, Automatic); Industrial Locomotives; Jeep Digger; Lift Slab Machine; Mulcher; Roller (Rubber Tire, 5 Ton or Under); Screw or Gypsum Pumps; Stabilizing or Concrete Mixer (Self-Propelled or 14S or Over); Stump Chipper; Trencher (Wheel Type or Chain Type Having 8-Inch Bucket & Under); Winches & A-Frames. Future Increase(s): Add \$1.60/hr on 6/2/2015; Add \$1.60/hr on 6/3/2016.	31.62	19.78	51.40
513	Air Compressor (&/or 400 CFM or Over); Air, Electric or Hydraulic Jacking System; Augers (Vertical & Horizontal); Boatmen (NOT Performing Work on the Great Lakes); Boiler (Temporary Heat); Crusher, Screening or Wash Plant; Elevator; Farm or Industrial Type Tractor; Fireman (Asphalt Plant NOT Performing Work on the Great Lakes); Forklift; Generator (&/or 150 KW or Over); Greaser; Heaters (Mechanical); Loading Machine (Conveyor); Oiler; Post Hole Digger or Driver; Prestress Machine; Pump (3 Inch or Over) or Well Points; Refrigeration Plant or Freeze Machine; Robotic Tool Carrier (With or Without Attachments); Rock, Stone Breaker; Skid Steer Loader (With or Without Attachments); Vibratory Hammer or Extractor, Power Pack. Future Increase(s): Add \$1.60/hr on 6/2/2015; Add \$1.60/hr on 6/3/2016.	30.99	19.78	50.77
514	Gas or Utility Pipeline, Except Sewer & Water (Primary Equipment). Future Increase(s): Add \$1/hr on 6/1/2015; Add \$1/hr on 5/30/2016.	36.34	22.14	58.48
515	Gas or Utility Pipeline, Except Sewer & Water (Secondary Equipment). Future Increase(s): Add \$1.65/hr on 6/1/2015.	33.12	19.35	52.47
516	Fiber Optic Cable Equipment	28.89	17.95	46.84

SEWER, WATER OR TUNNEL CONSTRUCTION
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Includes those projects that primarily involve public sewer or water distribution, transmission or collection systems and related tunnel work (excluding buildings).

SKILLED TRADES

CODE	TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY	HOURLY FRINGE BENEFITS	TOTAL
		\$	\$	\$
103	Bricklayer, Blocklayer or Stonemason	32.09	18.04	50.13
105	Carpenter Future Increase(s): Add \$1.50/hr on 6/1/2015; Add \$1.65/hr on 6/1/2016. Premium Increase(s): DOT PREMIUM: Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day.	34.13	20.61	54.74
107	Cement Finisher Future Increase(s): Add \$1.87 on 6/1/15; Add \$1.75 on 6/1/16. Premium Increase(s): DOT PREMIUMS: 1) Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day. 2) Add \$1.40/hr when the Wisconsin Department of Transportation or responsible governing agency requires that work be performed at night under artificial illumination with traffic control and the work is completed after sunset and before sunrise.	35.18	16.78	51.96
109	Electrician Premium Increase(s): DOT PREMIUM: Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day.	33.93	22.77	56.70
111	Fence Erector	18.00	6.09	24.09
116	Ironworker	31.50	20.01	51.51
118	Line Constructor (Electrical)	39.50	17.73	57.23
125	Pavement Marking Operator	30.10	17.34	47.44
126	Piledriver	29.56	25.71	55.27
130	Plumber	21.50	0.00	21.50
135	Steamfitter	42.95	17.81	60.76
137	Teledata Technician or Installer	22.25	12.24	34.49
143	Tuckpointer, Caulker or Cleaner	23.60	7.10	30.70
144	Underwater Diver (Except on Great Lakes)	35.40	15.90	51.30

Fringe Benefits Must Be Paid On <u>All</u> Hours Worked		HOURLY BASIC RATE OF PAY	HOURLY FRINGE BENEFITS	TOTAL
CODE	TRADE OR OCCUPATION	\$	\$	\$
146	Well Driller or Pump Installer	25.32	15.65	40.97
150	Heavy Equipment Operator - ELECTRICAL LINE CONSTRUCTION ONLY	35.55	15.57	51.12
151	Light Equipment Operator -ELECTRICAL LINE CONSTRUCTION ONLY	31.60	15.19	46.79
152	Heavy Truck Driver - ELECTRICAL LINE CONSTRUCTION ONLY	27.65	13.44	41.09
153	Light Truck Driver - ELECTRICAL LINE CONSTRUCTION ONLY	25.68	13.28	38.96
154	Groundman - ELECTRICAL LINE CONSTRUCTION ONLY	21.75	12.97	34.72

TRUCK DRIVERS

Fringe Benefits Must Be Paid On <u>All</u> Hours Worked		HOURLY BASIC RATE OF PAY	HOURLY FRINGE BENEFITS	TOTAL
CODE	TRADE OR OCCUPATION	\$	\$	\$
201	Single Axle or Two Axle Future Increase(s): Add \$1.15/hr on 6/1/2015. Premium Increase(s): DOT PREMIUM: Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day.	25.18	18.31	43.49
203	Three or More Axle	19.50	4.97	24.47
204	Articulated, Euclid, Dumptor, Off Road Material Hauler	32.89	18.96	51.85
205	Pavement Marking Vehicle	20.85	11.02	31.87
207	Truck Mechanic	19.50	4.97	24.47

LABORERS

Fringe Benefits Must Be Paid On <u>All</u> Hours Worked		HOURLY BASIC RATE OF PAY	HOURLY FRINGE BENEFITS	TOTAL
CODE	TRADE OR OCCUPATION	\$	\$	\$
301	General Laborer Future Increase(s): Add \$1.35/hr eff. 06/01/2015; Add \$1.25/hr eff. 06/06/2016 Premium Increase(s): Add \$.20 for blaster, bracer, manhole builder, caulker, bottomman and power tool; Add \$.55 for pipelayer; Add \$1.00 for tunnel work 0-15 lbs. compressed air; Add \$2.00 for over 15-30 lbs. compressed air; Add \$3.00 for over 30 lbs. compressed air.	26.34	15.13	41.47
303	Landscaper	39.43	0.00	39.43

Fringe Benefits Must Be Paid On <u>All</u> Hours Worked		HOURLY BASIC RATE OF PAY	HOURLY FRINGE BENEFITS	TOTAL
CODE	TRADE OR OCCUPATION	\$	\$	\$
304	Flagperson or Traffic Control Person	31.95	0.00	31.95
311	Fiber Optic Laborer (Outside, Other Than Concrete Encased)	18.33	13.65	31.98
314	Railroad Track Laborer	14.50	5.29	19.79

**HEAVY EQUIPMENT OPERATORS
SEWER, WATER OR TUNNEL WORK**

Fringe Benefits Must Be Paid On <u>All</u> Hours Worked		HOURLY BASIC RATE OF PAY	HOURLY FRINGE BENEFITS	TOTAL
CODE	TRADE OR OCCUPATION	\$	\$	\$
521	Backhoe (Track Type) Having a Mfgr.'s Rated Capacity of 130,000 Lbs. or Over; Caisson Rig; Crane, Tower Crane, Pedestal Tower or Derrick, With Boom, Leads &/or Jib Lengths Measuring 176 Ft or Over; Crane, Tower Crane, Pedestal Tower or Derrick, With or Without Attachments, With a Lifting Capacity of Over 100 Tons, Self-Erecting Tower Crane With a Lifting Capacity Of Over 4,000 Lbs., Crane With Boom Dollies; Master Mechanic; Pile Driver. Future Increase(s): Add \$1.55/hr on 6/1/2015. Premium Increase(s): Add \$.25/hr for operating tower crane.	37.24	20.10	57.34
522	Backhoe (Track Type) Having a Mfgr.'s Rated Capacity of Under 130,000 Lbs., Backhoe (Mini, 15,000 Lbs. & Under); Boring Machine (Directional); Concrete Bump Cutter, Grinder, Planing or Grooving Machine; Concrete Laser/Screed; Concrete Paver (Slipform); Concrete Pump (Over 46 Meter), Concrete Conveyor (Rotec or Bidwell Type); Concrete Spreader & Distributor; Crane, Tower Crane, Portable Tower, Pedestal Tower or Derrick, With Boom, Leads &/or Jib Lengths Measuring 175 Ft or Under; Crane, Tower Crane, Portable Tower, Pedestal Tower or Derrick, With or Without Attachments, With a Lifting Capacity of 100 Tons or Under, Self-Erecting Tower Crane With a Lifting Capacity of 4,000 Lbs. & Under; Dredge (NOT Performing Work on the Great Lakes); Milling Machine; Skid Rig; Telehandler; Traveling Crane (Bridge Type). Future Increase(s): Add \$1.60/hr on 6/2/2015; Add \$1.60/hr on 6/3/2016.	34.22	19.78	54.00
523	Air Track, Rotary or Percussion Drilling Machine &/or Hammers, Blaster; Boring Machine (Horizontal or Vertical); Bulldozer or Endloader (Over 40 hp); Crane (Carry Deck, Mini) or Truck Mounted Hydraulic Crane (10 Tons or Under); Concrete Pump (46 Meter & Under), Concrete Conveyor (Rotec or Bidwell Type); Concrete Slipform Placer Curb & Gutter Machine; Gradall (Cruz-Aire Type); Grader or Motor Patrol; Hydro-Blaster (10,000 PSI or Over); Manhoist; Material or Stack Hoist; Mechanic or Welder; Roller (Over 5 Ton); Scraper (Self Propelled or Tractor Drawn) 5 cu yd or More Capacity; Screed (Milling Machine); Sideboom; Straddle Carrier or Travel Lift; Tractor (Scraper, Dozer, Pusher, Loader); Tractor or Truck Mounted Hydraulic Backhoe; Tractor or Truck Mounted Hydraulic Crane (10 Tons or Under); Trencher (Wheel Type or Chain Type Having Over 8-Inch Bucket). Future Increase(s): Add \$1.60/hr on 6/2/2015; Add \$1.60/hr on 6/3/2016.	33.69	19.78	53.47

Fringe Benefits Must Be Paid On <u>All</u> Hours Worked		HOURLY BASIC RATE OF PAY	HOURLY FRINGE BENEFITS	TOTAL
CODE	TRADE OR OCCUPATION	\$	\$	\$
524	Backfiller; Broom or Sweeper; Bulldozer or Endloader (Under 40 hp); Compactor (Self-Propelled 85 Ft Total Drum Width & Over, or Tractor Mounted, Towed & Light Equipment); Concrete Batch Plant, Batch Hopper; Concrete Breaker (Large, Auto, Vibratory/Sonic, Manual or Remote); Concrete Conveyor System; Concrete Finishing Machine (Road Type); Environmental Burner; Fireman (Pile Driver & Derrick NOT Performing Work on the Great Lakes); Forestry Equipment, Timbco, Tree Shear, Tub Grinder, Processor; Hoist (Tugger, Automatic); Grout Pump; Jeep Digger; Lift Slab Machine; Mulcher; Power Subgrader; Pump (3 Inch or Over) or Well Points; Robotic Tool Carrier (With or Without Attachments); Roller (Rubber Tire, 5 Ton or Under); Screw or Gypsum Pumps; Stabilizing or Concrete Mixer (Self-Propelled or 14S or Over); Stump Chipper; Tining or Curing Machine; Trencher (Wheel Type or Chain Type Having 8-Inch Bucket & Under); Winches & A-Frames.	30.82	18.96	49.78
525	Air Compressor (&/or 400 CFM or Over); Air, Electric or Hydraulic Jacking System; Augers (Vertical & Horizontal); Compactor (Self-Propelled 84 Ft Total Drum Width & Under, or Tractor Mounted, Towed & Light Equipment); Crusher, Screening or Wash Plant; Farm or Industrial Type Tractor; Fireman (Asphalt Plant NOT Performing Work on the Great Lakes); Generator (&/or 150 KW or Over); Heaters (Mechanical); High Pressure Utility Locating Machine (Daylighting Machine); Loading Machine (Conveyor); Post Hole Digger or Driver; Refrigeration Plant or Freeze Machine; Rock, Stone Breaker; Skid Steer Loader (With or Without Attachments); Vibratory Hammer or Extractor, Power Pack.	30.69	18.46	49.15
526	Boiler (Temporary Heat); Forklift; Greaser; Oiler.	30.19	18.96	49.15
527	Work Performed on the Great Lakes Including Diver; Wet Tender or Hydraulic Dredge Engineer.	41.65	21.71	63.36
528	Work Performed on the Great Lakes Including 70 Ton & Over Tug Operator; Assistant Hydraulic Dredge Engineer; Crane or Backhoe Operator; Hydraulic Dredge Leverman or Diver's Tender; Mechanic or Welder.	41.65	21.71	63.36
529	Work Performed on the Great Lakes Including Deck Equipment Operator or Machineryman (Maintains Cranes Over 50 Tons or Backhoes 115,000 Lbs. or More); Tug, Launch or Loader, Dozer or Like Equipment When Operated on a Barge, Breakwater Wall, Slip, Dock or Scow, Deck Machinery.	35.72	17.85	53.57
530	Work Performed on the Great Lakes Including Deck Equipment Operator; Machineryman or Fireman (Operates 4 Units or More or Maintains Cranes 50 Tons or Under or Backhoes 115,000 Lbs. or Under), Deck Hand, Deck Engineer or Assistant Tug Operator; Off Road Trucks - Great Lakes ONLY.	35.46	20.40	55.86

AIRPORT PAVEMENT OR STATE HIGHWAY CONSTRUCTION

Includes all airport projects (excluding buildings) and all projects awarded by the Wisconsin Department of Transportation (excluding buildings).

SKILLED TRADES

Fringe Benefits Must Be Paid On <u>All</u> Hours Worked		HOURLY BASIC RATE OF PAY	HOURLY FRINGE BENEFITS	TOTAL
CODE	TRADE OR OCCUPATION	\$	\$	\$
103	Bricklayer, Blocklayer or Stonemason	32.09	18.04	50.13
105	Carpenter Future Increase(s): Add \$1.42/hr on 6/1/2015; Add \$1.42/hr on 6/1/2016. Premium Increase(s): DOT PREMIUM: Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day.	32.72	16.00	48.72
107	Cement Finisher Future Increase(s): Add \$1.87 on 6/1/15; Add \$1.75 on 6/1/16. Premium Increase(s): DOT PREMIUMS: 1) Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day. 2) Add \$1.40/hr when the Wisconsin Department of Transportation or responsible governing agency requires that work be performed at night under artificial illumination with traffic control and the work is completed after sunset and before sunrise.	35.18	16.78	51.96
109	Electrician Premium Increase(s): DOT PREMIUM: Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day.	33.93	22.77	56.70
111	Fence Erector	18.00	6.09	24.09
116	Ironworker	31.50	20.01	51.51
118	Line Constructor (Electrical)	39.50	17.73	57.23
124	Painter	26.65	13.10	39.75
125	Pavement Marking Operator	29.22	25.90	55.12
126	Piledriver Future Increase(s): Add \$1.44/hr on 6/1/2015; Add \$1.44/hr on 6/1/2016. Premium Increase(s): DOT PREMIUM: Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day.	33.24	16.00	49.24
133	Rofer or Waterproofer	29.40	11.31	40.71

Fringe Benefits Must Be Paid On <u>All</u> Hours Worked		HOURLY BASIC RATE OF PAY	HOURLY FRINGE BENEFITS	TOTAL
CODE	TRADE OR OCCUPATION	\$	\$	\$
137	Teledata Technician or Installer	22.25	12.24	34.49
143	Tuckpointer, Caulker or Cleaner	23.60	7.10	30.70
144	Underwater Diver (Except on Great Lakes)	35.40	15.90	51.30
150	Heavy Equipment Operator - ELECTRICAL LINE CONSTRUCTION ONLY	35.55	15.57	51.12
151	Light Equipment Operator -ELECTRICAL LINE CONSTRUCTION ONLY	31.60	15.29	46.89
152	Heavy Truck Driver - ELECTRICAL LINE CONSTRUCTION ONLY	27.65	13.44	41.09
153	Light Truck Driver - ELECTRICAL LINE CONSTRUCTION ONLY	25.68	12.83	38.51
154	Groundman - ELECTRICAL LINE CONSTRUCTION ONLY	21.73	12.17	33.90

TRUCK DRIVERS

Fringe Benefits Must Be Paid On <u>All</u> Hours Worked		HOURLY BASIC RATE OF PAY	HOURLY FRINGE BENEFITS	TOTAL
CODE	TRADE OR OCCUPATION	\$	\$	\$
201	Single Axle or Two Axle Future Increase(s): Add \$1.15/hr on 6/1/2015. Premium Increase(s): DOT PREMIUM: Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day.	25.18	18.31	43.49
203	Three or More Axle Future Increase(s): Add \$1.15/hr on 6/1/2015. Premium Increase(s): DOT PREMIUM: Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day.	25.28	18.31	43.59
204	Articulated, Euclid, Dumptor, Off Road Material Hauler Future Increase(s): Add \$1.25/hr on 6/1/2015; Add \$1.30/hr on 6/1/2016; Add \$1.25/hr on 6/1/2017. Premium Increase(s): DOT PREMIUMS: 1) Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day. 2) Add \$1.50/hr night work premium. See DOT'S website for details about the applicability of this night work premium at: http://www.dot.wi.gov/business/civilrights/laborwages/pwc.htm .	30.27	21.15	51.42
205	Pavement Marking Vehicle	23.16	21.13	44.29
206	Shadow or Pilot Vehicle	24.37	17.77	42.14

207	Truck Mechanic	24.52	17.77	42.29
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LABORERS

Fringe Benefits Must Be Paid On All Hours Worked

CODE	TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY \$	HOURLY FRINGE BENEFITS \$	TOTAL \$
301	General Laborer Future Increase(s): Add \$1.05/hr eff. 06/01/2015; Add \$1.00/hr eff. 06/01/2016; Add \$1.00/hr eff. 06/01/2017 Premium Increase(s): Add \$.10/hr for topman, air tool operator, vibrator or tamper operator (mechanical hand operated), chain saw operator and demolition burning torch laborer; Add \$.15/hr for bituminous worker (raker and luteman), formsetter (curb, sidewalk and pavement) and strike off man; Add \$.20/hr for blaster and powderman; Add \$.25/hr for bottomman; Add \$.35/hr for line and grade specialist; Add \$.45/hr for pipelayer. / DOT PREMIUMS: 1) Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day. 2) Add \$1.25/hr for work on projects involving temporary traffic control setup, for lane and shoulder closures, when work under artificial illumination conditions is necessary as required by the project provisions (including prep time prior to and/or cleanup after such time period).	30.41	15.14	45.55
302	Asbestos Abatement Worker	18.00	9.58	27.58
303	Landscaper Future Increase(s): Add \$1.05/hr eff. 06/01/2015; Add \$1.00/hr eff. 06/01/2016; Add \$1.00/hr eff. 06/01/2017 Premium Increase(s): DOT PREMIUMS: 1) Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day. 2) Add \$1.25/hr for work on projects involving temporary traffic control setup, for lane and shoulder closures, when work under artificial illumination conditions is necessary as required by the project provisions (including prep time prior to and/or cleanup after such time period).	30.41	15.14	45.55
304	Flagperson or Traffic Control Person Future Increase(s): Add \$1.05/hr eff. 06/01/2015; Add \$1.00/hr eff. 06/01/2016; Add \$1.00/hr eff. 06/01/2017 Premium Increase(s):	26.76	15.14	41.90

Fringe Benefits Must Be Paid On All Hours Worked

<u>CODE</u>	<u>TRADE OR OCCUPATION</u>	<u>HOURLY BASIC RATE OF PAY</u> \$	<u>HOURLY FRINGE BENEFITS</u> \$	<u>TOTAL</u> \$
	DOT PREMIUMS: 1) Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day. 2) Add \$1.25/hr when the Wisconsin Department of Transportation or responsible governing agency requires that work be performed at night under artificial illumination with traffic control and the work is completed after sunset and before sunrise.			
311	Fiber Optic Laborer (Outside, Other Than Concrete Encased)	18.33	13.65	31.98
314	Railroad Track Laborer	14.50	5.29	19.79

**HEAVY EQUIPMENT OPERATORS
AIRPORT PAVEMENT OR STATE HIGHWAY CONSTRUCTION**

Fringe Benefits Must Be Paid On All Hours Worked

<u>CODE</u>	<u>TRADE OR OCCUPATION</u>	<u>HOURLY BASIC RATE OF PAY</u> \$	<u>HOURLY FRINGE BENEFITS</u> \$	<u>TOTAL</u> \$
531	Crane, Tower Crane, Pedestal Tower or Derrick, With Boom, Leads &/or Jib Lengths Measuring 176 Ft or Over; Crane, Tower Crane, Pedestal Tower or Derrick, With or Without Attachments, With a Lifting Capacity of Over 100 Tons, Self-Erecting Tower Crane With a Lifting Capacity Of Over 4,000 Lbs., Crane With Boom Dollies; Traveling Crane (Bridge Type). Future Increase(s): Add \$1.25/hr on 6/1/2015; Add \$1.30/hr on 6/1/2016; Add \$1.25/hr on 6/1/2017. Premium Increase(s): DOT PREMIUMS: 1) Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day. 2) Add \$1.50/hr night work premium. See DOT'S website for details about the applicability of this night work premium at: http://www.dot.wi.gov/business/civilrights/laborwages/pwc.htm .	37.72	21.15	58.87
532	Backhoe (Track Type) Having a Mfgr.'s Rated Capacity of 130,000 Lbs. or Over; Caisson Rig; Crane, Tower Crane, Portable Tower, Pedestal Tower or Derrick, With Boom, Leads &/or Jib Lengths Measuring 175 Ft or Under; Crane, Tower Crane, Portable Tower, Pedestal Tower or Derrick, With or Without Attachments, With a Lifting Capacity of 100 Tons or Under, Self-Erecting Tower Crane With A Lifting Capacity Of 4,000 Lbs., & Under; Dredge (NOT Performing Work on the Great Lakes); Licensed Boat Pilot (NOT Performing Work on the Great Lakes); Pile Driver. Future Increase(s): Add \$1.25/hr on 6/1/2015; Add \$1.30/hr on 6/1/2016; Add \$1.25/hr on 6/1/2017. Premium Increase(s): DOT PREMIUMS: 1) Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day. 2) Add \$1.50/hr night work premium. See DOT'S website for details about the applicability of this night work premium at: http://www.dot.wi.gov/business/civilrights/laborwages/pwc.htm .	37.22	21.15	58.37

Fringe Benefits Must Be Paid On <u>All</u> Hours Worked		HOURLY BASIC RATE OF PAY	HOURLY FRINGE BENEFITS	TOTAL
CODE	TRADE OR OCCUPATION	\$	\$	\$
533	<p>Air Track, Rotary or Percussion Drilling Machine &/or Hammers, Blaster; Asphalt Heater, Planer & Scarifier; Asphalt Milling Machine; Asphalt Screed; Automatic Subgrader (Concrete); Backhoe (Track Type) Having a Mfgr.'s Rated Capacity of Under 130,000 Lbs., Backhoe (Mini, 15,000 Lbs. & Under); Bituminous (Asphalt) Plant & Paver, Screed; Boatmen (NOT Performing Work on the Great Lakes); Boring Machine (Directional, Horizontal or Vertical); Bridge (Bidwell) Paver; Bulldozer or Endloader; Concrete Batch Plant, Batch Hopper; Concrete Breaker (Large, Auto, Vibratory/Sonic, Manual or Remote); Concrete Bump Cutter, Grinder, Planing or Grooving Machine; Concrete Conveyor System; Concrete Laser/Screed; Concrete Paver (Slipform); Concrete Pump, Concrete Conveyor (Rotec or Bidwell Type); Concrete Slipform Placer Curb & Gutter Machine; Concrete Spreader & Distributor; Crane (Carry Deck, Mini) or Truck Mounted Hydraulic Crane (10 Tons or Under); Crane Wlth a Lifting Capacity of 25 Tons or Under; Forestry Equipment, Timbco, Tree Shear, Tub Grinder, Processor; Gradall (Cruz-Aire Type); Grader or Motor Patrol; Grout Pump; Hydro-Blaster (10,000 PSI or Over); Loading Machine (Conveyor); Material or Stack Hoist; Mechanic or Welder; Milling Machine; Post Hole Digger or Driver; Roller (Over 5 Ton); Scraper (Self Propelled or Tractor Drawn) 5 cu yds or More Capacity; Shoulder Widener; Sideboom; Skid Rig; Stabilizing or Concrete Mixer (Self-Propelled or 14S or Over); Straddle Carrier or Travel Lift; Tractor (Scraper, Dozer, Pusher, Loader); Tractor or Truck Mounted Hydraulic Backhoe; Trencher (Wheel Type or Chain Type); Tube Finisher; Tugger (NOT Performing Work on the Great Lakes); Winches & A-Frames.</p> <p>Future Increase(s): Add \$1.25/hr on 6/1/2015; Add \$1.30/hr on 6/1/2016; Add \$1.25/hr on 6/1/2017.</p> <p>Premium Increase(s): DOT PREMIUMS: 1) Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day. 2) Add \$1.50/hr night work premium. See DOT'S website for details about the applicability of this night work premium at: http://www.dot.wi.gov/business/civilrights/laborwages/pwc.htm.</p>	36.72	21.15	57.87

Fringe Benefits Must Be Paid On <u>All</u> Hours Worked		HOURLY BASIC RATE OF PAY	HOURLY FRINGE BENEFITS	TOTAL
CODE	TRADE OR OCCUPATION	\$	\$	\$
534	<p>Belting, Burlap, Texturing Machine; Broom or Sweeper; Compactor (Self-Propelled or Tractor Mounted, Towed & Light Equipment); Concrete Finishing Machine (Road Type); Environmental Burner; Farm or Industrial Type Tractor; Fireman (Asphalt Plant, Pile Driver & Derrick NOT Performing Work on the Great Lakes); Forklift; Greaser; Hoist (Tugger, Automatic); Jeep Digger; Joint Sawyer (Multiple Blade); Launch (NOT Performing Work on the Great Lakes); Lift Slab Machine; Mechanical Float; Mulcher; Power Subgrader; Robotic Tool Carrier (With or Without Attachments); Roller (Rubber Tire, 5 Ton or Under); Self Propelled Chip Spreader; Shouldering Machine; Skid Steer Loader (With or Without Attachments); Telehandler; Tining or Curing Machine.</p> <p>Future Increase(s): Add \$1.25/hr on 6/1/2015; Add \$1.30/hr on 6/1/2016; Add \$1.25/hr on 6/1/2017.</p> <p>Premium Increase(s): DOT PREMIUMS: 1) Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day. 2) Add \$1.50/hr night work premium. See DOT'S website for details about the applicability of this night work premium at: http://www.dot.wi.gov/business/civilrights/laborwages/pwc.htm.</p>	36.46	21.15	57.61
535	<p>Air Compressor (&/or 400 CFM or Over); Air, Electric or Hydraulic Jacking System; Augers (Vertical & Horizontal); Automatic Belt Conveyor & Surge Bin; Boiler (Temporary Heat); Concrete Proportioning Plant; Crusher, Screening or Wash Plant; Generator (&/or 150 KW or Over); Heaters (Mechanical); High Pressure Utility Locating Machine (Daylighting Machine); Mudjack; Oiler; Prestress Machine; Pug Mill; Pump (3 Inch or Over) or Well Points; Rock, Stone Breaker; Screed (Milling Machine); Stump Chipper; Tank Car Heaters; Vibratory Hammer or Extractor, Power Pack.</p> <p>Future Increase(s): Add \$1.25/hr on 6/1/2015; Add \$1.30/hr on 6/1/2016; Add \$1.25/hr on 6/1/2017.</p> <p>Premium Increase(s): DOT PREMIUMS: 1) Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day. 2) Add \$1.50/hr night work premium. See DOT'S website for details about the applicability of this night work premium at: http://www.dot.wi.gov/business/civilrights/laborwages/pwc.htm.</p>	36.17	21.15	57.32
536	Fiber Optic Cable Equipment.	28.89	17.95	46.84
537	Work Performed on the Great Lakes Including Diver; Wet Tender or Hydraulic Dredge Engineer.	41.65	21.71	63.36
538	Work Performed on the Great Lakes Including 70 Ton & Over Tug Operator; Assistant Hydraulic Dredge Engineer; Crane or Backhoe Operator; Hydraulic Dredge Leverman or Diver's Tender; Mechanic or Welder.	41.65	21.71	63.36

Fringe Benefits Must Be Paid On <u>All</u> Hours Worked		HOURLY BASIC RATE OF PAY	HOURLY FRINGE BENEFITS	TOTAL
CODE	TRADE OR OCCUPATION	\$	\$	\$
539	Work Performed on the Great Lakes Including Deck Equipment Operator or Machineryman (Maintains Cranes Over 50 Tons or Backhoes 115,000 Lbs. or More); Tug, Launch or Loader, Dozer or Like Equipment When Operated on a Barge, Breakwater Wall, Slip, Dock or Scow, Deck Machinery.	35.72	17.85	53.57
540	Work Performed on the Great Lakes Including Deck Equipment Operator, Machineryman or Fireman (Operates 4 Units or More or Maintains Cranes 50 Tons or Under or Backhoes 115,000 Lbs. or Under); Deck Hand, Deck Engineer or Assistant Tug Operator; Off Road Trucks-Great Lakes ONLY.	35.46	20.40	55.86

LOCAL STREET OR MISCELLANEOUS PAVING CONSTRUCTION
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Includes roads, streets, alleys, trails, bridges, paths, racetracks, parking lots and driveways (except residential or agricultural), public sidewalks or other similar projects (excluding projects awarded by the Wisconsin Department of Transportation).

SKILLED TRADES

CODE	TRADE OR OCCUPATION	Fringe Benefits Must Be Paid On <u>All</u> Hours Worked		
		HOURLY BASIC RATE OF PAY	HOURLY FRINGE BENEFITS	TOTAL
		\$	\$	\$
103	Bricklayer, Blocklayer or Stonemason	32.09	18.04	50.13
105	Carpenter Future Increase(s): Add \$1.42/hr on 6/1/2015; Add \$1.42/hr on 6/1/2016. Premium Increase(s): DOT PREMIUM: Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day.	32.72	16.00	48.72
107	Cement Finisher Future Increase(s): Add \$1.87 on 6/1/15; Add \$1.75 on 6/1/16. Premium Increase(s): DOT PREMIUMS: 1) Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day. 2) Add \$1.40/hr when the Wisconsin Department of Transportation or responsible governing agency requires that work be performed at night under artificial illumination with traffic control and the work is completed after sunset and before sunrise.	35.18	16.78	51.96
109	Electrician	35.72	19.17	54.89
111	Fence Erector	18.00	6.09	24.09
116	Ironworker	31.50	20.01	51.51
118	Line Constructor (Electrical)	39.50	17.73	57.23
124	Painter	25.75	16.60	42.35
125	Pavement Marking Operator	30.10	17.34	47.44
126	Piledriver	29.56	25.71	55.27
133	Rofer or Waterproofer	29.40	11.31	40.71
137	Teledata Technician or Installer	22.25	12.24	34.49
143	Tuckpointer, Caulker or Cleaner	23.60	7.10	30.70
144	Underwater Diver (Except on Great Lakes)	35.40	15.90	51.30
150	Heavy Equipment Operator - ELECTRICAL LINE CONSTRUCTION ONLY	35.55	15.57	51.12

Fringe Benefits Must Be Paid On <u>All</u> Hours Worked		HOURLY BASIC RATE OF PAY	HOURLY FRINGE BENEFITS	TOTAL
CODE	TRADE OR OCCUPATION	\$	\$	\$
151	Light Equipment Operator -ELECTRICAL LINE CONSTRUCTION ONLY	31.60	15.19	46.79
152	Heavy Truck Driver - ELECTRICAL LINE CONSTRUCTION ONLY	27.65	13.44	41.09
153	Light Truck Driver - ELECTRICAL LINE CONSTRUCTION ONLY	25.68	13.28	38.96
154	Groundman - ELECTRICAL LINE CONSTRUCTION ONLY	21.75	12.97	34.72

TRUCK DRIVERS

Fringe Benefits Must Be Paid On <u>All</u> Hours Worked		HOURLY BASIC RATE OF PAY	HOURLY FRINGE BENEFITS	TOTAL
CODE	TRADE OR OCCUPATION	\$	\$	\$
201	Single Axle or Two Axle Future Increase(s): Add \$1.15/hr on 6/1/2015. Premium Increase(s): DOT PREMIUM: Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day.	25.18	18.31	43.49
203	Three or More Axle	16.00	0.00	16.00
204	Articulated, Euclid, Dumptor, Off Road Material Hauler Future Increase(s): Add \$1.60/hr on 6/2/2015; Add \$1.60/hr on 6/3/2016.	33.69	19.78	53.47
205	Pavement Marking Vehicle	20.85	11.02	31.87
206	Shadow or Pilot Vehicle	24.37	17.77	42.14
207	Truck Mechanic	16.00	0.00	16.00

LABORERS

Fringe Benefits Must Be Paid On <u>All</u> Hours Worked		HOURLY BASIC RATE OF PAY	HOURLY FRINGE BENEFITS	TOTAL
CODE	TRADE OR OCCUPATION	\$	\$	\$
301	General Laborer	29.32	12.44	41.76
303	Landscaper Future Increase(s): Add \$1.05/hr eff. 06/01/2015; Add \$1.00/hr eff. 06/01/2016; Add \$1.00/hr eff. 06/01/2017 Premium Increase(s):	30.13	15.14	45.27

Fringe Benefits Must Be Paid On All Hours Worked

<u>CODE</u>	<u>TRADE OR OCCUPATION</u>	<u>HOURLY BASIC RATE OF PAY</u> \$	<u>HOURLY FRINGE BENEFITS</u> \$	<u>TOTAL</u> \$
	DOT PREMIUMS: 1) Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day. 2) Add \$1.25/hr for work on projects involving temporary traffic control setup, for lane and shoulder closures, when work under artificial illumination conditions is necessary as required by the project provisions (including prep time prior to and/or cleanup after such time period).			
304	Flagperson or Traffic Control Person	19.06	14.29	33.35
311	Fiber Optic Laborer (Outside, Other Than Concrete Encased)	18.33	13.65	31.98
314	Railroad Track Laborer	14.50	5.29	19.79

**HEAVY EQUIPMENT OPERATORS
CONCRETE PAVEMENT OR BRIDGE WORK**

Fringe Benefits Must Be Paid On All Hours Worked

<u>CODE</u>	<u>TRADE OR OCCUPATION</u>	<u>HOURLY BASIC RATE OF PAY</u> \$	<u>HOURLY FRINGE BENEFITS</u> \$	<u>TOTAL</u> \$
541	Crane, Tower Crane, Pedestal Tower or Derrick, With or Without Attachments, With a Lifting Capacity of Over 100 Tons, Self-Erecting Tower Crane With a Lifting Capacity Of Over 4,000 Lbs., Crane With Boom Dollies; Crane, Tower Crane, Pedestal Tower or Derrick, With Boom, Leads &/or Jib Lengths Measuring 176 Ft or Over; Master Mechanic. Future Increase(s): Add \$1.25/hr on 6/1/2015; Add \$1.30/hr on 6/1/2016; Add \$1.25/hr on 6/1/2017. Premium Increase(s): DOT PREMIUMS: 1) Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day. 2) Add \$1.50/hr night work premium. See DOT'S website for details about the applicability of this night work premium at: http://www.dot.wi.gov/business/civilrights/laborwages/pwc.htm .	37.72	21.15	58.87

Fringe Benefits Must Be Paid On <u>All</u> Hours Worked		HOURLY BASIC RATE OF PAY	HOURLY FRINGE BENEFITS	TOTAL
CODE	TRADE OR OCCUPATION	\$	\$	\$
542	<p>Backhoe (Track Type) Having a Mfgr.'s Rated Capacity of 130,000 Lbs. or Over; Caisson Rig; Crane, Tower Crane, Portable Tower, Pedestal Tower or Derrick, With or Without Attachments, With a Lifting Capacity of 100 Tons or Under, Self-Erecting Tower Crane With a Lifting Capacity of 4,000 Lbs. & Under; Crane, Tower Crane Portable Tower, Pedestal Tower or Derrick, With Boom, Leads &/or Jib Lengths Measuring 175 Ft or Under; Dredge (NOT Performing Work on the Great Lakes); Licensed Boat Pilot (NOT Performing Work on the Great Lakes); Pile Driver.</p> <p>Future Increase(s): Add \$1.25/hr on 6/1/2015; Add \$1.30/hr on 6/1/2016; Add \$1.25/hr on 6/1/2017.</p> <p>Premium Increase(s): DOT PREMIUMS: 1) Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day. 2) Add \$1.50/hr night work premium. See DOT'S website for details about the applicability of this night work premium at: http://www.dot.wi.gov/business/civilrights/laborwages/pwc.htm.</p>	37.22	21.15	58.37
543	<p>Air Track, Rotary or Percussion Drilling Machine &/or Hammers, Blaster; Automatic Subgrader (Concrete); Backhoe (Track Type) Having a Mfgr.'s Rated Capacity of Under 130,000 Lbs., Backhoe (Mini, 15,000 Lbs. & Under); Boring Machine (Directional, Horizontal or Vertical); Bridge (Bidwell) Paver; Bulldozer or Endloader; Concrete Batch Plant, Batch Hopper; Concrete Breaker (Large, Auto, Vibratory/Sonic, Manual or Remote); Concrete Bump Cutter, Grinder, Planing or Grooving Machine; Concrete Conveyor System; Concrete Laser/Screed; Concrete Paver (Slipform); Concrete Pump, Concrete Conveyor (Rotec or Bidwell Type); Concrete Slipform Placer Curb & Gutter Machine; Concrete Spreader & Distributor; Crane (Carry Deck, Mini) or Truck Mounted Hydraulic Crane (10 Tons or Under); Crane With a Lifting Capacity of 25 Tons or Under; Forestry Equipment, Timbco, Tree Shear, Tub Grinder, Processor; Gradall (Cruz-Aire Type); Grader or Motor Patrol; Grout Pump; Hydro-Blaster (10,000 PSI or Over); Loading Machine (Conveyor); Manhoist; Material or Stack Hoist; Mechanic or Welder; Milling Machine; Post Hole Digger or Driver; Scraper (Self Propelled or Tractor Drawn) 5 cu yds or More Capacity; Shoulder Widener; Sideboom; Skid Rig; Stabilizing or Concrete Mixer (Self-Propelled or 14S or Over); Straddle Carrier or Travel Lift; Tractor (Scraper, Dozer, Pusher, Loader); Tractor or Truck Mounted Hydraulic Backhoe; Trencher (Wheel Type or Chain Type); Tube Finisher; Tugger (NOT Performing Work on the Great Lakes); Winches & A-Frames.</p>	35.72	17.85	53.57

Fringe Benefits Must Be Paid On <u>All</u> Hours Worked		HOURLY BASIC RATE OF PAY	HOURLY FRINGE BENEFITS	TOTAL
CODE	TRADE OR OCCUPATION	\$	\$	\$
544	Backfiller; Belting, Burlap, Texturing Machine; Broom or Sweeper; Compactor (Self-Propelled or Tractor Mounted, Towed & Light Equipment); Concrete Finishing Machine (Road Type); Environmental Burner; Farm or Industrial Type Tractor; Fireman (Pile Driver & Derrick NOT Performing Work on the Great Lakes); Forklift; Greaser; Jeep Digger; Joint Sawyer (Multiple Blade); Launch (NOT Performing Work on the Great Lakes); Lift Slab Machine; Mechanical Float; Mulcher; Power Subgrader; Robotic Tool Carrier (With or Without Attachments); Self Propelled Chip Spreader; Shouldering Machine; Skid Steer Loader (With or Without Attachments); Telehandler; Tining or Curing Machine. Future Increase(s): Add \$1.25/hr on 6/1/2015; Add \$1.30/hr on 6/1/2016; Add \$1.25/hr on 6/1/2017. Premium Increase(s): DOT PREMIUMS: 1) Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day. 2) Add \$1.50/hr night work premium. See DOT'S website for details about the applicability of this night work premium at: http://www.dot.wi.gov/business/civilrights/laborwages/pwc.htm .	36.46	21.15	57.61
545	Air Compressor (&/or 400 CFM or Over); Air, Electric or Hydraulic Jacking System; Automatic Belt Conveyor & Surge Bin; Boiler (Temporary Heat); Concrete Proportioning Plant; Crusher, Screening or Wash Plant; Generator (&/or 150 KW or Over); Heaters (Mechanical); High Pressure Utility Locating Machine (Daylighting Machine); Mudjack; Oiler; Prestress Machine; Pug Mill; Pump (3 Inch or Over) or Well Points; Rock, Stone Breaker; Screed (Milling Machine); Stump Chipper; Tank Car Heaters; Vibratory Hammer or Extractor, Power Pack.	35.17	20.40	55.57
546	Fiber Optic Cable Equipment.	28.89	17.95	46.84
547	Work Performed on the Great Lakes Including Diver; Wet Tender or Hydraulic Dredge Engineer.	41.65	21.71	63.36
548	Work Performed on the Great Lakes Including 70 Ton & Over Tug Operator; Assistant Hydraulic Dredge Engineer; Crane or Backhoe Operator; Hydraulic Dredge Leverman or Diver's Tender; Mechanic or Welder.	41.65	21.71	63.36
549	Work Performed on the Great Lakes Including Deck Equipment Operator or Machineryman (Maintains Cranes Over 50 Tons or Backhoes 115,000 Lbs. or more); Tug, Launch or Loader, Dozer or Like Equipment When Operated on a Barge, Breakwater Wall, Slip, Dock or Scow, Deck Machinery.	35.72	17.85	53.57
550	Work Performed on the Great Lakes Including Deck Equipment Operator; Machineryman or Fireman (Operates 4 Units or More or Maintains Cranes 50 Tons or Under or Backhoes 115,000 Lbs. or Under); Deck Hand, Deck Engineer or Assistant Tug Operator; Off Road Trucks - Great Lakes ONLY.	35.46	20.40	55.86

**HEAVY EQUIPMENT OPERATORS
ASPHALT PAVEMENT OR OTHER WORK**

Fringe Benefits Must Be Paid On <u>All</u> Hours Worked				
CODE	TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY	HOURLY FRINGE BENEFITS	TOTAL
		\$	\$	\$
551	Crane, Tower Crane, Pedestal Tower or Derrick, With or Without Attachments, With a Lifting Capacity of Over 100 Tons, Self Erecting Tower Crane With a Lifting Capacity of Over 4,000 Lbs., Crane With Boom Dollies; Crane, Tower Crane, Pedestal Tower or Derrick, With Boom, Leads and/or Jib Lengths Measuring 176 Ft or Over; Master Mechanic.	36.72	20.40	57.12
552	Backhoe (Track Type) Having a Mfgr.'s Rated Capacity of 130,000 Lbs. or Over; Caisson Rig; Crane, Tower Crane, Portable Tower, Pedestal Tower or Derrick, With or Without Attachments, With a Lifting Capacity of 100 Tons or Under, Self-Erecting Tower Crane With a Lifting Capacity Of 4,000 Lbs. & Under; Crane, Tower Crane, Portable Tower, Pedestal Tower or Derrick, With Boom, Leads &/or Jib Lengths Measuring 175 Ft or Under; Dredge (NOT Performing Work on the Great Lakes); Licensed Boat Pilot (NOT Performing Work on the Great Lakes); Pile Driver. Future Increase(s): Add \$1.25/hr on 6/1/2015; Add \$1.30/hr on 6/1/2016; Add \$1.25/hr on 6/1/2017. Premium Increase(s): DOT PREMIUMS: 1) Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day. 2) Add \$1.50/hr night work premium. See DOT'S website for details about the applicability of this night work premium at: http://www.dot.wi.gov/business/civilrights/laborwages/pwc.htm .	37.22	21.15	58.37
553	Air, Track, Rotary or Percussion Drilling Machine &/or Hammers, Blaster; Asphalt Heater, Planer & Scarifier; Asphalt Milling Machine; Asphalt Screed; Backhoe (Track Type) Having a Mfgr.'s Rated Capacity of Under 130,000 Lbs., Backhoe (Mini, 15,000 Lbs. & Under); Bituminous (Asphalt) Plant & Paver, Screed; Boring Machine (Directional, Horizontal or Vertical); Bulldozer or Endloader; Concrete Breaker (Large, Auto, Vibratory/Sonic, Manual or Remote); Concrete Conveyor System; Concrete Laser/Screed; Concrete Slipform Placer Curb & Gutter Machine; Crane (Carry Deck, Mini) or Truck Mounted Hydraulic Crane (10 Tons or Under); Crane With a Lifting Capacity of 25 Tons or Under; Forestry Equipment, Timbco, Tree Shear, Tub Grinder, Processor; Gradall (Cruz-Aire Type); Grader or Motor Patrol; Hydro-Blaster (10,000 PSI or Over); Loading Machine (Conveyor); Manhoist; Material or Stack Hoist; Mechanic or Welder; Milling Machine; Post Hole Digger or Driver; Railroad Track Rail Leveling Machine, Tie Placer, Extractor, Tamper, Stone Leveler or Rehabilitation Equipment; Roller (Over 5 Ton); Scraper (Self Propelled or Tractor Drawn) 5 cu yds or More Capacity; Shoulder Widener; Sideboom; Skid Rig; Stabilizing or Concrete Mixer (Self-Propelled or 14S or Over); Tractor (Scraper, Dozer, Pusher, Loader); Tractor or Truck Mounted Hydraulic Backhoe; Trencher (Wheel Type or Chain Type); Tube Finisher; Tugger (NOT Performing Work on the Great Lakes); Winches & A-Frames. Future Increase(s): Add \$1.60/hr on 6/2/2015; Add \$1.60/hr on 6/3/2016.	33.69	19.78	53.47

Fringe Benefits Must Be Paid On <u>All</u> Hours Worked		HOURLY BASIC RATE OF PAY	HOURLY FRINGE BENEFITS	<u>TOTAL</u>
<u>CODE</u>	<u>TRADE OR OCCUPATION</u>	\$	\$	\$
554	Backfiller; Broom or Sweeper; Compactor (Self-Propelled or Tractor Mounted, Towed & Light Equipment); Concrete Finishing Machine (Road Type); Environmental Burner; Farm or Industrial Type Tractor; Fireman (Asphalt Plant, Pile Driver & Derrick NOT Performing Work on the Great Lakes); Forklift; Greaser; Hoist (Tugger, Automatic); Jeep Digger; Joint Sawyer (Multiple Blade); Launch (NOT Performing Work on the Great Lakes); Lift Slab Machine; Mechanical Float; Mulcher; Power Subgrader; Robotic Tool Carrier (With or Without Attachments); Roller (Rubber Tire, 5 Ton or Under); Self-Propelled Chip Spreader; Shouldering Machine; Skid Steer Loader (With or Without Attachments); Telehandler. Future Increase(s): Add \$1.25/hr on 6/1/2015; Add \$1.30/hr on 6/1/2016; Add \$1.25/hr on 6/1/2017.	36.17	20.80	56.97
555	Air Compressor (&/or 400 CFM or Over); Air, Electric or Hydraulic Jacking System; Augers (Vertical & Horizontal); Automatic Belt Conveyor & Surge Bin; Boiler (Temporary Heat); Crusher, Screening or Wash Plant; Generator (&/or 150 KW or Over); Heaters (Mechanical); High Pressure Utility Locating Machine (Daylighting Machine); Mudjack; Oiler; Prestress Machine; Pug Mill; Pump (3 Inch or Over) or Well Points; Rock, Stone Breaker; Screed (Milling Machine); Stump Chipper; Tank Car Heaters; Vibratory Hammer or Extractor, Power Pack. Future Increase(s): Add \$1.25/hr on 6/1/2015; Add \$1.30/hr on 6/1/2016; Add \$1.25/hr on 6/1/2017. Premium Increase(s): DOT PREMIUMS: 1) Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day. 2) Add \$1.50/hr night work premium. See DOT'S website for details about the applicability of this night work premium at: http://www.dot.wi.gov/business/civilrights/laborwages/pwc.htm .	36.17	21.15	57.32
556	Fiber Optic Cable Equipment.	27.89	17.20	45.09

RESIDENTIAL OR AGRICULTURAL CONSTRUCTION

Includes single family houses or apartment buildings of no more than four (4) stories in height and all buildings, structures or facilities that are primarily used for agricultural or farming purposes, excluding commercial buildings. For classification purposes, the exterior height of a residential building, in terms of stories, is the primary consideration. All incidental items such as site work, driveways, parking lots, private sidewalks, private septic systems or sewer and water laterals connected to a public system and swimming pools are included within this definition. Residential buildings of five (5) stories and above are NOT included within this definition.

SKILLED TRADES

<u>CODE</u>	<u>TRADE OR OCCUPATION</u>	<u>HOURLY BASIC RATE OF PAY</u> \$	<u>HOURLY FRINGE BENEFITS</u> \$	<u>TOTAL</u> \$
Fringe Benefits Must Be Paid On <u>All</u> Hours Worked				
101	Acoustic Ceiling Tile Installer	33.07	16.07	49.14
102	Boilermaker	32.05	28.04	60.09
103	Bricklayer, Blocklayer or Stonemason Future Increase(s): Add \$1.40 on 06/01/2015; Add \$1.45 on 06/06/2016 Premium Increase(s): DOT PREMIUM: Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day.	32.82	18.66	51.48
104	Cabinet Installer	34.42	0.00	34.42
105	Carpenter	31.40	2.01	33.41
106	Carpet Layer or Soft Floor Coverer	30.00	0.00	30.00
107	Cement Finisher	24.08	0.00	24.08
108	Drywall Taper or Finisher	8.50	0.00	8.50
109	Electrician	20.00	6.62	26.62
110	Elevator Constructor	23.26	0.00	23.26
111	Fence Erector	16.00	3.76	19.76
112	Fire Sprinkler Fitter	39.00	18.00	57.00
113	Glazier Future Increase(s): Add \$.75/hr eff. 06/01/2015; Add \$.90/hr eff. 06/01/2016	37.07	14.42	51.49
114	Heat or Frost Insulator	33.43	25.81	59.24
115	Insulator (Batt or Blown)	23.00	10.55	33.55
116	Ironworker	31.50	20.01	51.51
117	Lather	31.40	2.01	33.41
119	Marble Finisher	16.25	2.32	18.57
120	Marble Mason	32.09	18.04	50.13

Fringe Benefits Must Be Paid On <u>All</u> Hours Worked		HOURLY BASIC RATE OF PAY	HOURLY FRINGE BENEFITS	TOTAL
CODE	TRADE OR OCCUPATION	\$	\$	\$
121	Metal Building Erector	18.00	5.88	23.88
123	Overhead Door Installer	16.65	1.03	17.68
124	Painter	25.75	8.94	34.69
125	Pavement Marking Operator	18.75	2.47	21.22
129	Plasterer	25.00	10.45	35.45
130	Plumber	30.00	10.44	40.44
132	Refrigeration Mechanic	17.00	13.56	30.56
133	Rofer or Waterproofer	15.00	1.37	16.37
134	Sheet Metal Worker	22.54	5.20	27.74
135	Steamfitter	23.62	16.12	39.74
137	Teledata Technician or Installer	18.00	28.48	46.48
138	Temperature Control Installer	22.00	1.62	23.62
139	Terrazzo Finisher	16.25	2.32	18.57
140	Terrazzo Mechanic	30.71	16.52	47.23
141	Tile Finisher	23.85	17.18	41.03
142	Tile Setter Future Increase(s): Add \$1.40/hr on 6/01/2015; Add \$1.45/hr on 6/06/2016.	31.55	18.26	49.81
143	Tuckpointer, Caulker or Cleaner	14.00	8.75	22.75
146	Well Driller or Pump Installer	12.75	9.50	22.25
147	Siding Installer	17.25	0.00	17.25

TRUCK DRIVERS

Fringe Benefits Must Be Paid On <u>All</u> Hours Worked		HOURLY BASIC RATE OF PAY	HOURLY FRINGE BENEFITS	TOTAL
CODE	TRADE OR OCCUPATION	\$	\$	\$
201	Single Axle or Two Axle	16.50	0.00	16.50
203	Three or More Axle	18.00	2.44	20.44
205	Pavement Marking Vehicle	20.85	11.02	31.87
207	Truck Mechanic	18.00	2.44	20.44

LABORERS

Fringe Benefits Must Be Paid On <u>All</u> Hours Worked		HOURLY BASIC RATE OF PAY	HOURLY FRINGE BENEFITS	TOTAL
CODE	TRADE OR OCCUPATION	\$	\$	\$
301	General Laborer	24.21	8.02	32.23
302	Asbestos Abatement Worker	16.50	8.21	24.71
303	Landscaper	12.00	0.00	12.00
311	Fiber Optic Laborer (Outside, Other Than Concrete Encased)	18.33	13.65	31.98
315	Final Construction Clean-Up Worker	10.00	3.47	13.47

**HEAVY EQUIPMENT OPERATORS
RESIDENTIAL OR AGRICULTURAL CONSTRUCTION**

Fringe Benefits Must Be Paid On <u>All</u> Hours Worked		HOURLY BASIC RATE OF PAY	HOURLY FRINGE BENEFITS	TOTAL
CODE	TRADE OR OCCUPATION	\$	\$	\$
557	Asphalt Heater, Planer & Scarifier; Asphalt Milling Machine; Asphalt Screed; Backhoe (Track Type); Backhoe (Mini, 15,000 Lbs. & Under); Bituminous (Asphalt) Plant & Paver, Screed; Boring Machine (Directional, Horizontal or Vertical); Bulldozer or Endloader; Concrete Breaker (Large, Auto, Vibratory/Sonic, Manual or Remote); Concrete Bump Cutter, Grinder, Planing or Grooving Machine; Concrete Conveyor System; Concrete Laser/Screed; Concrete Paver (Slipform); Concrete Pump, Concrete Conveyor (Rotec or Bidwell Type); Concrete Slipform Placer Curb & Gutter Machine; Concrete Spreader & Distributor; Crane (Carry Deck, Mini) or Truck Mounted Hydraulic Crane (10 Tons or Under); Crane With a Lifting Capacity of 25 Tons or Under; Crane, Shovel, Dragline, Clamshells; Forestry Equipment, Timberco, Tree Shear, Tub Grinder, Processor; Grader or Motor Patrol; Grout Pump; Hydro-Blaster (10,000 PSI or Over); Loading Machine (Conveyor); Manhoist; Material or Stack Hoist; Mechanic or Welder; Milling Machine; Roller (Over 5 Ton); Scraper (Self Propelled or Tractor Drawn) 5 cu yds or More Capacity; Shoulder Widener; Skid Rig; Stabilizing or Concrete Mixer (Self-Propelled or 14S or Over); Tractor (Scraper, Dozer, Pusher, Loader); Tractor or Truck Mounted Hydraulic Backhoe; Tractor or Truck Mounted Hydraulic Crane (10 Tons or Under); Trencher (Wheel Type or Chain Type); Winches & A-Frames.	34.22	19.78	54.00

Future Increase(s):
Add \$1.60/hr on 6/2/2015; Add \$1.60/hr on 6/3/2016.

558	Air Compressor (&/or 400 CFM or Over); Air, Electric or Hydraulic Jacking System; Backfiller; Belting, Burlap, Texturing Machine; Boiler (Temporary Heat); Broom or Sweeper; Compactor (Self-Propelled or Tractor Mounted, Towed & Light Equipment); Concrete Finishing Machine (Road Type); Farm or Industrial Type Tractor; Forklift; Generator (&/or 150 KW or Over); Heaters (Mechanical); High Pressure Utility Locating Machine (Daylighting Machine); Jeep Digger; Lift Slab Machine; Mulcher; Oiler; Post Hole Digger or Driver; Power Subgrader; Pump (3 Inch or Over) or Well Points; Robotic Tool Carrier (With or Without Attachments); Rock, Stone Breaker; Roller (Rubber Tire, 5 Tons or Under); Screed (Milling Machine); Self Propelled Chip Spreader; Shouldering Machine; Skid Steer Loader (With or Without Attachments); Stump Chipper; Telehandler; Vibratory Hammer or Extractor, Power Pack.	36.72	21.15	57.87
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Future Increase(s):

Add \$1.25/hr on 6/1/2015; Add \$1.30/hr on 6/1/2016;

Add \$1.25/hr on 6/1/2017.

Premium Increase(s):

DOT PREMIUMS: 1) Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day. 2) Add \$1.50/hr night work premium.

See DOT'S website for details about the applicability of this night work premium at: <http://www.dot.wi.gov/business/civilrights/laborwages/pwc.htm>.

***** END OF RATES *****

PREVAILING WAGE – Contractors

Any public works project that has a total estimated project cost that equals or exceeds prevailing wage project thresholds requires a prevailing wage rate determination issued by the Department of Workforce Development (DWD). Public works include erecting, constructing, remodeling, repairing, demolishing, alterations, painting and decorating projects for a local governmental unit or state agency. State law excludes minor service or maintenance work, warranty work, or work under a supply-and-installation contract. There is a statutory definition for most of these exclusions. The prevailing wage laws that apply to local governmental units and their contractors are §§66.0903 and 103.503, Wis. Stats. The prevailing wage laws that apply to state agencies and their contractors are §§103.49 and 103.503, Wis. Stats. The applicable administrative rules for all prevailing wage projects are DWD 290 and DWD 294, Wis. Adm. Code. These laws include provisions that apply to all contractors and subcontractors working on prevailing wage projects.

Any contractor or subcontractor working on a local governmental unit or state agency's public works project that equals or exceeds current prevailing wage project thresholds must do all of the following:

- Receive and review the project's prevailing wage rate determination (i.e., white sheet).
- Tell subcontractors the project is subject to state prevailing wage law and include the prevailing wage rate determination in the construction contract, or if there is no written contract, provide a copy of the project determination to each subcontractor.
- Hire subcontractors who do *not* appear on the "Consolidated List of Debarred Contractors."
- Have a written substance abuse testing program in place that fulfills the requirements of §103.503, Wis. Stats., before commencing work on the project.

- Notify subcontractors that if DWD finds that a contractor or subcontractor violated the prevailing wage law, DWD will assess liquidated damages of 100% of the wages owed to employees.
- Apply to DWD for subjourney wage rates prior to employing these individuals on the project.
- Receive and retain a completed Affidavit of Compliance from each subcontractor brought on to the project before providing final payment to those subcontractors.
- Submit a completed Affidavit of Compliance to the contractor who brought the subcontractor on to the project before receiving final payment for the project.
- Maintain payroll records for 3 years that comply with §§66.0903(10)(a) or 103.49(5)(a), Stats. and DWD 274.06.
- Respond to requests from DWD or the project owner to provide payroll records and/or respond to prevailing wage complaints filed by employees or third parties.

For more information, visit the prevailing wage website: http://dwd.wisconsin.gov/er/prevailing_wage_rate/default.htm. For further assistance, call the Equal Rights Division at 608-266-6861 and ask for prevailing wage.