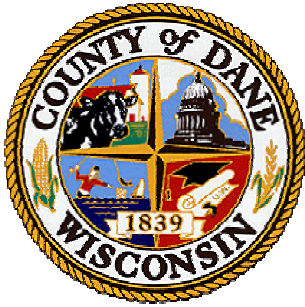


RFB NO. 310013



CONSTRUCTION DOCUMENTS PROJECT MANUAL

DANE COUNTY DEPARTMENT OF PUBLIC WORKS,
HIGHWAY AND TRANSPORTATION

PUBLIC WORKS SOLID WASTE DIVISION
1919 ALLIANT ENERGY CENTER WAY
MADISON, WISCONSIN 53713

REQUEST FOR BIDS NO. 310013 CONSTRUCTION OF WASTE TRANSFER STATION BUILDING AND CLEAN SWEEP BUILDING DANE COUNTY LANDFILL SITE #2 - RODEFELD 7102 U.S. HIGHWAY 12 & 18 MADISON, WISCONSIN

Opening Date / Time: **THURSDAY, JUNE 10, 2010 / 2:00 P.M.**

Location: **PUBLIC WORKS OFFICE**

Performance / Payment Bond: **100% OF CONTRACT AMOUNT**

Bid Deposit: **5% OF BID AMOUNT**

FOR INFORMATION ON THIS REQUEST FOR BIDS, PLEASE CONTACT:

JOHN WELCH, PROJECT MANAGER
TELEPHONE NO.: 608/267-8815
FAX NO.: 608/267-1533
E-MAIL: WELCH@CO.DANE.WI.US

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DOCUMENT INDEX FOR RFB NO. 310013

DIVISION 00 - PROCUREMENT AND CONTRACTING REQUIREMENTS

Project Manual Cover Page
Documents Index
Invitation to Bid (Legal Notice)
Instructions to Bidders, including Geotechnical Reports

- Geotechnical Exploration and Analyses Report, dated January 19, 2010
- Modulus of Subgrade Reaction, dated January 27, 2010
- Supplementary Geotechnical Exploration Recommendations, dated April 19, 2010
- Sitework, Earthwork, and Excavation Specification Review, dated April 19, 2010

Bid Form
Fair Labor Practices Certification
Best Value Contracting Application
Sample Public Works Contract
Sample Bid Bond
Sample Performance Bond
Sample Payment Bond
General Conditions of Contract
Supplementary Conditions

DIVISION 01 - GENERAL REQUIREMENTS

01 01 00 Recycling
01 10 00 Summary
01 20 00 Price and Payment Procedures
01 30 00 Administrative Requirements
01 33 00 Submittal Procedures – Facility Construction
01 40 00 Quality Requirements – Facility Construction
01 50 00 Temporary Facilities and Controls – Facility Construction
01 60 00 Product Requirements – Facility Construction
01 70 00 Execution Requirements – Facility Construction

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03 31 00 Structural Concrete
03 41 13 Precast Concrete Hollow Core Planks

DIVISION 04 - MASONRY

04 05 03 Masonry Mortaring and Grouting
04 20 13 Single-Wythe Unit Masonry

DIVISION 05 - METALS

05 51 00 Metal Stairs
05 52 00 Metal Railings

DIVISION 06 - WOOD, PLASTICS, AND COMPOSITES

06 10 53	Miscellaneous Rough Carpentry
06 20 00	Finish Carpentry
06 61 16	Solid Surfacing Fabrications

DIVISION 07 - THERMAL AND MOISTURE PROTECTION

07 13 00	Sheet Waterproofing
07 14 00	Fluid-Applied Waterproofing
07 21 13	Board Insulation
07 84 00	Firestopping
07 90 00	Joint Protection

DIVISION 08 - OPENINGS

08 12 14	Standard Steel Frames
08 13 14	Standard Steel Doors
08 33 23	Overhead Coiling Doors
08 36 13	Sectional Doors
08 51 14	Interior Aluminum Windows
08 71 00	Door Hardware
08 80 00	Glazing

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09 21 16	Gypsum Board Assemblies
09 65 00	Resilient Flooring
09 68 13	Tile Carpeting
09 90 00	Painting and Coating
09 96 00	High-Performance Coatings

DIVISION 10 - SPECIALTIES

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10 28 00	Toilet, Bath, and Laundry Accessories
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DIVISION 11 - EQUIPMENT

11 13 13	Loading Dock Bumpers
11 13 19	Loading Dock Levelers

DIVISION 13 - SPECIAL CONSTRUCTION

13 34 19	Metal Building Systems
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DIVISION 21 - FIRE SUPPRESSION

- 21 05 00 Basic Fire Suppression Materials and Methods
- 21 13 00 Sprinkler Systems
- 21 13 16 Dry-Pipe Fire Suppression Sprinklers

DIVISION 22 - PLUMBING

- 22 05 00 Basic Plumbing Materials and Methods
- 22 05 13 Motor Requirements for Plumbing Equipment
- 22 05 14 Plumbing Specialties
- 22 05 15 Plumbing Piping Specialties
- 22 05 23 Valves for Plumbing Piping
- 22 05 29 Hangers and Supports for Plumbing
- 22 07 00 Plumbing Insulation
- 22 11 00 Facility Water Distribution
- 22 13 00 Facility Sanitary Sewerage
- 22 14 00 Facility Storm Drainage
- 22 30 00 Plumbing Equipment
- 22 42 00 Plumbing Fixtures

DIVISION 23 - HEATING, VENTILATING, AND AIR CONDITIONING

- 23 05 00 Basic HVAC Requirements
- 23 05 13 Motor Requirements for HVAC Equipment
- 23 05 14 Variable Frequency Drives
- 23 05 15 Piping Specialties
- 23 05 23 General Duty Valves for HVAC Piping
- 23 05 29 Hangers and Supports for HVAC Piping and Equipment
- 23 05 53 Identification for HVAC Piping and Equipment
- 23 05 93 Testing, Adjusting, and Balancing for HVAC
- 23 07 00 HVAC Insulation
- 23 09 14 Pneumatic and Electrical Instrumentation and Control Devices for HVAC
- 23 09 23 Direct Digital Control System for HVAC
- 23 09 93 Sequence of Operation for HVAC Controls
- 23 21 13 Hydronic Piping
- 23 21 23 Hydronic Pumps
- 23 22 16 Underground Heating Piping
- 23 31 00 HVAC Ducts and Casings
- 23 33 00 Air Duct Accessories
- 23 34 00 HVAC Fans
- 23 37 13 Diffusers, Registers, and Grilles
- 23 41 00 Particulate Air Filtration
- 23 52 13 Electric Hot Water Boilers
- 23 57 00 Heat Exchangers for HVAC
- 23 72 00 Air-to-Air Energy Recovery Equipment
- 23 73 12 Air Handling Unit Coils
- 23 73 13 Modular Indoor Central-Station Air Handling Units
- 23 81 28 Split System Air Conditioning Units
- 23 82 00 Convection Heating and Cooling Units
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DIVISION 26 - ELECTRICAL

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26 05 19	Building Wire and Cable
26 05 26	Grounding and Bonding
26 05 29	Electrical Hangers and Supports
26 05 33	Raceway and Boxes
26 05 53	Electrical Identification
26 22 00	Low-Voltage Transformers
26 24 13	Switchboards
26 24 16	Panelboards
26 27 26	Wiring Devices
26 28 19	Enclosed Switches
26 29 33	Motor Wiring
26 51 00	Interior Lighting
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DIVISION 28 - ELECTRONIC SAFETY AND SECURITY

28 31 00	Fire Detection and Alarm System
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DIVISION 31 - EARTHWORK

31 02 00	General Requirements for Sitework
31 05 13	Soils for Earthwork
31 05 16	Aggregates for Earthwork
31 10 00	Site Clearing
31 22 13	Rough Grading
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31 23 16	Utility Trench Excavation, Backfill, Compaction
31 25 13	Erosion Controls

DIVISION 32 - EXTERIOR IMPROVEMENTS

32 11 23	Aggregate Base Course
32 12 16	Asphalt Paving
32 12 18	Porous Asphaltic Concrete Pavement
32 13 13	Concrete Paving
32 90 00	Planting
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DIVISION 33 - UTILITIES

33 11 00	Site Water System
33 13 00	Water Main Disinfection
33 17 00	Water Main Testing
33 31 00	Site Sanitary Sewer System
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33 42 23 Concrete Box Culverts
33 46 00 Subdrainage

DRAWINGS

To be printed to correct scale or size, plot sheets on 30" x 42" (E1) paper

Civil Drawings

C200 – Demolition and Erosion Control Plan
C300 – Site and landscape Plan
C400 – Grading Plan
C500 – Utility Plan
C700 – Jointing Plan
C900 – Erosion Control Pan
C901 – Paving Details
C902 – Utility Details
C903 – Site Details

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A101 – HHW First Floor Plan/WTS Lower Level Plan
A102 – HHW Mezzanine Plan/WTS Upper Level Plan
A103 – HHW First Floor Equipment Plan – For Reference Only
A121 – Roof Plan
A300 – Building Elevations
A301 – Building Elevations
A400 – Building Sections
A401 – Building Sections
A501 – Enlarged partial Plan and Details
A600 – Door Schedule and Door, Window, and Frame Elevations

Structural Drawings

S000 – General Notes
S100 – Foundation Plan
S101 – Structural Upper Level Plan
S500 – Details
S501 – Details
S502 - Details

Mechanical Drawings

M000 – Mechanical Symbols, Abbreviations, and Sheet Index
M201 – HHW First Floor Plan/WTS Lower Level HVAC Plan
M202 – HHW Mezzanine Plan/WTS Upper Level HVAC Plan
M203 – Generator Building HVAC Plans
M800 – Mechanical Details
M801 – Mechanical Details
M900 – Mechanical Schedules

Electrical Drawings

- E000 – Electrical Symbols, Abbreviations, and Sheet Index
- E001 – Site Electrical Plan, lighting Fixture Schedule, and Details
- E002 – Site Photometric Plan
- E101 – HHW First Floor Plan/WTS Lower Level Electrical Plan
- E102 – HHW Mezzanine Plan/WTS Upper Level Electrical Plan
- E103 – HHW/WTS Grounding System Electrical Plan
- E201 – HHW First Floor Plan/WTS Lower Level System Plan
- E201 – HHW First Floor Plan/WTS Lower Level System Plan
- E401 – Electrical Schedules
- E402 – Electrical Schedules & One-Line Diagrams
- E500 – Electrical Details

Plumbing Drawings

- P000 – Plumbing Symbols, Abbreviations, & Schedules
- P100 – HHW First Floor Plan/WTS Lower Level Below Slab Plumbing Plan
- P101 – HHW First Floor Plan/WTS Lower Level Plumbing Plan
- P102 – HHW Mezzanine Plan/WTS Upper Level Plumbing Plan
- P300 – Plumbing Isometrics
- P500 – Plumbing Details

Fire Protection Drawings

- FP101 – HHW First Floor Plan/WTS Lower Level Fire Protection Plan
- FP102 – HHW Mezzanine Plan/WTS Upper Level Fire Protection Plan

LEGAL NOTICE

INVITATION TO BID

Dane County Public Works, Highway & Transportation Dept., 1919 Alliant Energy Center Way, Madison, WI 53713, will receive sealed Bids until:

2:00 P.M., THURSDAY, JUNE 10, 2010

REQUEST FOR BIDS NO. 310013

**CONSTRUCTION OF WASTE TRANSFER
STATION BUILDING & CLEAN SWEEP BUILDING
DANE COUNTY LANDFILL SITE #2
7102 U.S. HIGHWAY 12 & 18
MADISON, WISCONSIN 53718**

Dane County is inviting Bids for the construction of a 20,850 square foot waste transfer station building and an adjacent 4,800 sq ft Clean Sweep building. Construction includes two pre-engineered metal buildings, concrete work, and associated civil/site, HVAC, electrical, plumbing, hydronic heat, alarm, and utility work. Work also includes installation of a system to utilize waste heat from generator engines.

Request for Bids package may be obtained at Dane County Public Works, Highway & Transportation Dept., 1919 Alliant Energy Center Way, Madison, WI 53713, by calling 608-266-4018, or downloading it from www.danepurchasing.com/rfps.aspx. Please call John Welch, Recycling & Project Manager, 608-267-8815, for any questions or additional information.

Refundable fee of \$50.00 per Request for Bids package (drawings & specifications) is required for each hard copy. Non-refundable fee of \$15.00 per set is required for shipping. Separate checks are required for shipping. Combined checks will not be accepted. Make checks payable to Dane County.

Pre-bid tour will be held on Tuesday, June 1, 2010 at 10:00 a.m. Meet at the scale house at Dane County Landfill Site #2, Madison, WI. Bidders are strongly encouraged to attend.

All Bidders wishing to submit Bids must be a registered vendor with Dane County & pay an annual registration fee & be prequalified as a Best Value Contractor. Complete Vendor Registration Form at www.danepurchasing.com or obtain one by calling 608/266-4131. Complete Prequalification Application for Contractors at www.co.dane.wi.us/pwht/pwengineer.aspx or obtain one by calling 608-266-4018.

**PUBLISH: MAY 13 & 20, 2010 - WISCONSIN STATE JOURNAL
MAY 13 & 20, 2010 - DAILY REPORTER**

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INSTRUCTIONS TO BIDDERS

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1. GENERAL

- A. Before submitting Bid, bidder shall thoroughly examine all Construction Documents. Successful Bidder shall be required to provide all the Work that is shown on Drawings, set forth in Specifications, or reasonably implied as necessary to complete Contract for this project.
- B. Bidder shall visit site to become acquainted with adjacent areas, means of approach to site, conditions of actual site and facilities for delivering, storing, placing, and handling of materials and equipment.
- C. Pre-bid meeting is scheduled on Tuesday, June 1, 2010 at 10:00 AM at Dane County Landfill Site #2 – Rodefild, 7102 U.S. Highway 12& 18. This site is located across from the Yahara Hills Golf Course. Attendance by all bidders is optional, however bidders and subcontractors are strongly encouraged to attend.
- E. Failure to visit site or failure to examine any and all Construction Documents will in no way relieve successful Bidder from necessity of furnishing any necessary materials or equipment, or performing any work, that may be required to complete the Work in accordance with Drawings and Specifications. Neglect of above requirements will not be accepted as reason for delay in the Work or additional compensation.

2. DRAWINGS AND SPECIFICATIONS

- A. Drawings and Specifications that form part of this Contract, as stated in Article 1 of General Conditions of Contract, are enumerated in Document Index of these Construction Documents.
- B. Complete sets of Drawings and Specifications for all trades will be issued to all Bidders, irrespective of category of work to be bid on, in order that all Bidders may be familiar with work of other trades as they affect their bid.
- C. For deposit refund, return complete sets of Drawings and Specifications to same location they were picked up within 90 days after Bid Opening date. After that time, deposit will be forfeited.

3. INTERPRETATION

- A. No verbal explanation or instructions will be given in regard to meaning of Drawings or Specifications before Bid Opening. Bidders shall bring inadequacies, omissions or conflicts to Owner or Architect / Engineer's attention at least ten (10) days before Bid Opening. Prompt clarification will be available to all bidders by Addendum.
- B. Failure to so request clarification or interpretation of Drawings and Specifications will not relieve successful Bidder of responsibility. Signing of Contract will be considered as implicitly denoting that Contractor has thorough understanding of scope of the Work and comprehension of Construction Documents.
- C. Owner or Architect / Engineer will not be responsible for verbal instructions.

4. QUALIFICATIONS OF BIDDER (CONTRACTOR AND SUBCONTRACTOR)

- A. Before award of Contract can be approved, Owner shall be satisfied that Bidder involved meets following requirements:
 - 1. Has completed at least one (1) project of at least fifty percent (50%) of size or value of Division of work being bid and type of work completed is similar to that being bid. If greater magnitude of experience is deemed necessary, other than size or value of work, such requirements will be described in appropriate section of Specifications.
 - 2. Maintains permanent place of business.
 - 3. Can be bonded for terms of proposed Contract.
 - 4. Has record of satisfactorily completing past projects. Criteria which will be considered in determining satisfactory completion of projects by bidder will include:
 - a) Completed contracts in accordance with drawings and specifications.
 - b) Diligently pursued execution of work and completed contracts according to established time schedule unless Owner grants extensions.
 - c) Fulfilled guarantee requirements of construction documents.
 - d) Is not presently on ineligible list maintained by County's Department of Administration for noncompliance with equal employment opportunities and affirmative action requirements.
 - e) Authorized to conduct business in Wisconsin. By submitting Bid, bidder warrants that it has: complied with all necessary requirements to do business in State of Wisconsin; that persons executing contract on its behalf are authorized to do so; and,

if corporation, that name and address of bidder's registered agent are as set forth in Contract. Bidder shall notify Owner immediately, in writing, of any change in its registered agent, their address, and bidder's legal status. For partnership, term "registered agent" shall mean general partner.

B. Contractors or subcontractors wishing to perform work of Specification Section 23 83 16 In-Floor Hydronic Heating System must be prequalified before bidding on Work of this Specification Section. Prequalified contractors for this Work are:

1. General Heating
2. H&H Industries
3. Illingworth-Kilgust
4. North American Mechanical

C. If other contractors wish to be added to the list of prequalified contractors for Work in Specification Section 23 83 16 In-Floor Hydronic Heating System, they must submit information supporting their qualifications by June 1, 2010 at 3:00 PM CST. At a minimum, contractor must meet the following qualification requirements:

1. Company specializing in performing work of this section with minimum five (5) years documented experience.
2. Company has performed at least three (3) similar projects, each with a dollar amount of at least half the value of this Work. Provide references and contact information for prior projects.

D. County's Public Works Project Engineer will make such investigations as are deemed necessary to determine ability of bidder to perform the Work, and bidder shall furnish to County's Public Works Project Engineer or designee all such information and data for this purpose as County's Public Works Project Engineer may request. Owner reserves right to reject Bid if evidence submitted by, or investigation of, bidder fails to satisfy Owner that bidder is responsible and qualified to carry out obligations of Contract and to complete the Work contemplated therein.

5. BID GUARANTEE

A. Bank certified check, cashier's check or Bid Bond, payable to County in amount not less than five percent (5%) of maximum bid, shall accompany each Bid as guarantee that if Bid is accepted, Bidder will execute and return proposed Contract and Performance and Payment Bonds within ten (10) days after being notified of acceptance of Bid. Company issuing bonds must be licensed to do business in Wisconsin.

B. Any bid, which is not accompanied by bid guarantee, will be considered "No Bid" and will not be read at Bid Opening.

C. If successful Bidder so delivers Contract, Certificate of Insurance, and Performance and Payment Bonds, check will be returned to Bidder. In case Bidder fails to deliver such

Contract, insurance, and bond, amount of bid guarantee will be forfeited to County as liquidated damages.

- D. All checks tendered as bid guarantee, except those of three lowest qualified, responsible bidders, will be returned to their makers within three (3) days after Bid Opening. All such retained checks will be returned immediately upon signing of Contract and Performance and Payment Bonds by successful Bidder.

6. WITHDRAWAL OF BIDS

- A. Bids may be withdrawn by written request received from bidder or authorized representative thereof prior to time fixed for Bid Opening, without prejudice to right of bidder to file new Bid. Withdrawn Bids will be returned unopened. Negligence on part of bidder in preparing their Bid confers no right for withdrawal of Bid after it has been opened.
- B. No Bid may be withdrawn for period of ninety (90) days after Bid Opening date.
- C. If Bid contains error, omission or mistake, bidder may limit liability to amount of bidder's guarantee by giving written Notice of Intent not to execute Contract to Owner within seventy-two (72) hours of Bid Opening.

7. CONTRACT FORM

- A. Sample copy of contract that successful Bidder will be required to enter into is included in these Construction Documents and bidders are required to familiarize themselves with all conditions contained therein.

8. CONTRACT INTERESTS BY COUNTY PUBLIC OFFICIALS

- A. In accordance with Wisconsin Statute 946.13, county official may not bid for or enter into any contract involving receipts or disbursements of more than \$7,500.00 in a year, in which they have private pecuniary interest, direct or indirect if at same time they are authorized to take official action with respect to making of this Contract. Any contract entered into in violation of this Statute is void and County incurs no liability thereon. This subsection does not affect application and enforcement of Wisconsin Statute 946.13 by state prosecutors in criminal courts of this state.

9. EMERGING SMALL BUSINESS PROVISIONS

- A. **Emerging Small Business Definition.** For purposes of this provision, ESB is defined as:
 - 1. Independent business concern that has been in business minimum of one year;
 - 2. Business located in State of Wisconsin;
 - 3. Business comprised of less than 25 employees;
 - 4. Business must not have gross sales in excess of three million dollars (\$3,000,000.00) over past three years; and
 - 5. Business does not have history of failing to complete projects.

- B. **Emerging Small Business (ESB) Involvement.** Bidder shall make good faith effort to award minimum of ten percent (10%) of the Work to ESBs. Bidder shall submit report to Dane County Contract Compliance Officer within twenty-four (24) hours after Bid Opening demonstrating such efforts. Good faith efforts means significant contact with ESBs for purposes of soliciting bids from them. Failure to make or demonstrate good faith efforts will be grounds for disqualification.
- C. **Emerging Small Business Report.** Emerging Small Business Enterprise Report is to be submitted by Bidder in separate envelope marked "Emerging Small Business Report". This report is due by 2:00 p.m. following specified twenty-four (24) hours after Bid Opening. Bidder who fails to submit Emerging Small Business Report shall be deemed not responsive.
- D. **ESB Goal.** Ten percent (10%) ESB participation is goal of this project. ESB utilizations are shown as percentage of total Bid. If Bidder meets or exceeds specified goal, Bidder is only required to submit Form A - Certification, and Form B - Involvement. Goal shall be met if Bidder qualifies as ESB.
- E. **Report Contents.** Following award of Contract, Bidder shall submit copies of executed contracts for all Emerging Small Businesses. Emerging Small Business Report shall consist of these:
1. Form A - Certification;
 2. Form B - Involvement;
 3. Form C - Contacts;
 4. Form D - Certification Statement (if appropriate); and
 5. Supportive documentation (i.e., copies of correspondence, telephone logs, copies of advertisements).
- F. **ESB Listing.** Bidders will solicit bids from ESB listing provided by Dane County.
- G. **ESB Certification.** All contractors, subcontractors and suppliers seeking ESB certification must complete and submit Emerging Small Business Certification Application to Dane County Contract Compliance Program.
- H. **Certification Statement.** If ESB firm has not been certified by County as ESB prior to submittal of this Bid, ESB Report cannot be used to fulfill ESB goal for this project unless firm provides "Form D - Certification Statement". Certification statement must be completed and signed by ESB firm.
- I. **Questions.** Questions concerning Emerging Small Business provisions shall be directed to:
Dane County Contract Compliance Officer
City-County Building, Room 421
210 Martin Luther King, Jr. Blvd.
Madison, WI 53703
608/266-5623
- J. **Substituting ESBs.** In event of any significant changes in subcontract arrangements or if need arises to substitute ESBs, Bidder shall report such proposed changes to Contract Compliance Officer to making any official changes and request authorization to substitute

ESB firm. Bidder further agrees to make every possible effort to replace ESB firm with another qualified ESB firm.

- K. **Good Faith Efforts.** Good faith efforts can be demonstrated by meeting all of these obligations:
1. Selecting portions of the Work to be performed by ESBs in order to increase likelihood of meeting ESB goal including, where appropriate, breaking down Contract into smaller units to facilitate ESB participation.
 2. Advertising in general circulation, trade associations, and women / minority focus media concerning subcontracting opportunities.
 3. Providing written notices to reasonable number of specific ESBs that their interest in Contract was being solicited in sufficient time to allow ESBs to participate effectively.
 4. Following up on initial solicitations of interest by contacting ESBs within five (5) working days prior to Bid Opening date to determine with certainty whether ESB were interested, to allow ESBs to prepare bids.
 5. Providing interested ESB with adequate information about Drawings, Specifications and requirements of Contract.
 6. Using services of available minority, women and small business organizations and other organizations that provide assistance in recruitment of MBEs / WBEs / ESBs.
 7. Negotiating in good faith with interested ESBs, not rejecting ESBs as unqualified without sound reason based on thorough investigation of their capabilities.
 8. Submitting required project reports and accompanying documents to County's Contract Compliance Officer within twenty-four (24) hours after Bid Opening.
- L. **Appeals Disqualification of Bid.** Bidder who is disqualified may appeal to Public Works & Transportation Committee and Equal Opportunity Commission.

10. METHOD OF AWARD - RESERVATIONS

- A. Following will be basis of award of Contract, providing cost does not exceed amount of funds then estimated by County as available to finance Contract(s):
1. Lowest dollar amount submitted by qualified responsible bidder on Base Bid for all work comprising project, combined with such additive Owner accepted alternates.
 2. Owner reserves right to reject all bids or any bid, to waive any informality in any bid, and to accept any bid that will best serve interests of County.
 3. Unit Prices and Informational Bids will not be considered in establishing low bidder.

11. SECURITY FOR PERFORMANCE AND PAYMENTS

- A. Simultaneous with delivery of signed Contract, Bidder shall be required to furnish Performance and Payment Bonds as specified in Article 29 of General Conditions of Contract, "Contract Security". Surety Company shall be licensed to do business in Wisconsin. Performance and Payment Bonds must be dated same date or subsequent to date

of Contract. Performance and Payment Bonds must emulate information in Sample Performance and Payment Bonds in Construction Documents.

- B. Provide certified copy of power of attorney from Surety Company showing that agent who signs Bond has power of attorney to sign for Surety Company. Secretary or Assistant Secretary of company must sign this certification, not attorney-in-fact. Certification must bear same or later date as Bond. Power of Attorney must emulate model power of attorney information detailed in Sample Performance and Payment Bonds.
- C. If Bidder is partnership or joint venture, State certified list, providing names of individuals constituting partnership or joint venture must be furnished. Contract itself may be signed by one partner of partnership, or one partner of each firm comprising joint venture, but Performance and Payment Bonds must be signed by all partners.
- D. If Bidder is a corporation, it is necessary that current certified copy of resolution or other official act of directors of corporation be submitted showing that person who signs Contract is authorized to sign contracts for corporation. It is also necessary that corporate seal be affixed to resolution, contract, and performance and payment bonds. If your corporation has no seal, it is required that above documents include statement or notation to effect that corporation has no seal.

12. TAXES

- A. Bidder shall include in Bid, all Sales, Consumer, Use and other similar taxes required by law.
- B. In accordance with Wisconsin Statute 71.80(16)(a), successful nonresident bidder, whether incorporated or not, and not otherwise regularly engaged in business in this state, shall file surety bond with State of Wisconsin Department of Revenue payable to Department of Revenue, to guarantee payment of income taxes, required unemployment compensation contributions, sales and use taxes and income taxes withheld from wages of employees, together with any penalties and interest thereon. Amount of bond shall be three percent (3%) of Contract or subcontract price on all contracts of \$50,000 or more.

13. SUBMISSION OF BIDS

- A. All Bids shall be submitted on standard Bid Form bound herein and only Bids that are made on this Bid Form will be considered. Entire Bid Form and other supporting documents, if any, shall be removed or copied from Construction Documents, filled out, and submitted in manner specified hereinafter. Submit completed Bid Bond with Bid as well.
- B. No bids for any subdivision or any sub-classification of this Work, except as indicated, will be accepted. Any conditional Bid, amendment to Bid Form or appended item thereto, or inclusion of any correspondence, written or printed matter, or details of any nature other than that specifically called for, which would alter any essential provision of Construction Documents, or require consideration of unsolicited material or data in determining award of Contract, will disqualify Bid. Telecommunication alterations to Bid will not be accepted.
- C. Bidders must submit single Bid for all the Work.
- D. Bid amounts shall be inserted in words and in figures in spaces provided on Bid Form; in case of conflict, written word amounts will govern.

- E. Addenda issued after Bid Letting shall become part of Construction Documents. Bidders shall acknowledge receipt of such addenda in appropriate space provided on Bid Form. Bid will be rejected if receipt of any particular addendum applicable to award of Contract has not been acknowledged on Bid Form.
- F. Bids shall be signed, placed in envelope, sealed and delivered before time of closing to place designated in Invitation to Bid, and identified with project name, bid number, location, Bid Opening date, name and address of bidder.
- G. Bidder shall be responsible for sealed Bid being delivered to place designated for Bid Opening on or before date and time specified. Bids received after time of closing will be rejected and returned to bidder unopened.
- H. Bid will be considered invalid and will be rejected if bidder has not signed it.
- I. Faxed Bids will not be accepted.
- J. Bidder's organization shall submit completed with Bid, Fair Labor Practices Certification form, included in these Construction Documents.

14. SUBCONTRACTOR LISTING

- A. Bidders shall be required to submit list of major subcontractors for General Construction, Plumbing, HVAC, Concrete, Metal Building, and Electrical work proposed for this project to include committed prices for each subcontractor. List shall be placed in separate sealed envelope that must be clearly identified as "Major Subcontractor List", for named project and name of Bidder submitting it. County must receive envelope within twenty-four (24) hours after Bid Opening.

15. ALTERNATE BIDS

- A. Bidder shall carefully read requests for Alternate Bids, and thoroughly examine Drawings and Specifications to determine extent various changes and conditions will affect Bid.
- B. Space is provided in Bid Form for requested Alternate Bids. Failure to submit bid for any requested Alternate Bids may result in rejection of entire Bid.
- C. Bidder shall state amount to be added / subtracted to Base Bid for providing alternates, including all incidentals, omissions, additions, and adjustments as may be necessary or required by such changes. If there is no difference in price, Bidder shall state, "No Change".
- D. Descriptions of requested Alternate Bids are as set forth in Construction Documents.

16. INFORMATIONAL BIDS

- A. Not Applicable.

17. UNIT PRICES

- A. Not Applicable.

18. COMMENCEMENT AND COMPLETION

- A. Successful Bidder shall commence work when schedule and weather permit, but no later than stated in Bid Form. Contractor shall pursue the Work regularly and continuously at reasonable rate to insure completion of the Work within time stated in Bid.
- B. Should it be found impossible to complete the Work on or before time specified for completion, written request may be submitted for extension of time setting forth reasons believed to justify granting of such request. Refer to Article 20 of General Conditions of Contract, titled "Time for Completion".

19. WORK BY OWNER

- A. This work will be accomplished by Owner or will be let under separate contracts and will not be included under this Contract:
 - 1. Owner will remove all pavement and existing retaining walls on the site.
 - 2. Owner will install all asphaltic pavement.
 - 3. Owner will excavate the existing fill material and/or topsoil followed by proof-rolling and/or thorough compaction of the exposed surface under all proposed paved and building areas to 95% Modified Proctor density. Owner will fill to elevation 871.50 average elevation over the site. Contractor shall verify elevations prior to beginning work. Contractor will receive no extra payment for work unless the average elevation varies by more than 3 inches from 871.50
 - 4. Owner will purchase the waste compactors and have them delivered to the site. Owner will also arrange with the compactor supplier to install the waste compactors. Contractor to coordinate compactor installation with all other Work.

20. SPECIAL HAZARDS COVERAGE

- A. Not Applicable.

FORM A

**DANE COUNTY
EMERGING SMALL BUSINESS REPORT - CERTIFICATION**

In accordance with General Conditions of Contract, submit this Emerging Small Business Report within 24 hours after Bid Opening.

PROJECT NAME: _____

BID NO.: _____ BID OPENING DATE: _____

BIDDER INFORMATION

COMPANY NAME: _____

ADDRESS: _____

TELEPHONE NO.: _____

CONTACT PERSON: _____

FORM B

**DANE COUNTY
EMERGING SMALL BUSINESS REPORT - INVOLVEMENT**

Page ___ of ___
(Copy this Form as necessary to provide complete information)

COMPANY NAME: _____

PROJECT NAME: _____ BID NO.: _____

ESB NAME: _____ CONTACT PERSON: _____

ADDRESS: _____ PHONE NO.: _____

CITY: _____ STATE: _____ ZIP: _____

Indicate percentage of financial commitment to this ESB: _____ % Amount: \$ _____

ESB NAME: _____ CONTACT PERSON: _____

ADDRESS: _____ PHONE NO.: _____

CITY: _____ STATE: _____ ZIP: _____

Indicate percentage of financial commitment to this ESB: _____ % Amount: \$ _____

ESB NAME: _____ CONTACT PERSON: _____

ADDRESS: _____ PHONE NO.: _____

CITY: _____ STATE: _____ ZIP: _____

Indicate percentage of financial commitment to this ESB: _____ % Amount: \$ _____

FORM C

**DANE COUNTY
EMERGING SMALL BUSINESS REPORT - CONTACTS**

Page ___ of ___
(Copy this Form as necessary to provide complete information)

COMPANY NAME: _____

PROJECT NAME: _____ BID NO.: _____

	<u>ESB FIRM NAME CONTACTED</u>	<u>DATE</u>	<u>PERSON CONTACTED</u>	<u>DID ESB BID?</u>	<u>DID YOU ACCEPT BID?</u>	<u>REASON FOR REJECTION</u>
1)	_____	_____	_____	_____	_____	_____
2)	_____	_____	_____	_____	_____	_____
3)	_____	_____	_____	_____	_____	_____
4)	_____	_____	_____	_____	_____	_____
5)	_____	_____	_____	_____	_____	_____
6)	_____	_____	_____	_____	_____	_____
7)	_____	_____	_____	_____	_____	_____

FORM D

**DANE COUNTY
EMERGING SMALL BUSINESS REPORT - CERTIFICATION STATEMENT**

I, _____, _____ of
Name Title

_____ certify to best of my knowledge and
Company

belief that this business meets Emerging Small Business definition as indicated in Article 9 of the Instructions to Bidders and that information contained in this Emerging Small Business Report is true and correct.

Bidder's Signature

Date



SOILS & ENGINEERING SERVICES, INC.

CONSULTING CIVIL ENGINEERS SINCE 1966

January 19, 2010

Project 12844 R01

Mr. John Welch
Dane County Dept. of Public Works, Highway & Transportation
Solid Waste Division
1919 Alliant Energy Center Way
Madison, Wisconsin 54713

Subject: Geotechnical Exploration and Analyses Report
New Waste Transfer Station
Rodefeld Landfill
7102 US Highway 12
Dane County, Wisconsin

Dear Mr. Welch:

We have completed the requested geotechnical exploration consisting of the performance of twelve standard and eight auger soil borings at the subject project site. The purpose of the borings was to obtain information concerning the subsoil, bedrock, and groundwater conditions at the boring locations. The intent of this report is to convey the information obtained, our evaluation of the conditions encountered, and to offer recommendations for the design and construction of the proposed project. Soils & Engineering Services, Inc. should be employed to make observations and perform tests at the time of excavation and construction of the proposed project to verify the soil and groundwater conditions encountered by this exploration and to validate the recommendations made in this geotechnical report.

PROJECT INFORMATION

The proposed project will include the design and construction of a new waste transfer station at the Rodefeld Landfill on US Highway 12/18 in the Dane County, Wisconsin.

The waste transfer station structure will have four different areas, household hazardous waste area, tipping slab area, compactor area, and drive-thru area. The tipping slab, compactor, and drive-thru areas will be housed in a metal building section with a cast-in-place concrete floor and approximate dimensions of 180 feet long by 115 feet wide by 53 feet high. The household hazardous waste area will be a masonry concrete block building section with a cast-in-place concrete floor and approximate dimensions of 90 feet long by 50 feet wide by 20 feet high. The finished floor elevations of the household hazardous waste, tipping slab, compactor, and drive-thru areas are 876.00, 890.83, 872.00, and 880.83 feet, respectively. We understand the proposed structure is to be supported on a foundation consisting of cast-in-place concrete walls and spread footings resting at various elevations ranging from approximately 867 to 887 feet.

We understand the tipping slab area has a floor load of 600 pounds per square foot. The wall footings for this project carry 4,000 pounds per lineal foot. The proposed building will have two sizes of exterior wall columns with structural loads of 81 and 144 kips. A continuous footing in the compactor area will support a line of twelve interior columns with structural loads of 220 kips each.

Due to the significant finished exterior grade relief around the proposed structure, the proposed structure include several retaining walls.

FIELD EXPLORATION

We performed 12 standard soil borings, designated Borings 1 through 12, and eight auger soil borings, designated Auger Borings 1W, 7W, and PM7 through PM12, at the locations presented on enclosed Location Sketch, Drawing 12844-0.5.

We performed Borings 1 through 6 in October 2009 as directed by Mr. Abdullah Younes with your office and the completed Soil Boring Records submitted to you as requested without a geotechnical analysis. Subsequently, you requested us to complete a geotechnical analysis of the results of the Borings 1 through 6 exploration. Based on our review of completed field work, we recommended field work be performed due to the loose granular soils present at the site to a depth of at least 40 feet below existing grade and the large amount of fill material required to raise the grade to accommodate the proposed tipping slab area of the proposed structure. We recommended the field work consist of six standard soil borings (Borings 7 through 12) be completed to a depth of at least 60 feet below existing grade, completion of two field pressuremeter tests at random depths below existing grade in each of six auger soil borings (Auger Borings PM7 through PM12) completed adjacent to the new standard soil borings, and installation of two temporary monitoring wells (Auger Borings 1W and 7W) to approximately 25 feet below existing grade. The additional borings



would be completed using mud rotary drilling methods. We completed the recommended additional field work in December 2009.

The borings completed for this project extended to the following depths below existing grade.

<u>Boring</u>	<u>Depth</u>	<u>Boring</u>	<u>Depth</u>	<u>Auger Boring</u>	<u>Depth</u>	<u>Auger Boring</u>	<u>Depth</u>
1	35'-0"	7	60'-0"	PM7	30'-10"	1W	25'-6"
2	40'-0"	8	60'-0"	PM8	31'-10"	7W	25'-6"
3	20'-0"	9	60'-0"	PM9	31'-4"		
4	20'-0"	10	60'-0"	PM10	40'-10"		
5	20'-0"	11	60'-0"	PM11	35'-4"		
6	20'-0"	12	60'-0"	PM12	28'-10"		

As directed for Borings 1 through 6, we obtained soil samples at continuously starting at a depth of 1-foot below the ground surface to a depth of 20 feet. The sampling interval was increased to 5 feet from a depth of 15 feet to the end of the boring for Borings 1 and 2. This sampling was accomplished using a 2-inch-outside-diameter, split-barrel sampler inside 2.25-inch-inside-diameter, hollow-stem augers. Hollow-stem augers serve as temporary casing to maintain an open borehole in most soil and water conditions.

For Borings 7 through 12, we obtained soil samples at 2½-foot intervals starting at a depth of 1-foot below the ground surface and continued to a depth where at least three consecutive samples had standard penetration resistance of at least 20 with a minimum depth of 20 feet.¹ We then increased the sampling interval to 5 feet to the end of the boring. This sampling was accomplished using a 2-inch-outside-diameter, split-barrel sampler inside 3- to 4-inch-inside-diameter, steel casing. We use steel casing to maintain an open borehole.

All sampling was performed according to ASTM Designation D 1586. The recovered soils were visually identified according to the Unified Soil Classification System (USCS).

The field exploration program also included the installation of two groundwater monitoring wells to obtain "long-term" readings of the groundwater levels at the subject project site. The monitoring wells consisted of the installation of 1-inch-diameter Schedule 40 PVC riser and screen. We backfilled the annular space around the pipe with filter sand to approximately 2 feet above the top of the slotted pipe section. We obtained groundwater

¹Standard penetration resistance is the sum of the number of blows required to drive the split-barrel sampler 12 inches with a 140-pound hammer falling 30 inches.



level readings from the wells at 1, 2, and 7 days after completion of installation of the wells. We then abandoned the wells in accordance with Wisconsin Department of Natural Resources procedures.

In addition to the soil borings and groundwater monitoring wells, the field exploration at the project site included the performance of 13 Pressuremeter tests to evaluate the "in-situ" strength and compressibility of the native soil strata encountered at the boring locations. We performed two pressuremeter tests in the boreholes of Auger Borings PM7 through PM9, PM11, and PM12. We performed three pressuremeter tests in the borehole of Auger Boring PM10. We will provide additional information and discussion regarding the Pressuremeter tests later in this report.

The Soil Boring Records and Auger Boring Records, which depict the subsoil stratification at the boring location, are presented on enclosed Drawings 12844-2 and 12844-31. The Notes and Legend page, which presents information pertinent to the Soil Boring Records, is outlined on enclosed Drawing 12844.1-1.

SOIL STRATIGRAPHY

A general soil profile can be characterized as fill material over topsoil overlying naturally deposited (native) soil strata to the maximum depth of the borings. The borings did not encounter bedrock.

The borings encountered 1 to 5 inches of hot-mix asphalt (HMA) pavement over 5 to 36 inches of base course overlying 0 to 64 inches of fill material. The base course encountered consisted of crushed stone and silty sand and gravel material. The fill material encountered consisted of layers and mixtures of silty sand, gravel, topsoil, clay, and coarse crushed stone. Boring 7 did not encounter any fill material. Beneath the fill material, the borings encountered 0 to 30 inches of topsoil. Borings 6 and 10 did not encounter any topsoil. Below the topsoil, the borings encountered a variable native soil stratification. The predominant native soil strata encountered by the borings consisted of Silty Fine Sand, occasional to much gravel (SM); Silty Fine Sand, trace to much gravel (SM); and Seams and Layers of Silty Fine Sand (SM) and Fine Sand with Silt (SP/SM), occasional to trace gravel. Other native soil strata encountered by the borings consisted of Lean Clay (CL); Sandy Lean Clay (CL); Silt (ML); Sandy Silty Clay (CL-ML); Silty Clayey Fine Sand, little to much gravel (SC/SM); Varved Lean Clay (CL) and Silt (ML) Lenses; and Silty Fine to Coarse Gravel, much sand (GM).

Please refer to the enclosed Soil Boring Records for a further description of the fill material, topsoil, and native soil strata encountered at the boring locations.



GROUNDWATER

The borings encountered groundwater at the following depths and corresponding elevations:

Boring	Ground Surface Elevation (feet)	Groundwater		Caved Level		Notes	When Measured
		Depth (feet)	Elevation (feet)	Depth (feet)	Elevation (feet)		
1	874.7	—	—	16.5	858.2	Wet	At completion
		10.5	864.2	—	—		At ½ hour
2	873.2	16.3	856.9	21.5	851.7		At completion
		14.0	859.2	16.0	857.2		At 1½ hours
3	873.8	—	—	17.0	856.8	Moist	At completion
		13.8	860.0	14.5	859.3		At 6 hours
4	871.9	10.5	861.4	—	—		At completion & 7 hours
5	874.0	—	—	16.0	858.0	Moist	At completion
		14.1	859.9	15.0	859.0		At 5 hours
6	872.9	—	—	16.0	856.9	Moist	At completion
		13.2	859.7	13.5	859.4		At 3½ hours
7	873.4	13.3	860.1	—	—		estimated
8	874.6	14.2	860.4	—	—		At completion
		14.4	860.2	—	—		estimated
9	873.1	12.9	860.2	—	—		estimated
10	874.6	14.4	860.2	—	—		estimated
11	873.7	13.5	860.2	—	—		estimated
12	874.6	14.4	860.2	—	—		estimated
1W	874.7	14.3	860.4	—	—		24 hours
		14.4	860.3	—	—		48 hours
		14.4	860.3	—	—		7 days
7W	873.4	12.3	861.1	—	—		24 hours
		13.3	860.1	—	—		48 hours
		13.3	860.1	—	—		7 days



The groundwater level readings obtained suggest the groundwater is between approximately elevations 861 and 861 feet. The water encountered above this level in most probability is water that is stored within the fill material.

The groundwater level is expected to fluctuate as influenced by precipitation, snowmelt, surface water runoff, the stage of the nearby creek, and other hydrological and hydrogeological factors. The groundwater level at the time of construction of the proposed project may be different from the groundwater levels encountered on the day that we performed the borings.

LABORATORY AND FIELD TEST RESULTS

We performed laboratory and field tests on selected soil samples obtained during the geotechnical exploration at the subject project site. The laboratory tests consisted of determining the natural moisture content (NM), Atterberg limits (liquid limit [LL] and plastic limit [PL]), unconfined compressive strength (q_u), wet and dry densities (γ_w and γ_d), and particle size distribution analysis including percentage of silt and clay particles. In addition to the above tests, we tested some of the cohesive soils for approximate unconfined compressive strength with a calibrated-spring penetrometer (q_p).

The field tests consisted of the standard penetration test (SPT) and the pressuremeter test. We performed the SPT during the sampling procedure at each of the boring locations. The SPT is the number of blows per foot ("N" value) needed to drive the split-barrel sampler using a 140-pound hammer free-falling for 30 inches. We performed 13 Pressuremeter tests in the boreholes of Auger Borings PM7 through PM12 at depths ranging from 12.5 to 40.0 feet below existing grade to evaluate the in-situ strength and compressibility characteristics of the native soil strata encountered at the project site. Two of the pressuremeter tests were unsuccessful in obtaining relevant data points due to either breakage of the pressuremeter probe during performance of the test or due to an excessively large diameter borehole.

We used a TEXAM Pressuremeter to perform the pressuremeter tests. The pressuremeter test procedure consists of lowering a cylindrical device (commonly referred to as the probe) into a pre-drilled borehole. At the test depth, we recorded the initial volume of the probe and applied an internal pressure to expand the probe laterally against the borehole sidewalls. We continue increasing the pressure in increments until the native soil reaches a "failure" condition. We correct the pressure and volume data readings obtained during the tests to account for calibration of the probe including pressure and volume losses incurred during the tests.



We used the measured stress-strain characteristics and soil failure pressures obtained from the pressuremeter tests to estimate the bearing capacity and settlement of the soil which will be supporting the foundations for the proposed building. We used each of the pressuremeter test results to determine the Pressuremeter (Deformation) Modulus, "E," and the Limit Pressure, "P_L." The Pressuremeter Modulus is representative of the elasticity of the soil and is used to compute the estimated amount of settlement of the soil due to an increase in the loading conditions at the site. The Limit Pressure is related to the shear strength of the soil and is used to compute the ultimate bearing capacity.

We have included the laboratory and field test results on the Soil Boring Records and/or on enclosed Laboratory Test Result Records, Figures 12844-A through 12844-C, and Field Test Result Records, Figures 12844-D through P.

The laboratory and field test results indicate the following:

- The existing fill material is in a damp to moist relative moisture condition and in a loose to medium dense state of relative density.
- The Lean Clay (CL) stratum is in a moist relative moisture condition, of medium plasticity, and of stiff consistency.
- The Sandy Silty Clay (CL-ML) stratum is in a saturated relative moisture condition, of slight plasticity, and in a medium dense state of relative density.
- The Sandy Lean Clay (CL) stratum is in a moist relative moisture condition and of stiff consistency.
- The Silt (ML) stratum is in a saturated relative moisture condition, of none to slight plasticity, and of soft to medium consistency.
- The Varved Lean Clay (CL) and Silt (ML) Lenses stratum is in a moist to saturated relative moisture condition and of stiff consistency.
- The Seams and Layers of Silty Fine Sand (SM) and Fine Sand with Silt (SP/SM), occasional to trace gravel and Silty Fine to Coarse Gravel, much sand (GM) strata are in a damp to saturated relative moisture condition and in a medium dense state of relative density.
- The Silty Fine Sand, occasional to much gravel (SM) and Silty Clayey Fine Sand, little to much gravel (SC/SM) strata are in a moist



to saturated relative moisture condition, of moderate fines content, and in a very loose to loose state of relative density with occasional medium dense layers.

- The Silty Fine Sand, trace to much gravel (SM) stratum is in a saturated relative moisture condition and in a dense state of relative density with occasional loose seams.

Please refer to the enclosed Soil Boring Records for additional information regarding the laboratory and field test results.

CONCLUSIONS

Based on the available information, it is our opinion the project area is a feasible location for the design and construction of the proposed facility.

Based on the results of the laboratory and field tests, the upper granular strata to approximate elevation 835.4 to 842.7 feet are in a very loose to loose state of relative density. Due to this poor state of relative density, we anticipate settlement of the proposed structure to occur due to the increase in the overburden pressure from the placement of new fill material to raise the grade to prepare the area for the construction of the proposed structure and the additional loading from the structure itself. Differential settlement of the structure due to the variable thickness of the very loose to loose granular strata and the variation in the amount of proposed fill material within the structure should be anticipated. We understand differential settlement of the structure may be tolerated in the structure design.

We used the pressuremeter test results to estimate the amount of settlement of the various areas of the proposed structure. As an alternative to including differential settlement in the structure design, improvement of the underlying very loose to loose granular strata could be accomplished by using ground modification methods such as surcharging, vibro-compaction, vibro-replacement, dynamic compaction, or stone columns to increase the state of relative density of the upper granular strata. This report will address placement of new fill material in a controlled manner to prepare the building area for construction of the proposed structure supported on a shallow foundation system consisting of standard shallow, frost-depth, spread footings. Should you desire to explore the use of ground modification methods, please contact us.



COMMENTS AND RECOMMENDATIONS FOR THE NEW WASTE TRANSFER STATION

Based on the information obtained, we offer the following comments and recommendations:

1. Site Preparation

Site preparations should include removing the existing HMA pavement, base course, fill material, topsoil, and/or vegetation from the area of the proposed improvement. We expect removal of the surficial materials can be accomplished with normal earth-moving equipment. The soil borings indicate that removal of these materials will vary approximately between 4 and 10 feet of depth below existing grade. The HMA pavement encountered was found to be between 1 and 8 inches thick. The base course encountered was found to be between 5 and 36 inches thick. The fill material encountered was found to be between 19 and 64 inches thick. The topsoil encountered was found to be between 12 and 30 inches thick. More or less HMA pavement, base course, fill material, and topsoil may be encountered in unexplored areas of the proposed improvement. The base course, fill material, and topsoil could be stockpile for reuse in landscape areas.

2. Excavation Recommendations

We expect the excavations for this project to be performed with conventional earth-excavation equipment such as hydraulic backhoes and scrappers. We recommend hydraulic backhoes be equipped with a cleaning bucket to minimize the disturbance to the soils at the base of an excavation. A cleaning bucket is a conventional bucket equipped with a continuous cutting edge. This could be fabricated by welding a steel plate in front of the cutting teeth.

The excavation to remove the existing fill material should extend horizontally outward from the highest exterior footing bottom elevation at least 1-foot for every foot of excavation below the proposed footing bottom elevation.

Following completion of the site preparation excavation of all of topsoil and fill material, we recommend the exposed soil be proof-rolled or compacted. Exposed cohesive soils should be proof-rolled and exposed granular soils should be thoroughly compacted.

Proof-rolling of cohesive subgrade surfaces should be performed using a heavily-loaded, triaxle, dump truck or similar rubber-tire equipment. The equipment used should traverse the exposed cohesive soil twice each in two directions that are



perpendicular to each other. Soils & Engineering Services, Inc. personnel should observe the proof-rolling procedure. If the subgrade soil exhibits rutting, pumping, or yielding during the initial proof-rolling, the proof-rolling should be stopped and the need for subgrade stabilization should be considered. Subgrade stabilization may consist of lean clay removal, excavation below subgrade (EBS) elevation, placement of a separation-type geotextile and coarse crushed stone, or other possible methods.

Thorough compaction of granular subgrade surfaces should be performed using a self-propelled or tow-behind vibratory, steel-drum compactor or a backhoe-mounted, vibratory-plate compactor. The granular soil should be compacted to a density of at least 95 percent of the maximum dry density determined for the soil according to ASTM Designation D 1557 for a minimum depth of 18 inches below the excavation bottom. Soils & Engineering Services, Inc. personnel should test the compacted native soil to verify that the minimum density has been achieved before placing compacted granular fill material. If the soils exposed by the excavation cannot be compacted, additional undercut may be necessary and/or possibly subgrade stabilization with placement of a geotextile on the subgrade surface followed by a coarse crushed stone layer.

After completion of the thorough compaction or proof-rolling operations, compacted site fill material should be placed and compacted as specified below in Section 3.

3. Site Filling

Several feet of material will need to be placed to fill the site to reach the proposed finished site grade elevation. We understand the on-site stockpiled cohesive/granular mixed material could be used for the site filling around the proposed structure. This material is delivered to the landfill for usage as daily cover and the physical characteristics of the material is very variable. Due to the high fines content of this preferred material, obtaining the required minimum compacted density may be difficult. If needed, compacted granular fill material should be used in areas where the minimum compacted density cannot be obtained for the selected material being used to raise the grade.

Soils & Engineering Services, Inc. should monitor the compactive effort at regular depths and intervals to verify that the minimum density is achieved, especially during initial placement of the compacted fill material. Any compacted lift that does not meet the specified density should receive additional compactive effort and then be retested until the required density is achieved. Subsequent lifts should not be placed until the specified minimum density is achieved on the preceding lift.



The weight and compacting energy of the compactor selected to compact the backfill material adjacent the walls will impart lateral loads to the walls. This should be taken into consideration by the structural engineer during design of the foundation and retaining walls and by the earthwork contractor during the selection process of which compactor to use to compact the backfill material so the foundation and retaining walls are not over stressed during compaction operations. The structural engineer designing the walls could be consulted to aid in the selection of the compactor to be used to backfill the foundation and retaining walls.

During cold weather conditions, fill material should not be deposited over frozen soil, either frozen native soil or frozen fill material. Also, fill material to be placed and compacted should not be frozen or contain snow or ice.

a. Compacted Cohesive/Granular Mixed Fill Material

Compacted cohesive/granular mixed fill material should have all particles larger than 6 inches in the biggest dimension removed prior to compaction of the placed material. This material should be placed in maximum 3- to 6-inch-thick loose lifts. Each lift should be thoroughly compacted to at least 90 percent of the maximum dry density determined for the material in accordance with ASTM Designation D 1557 at a moisture content approximately 2 percent above optimum moisture. In addition, the material shall be well-knit together to eliminate voids within the soil mass and have a minimum unconfined compressive strength of 2.0 tons per square foot as measured with a calibrated-spring penetrometer.

We recommend large segmented-pad compactors be utilized to compact the on-site cohesive/granular mixed material. This type of compactor will help to kneed the placed material into a well-knit soil mass. The size of the compactor used to compact the on-site cohesive/granular mixed fill material is anticipated to be larger than what would be needed to compact granular fill material. We recommend smooth drum or flat plate vibratory compactors not be used to compact the on-site cohesive/granular mixed fill material.

b. Compacted Granular Fill Material

Compacted granular fill material should consist of imported granular fill material. Imported granular fill material should consist of well-graded sand, or sand and gravel, with a maximum aggregate size of 2½ inches in the greatest dimension, not more than 30 percent of the material retained on the ¾-inch sieve, and not more than 25 percent passing the No. 200-mesh sieve.



The granular fill material should be placed in maximum 6- to 12-inch-thick loose lifts, depending on the soil type being compacted. Each lift should be thoroughly compacted to at least 95 percent of the maximum dry density determined for the material in accordance with ASTM Designation D 1557.

4. Foundation Excavation Observations

Soils & Engineering Services, Inc. should observe and test all foundation excavation bottom and side walls. Following acceptance of the exposed excavation surfaces, construction of proposed foundation footings could be accomplished.

5. Foundation Recommendations

If the existing fill material and topsoil are removed exposing the native soil as specified above, spread footings may be used for foundation support of the proposed improvement. Based on the information provided regarding the proposed top of footing elevations and the footing thicknesses, we determined the spread footings should rest on compacted site fill material or native soil. Using this information and the pressuremeter test results, we computed allowable soil bearing pressures for the various proposed footings in each of the four building areas.

If the above recommendations are implemented and based on the computations performed, we recommend an allowable soil bearing pressure of 3,000 pounds per square foot (psf) may be used for the design of the footings. As previously recommended, Soils & Engineering Services, Inc. should observe and test the soil at the bottom of all footing excavations to verify the strength and suitability of the soil to adequately support the recommended design soil bearing pressure of 3,000 psf.

To prevent excessively narrow footings, we recommend that wall and isolated spread footings be designed and constructed with minimum dimensions of 18 and 24 inches, respectively, even if the applied footing bearing pressure is less than the allowable soil bearing pressure.

We recommend that footings and foundation walls include a sufficient quantity of reinforcing steel to reduce the shrinkage effect of the concrete. The steel will also reduce the potential for differential settlement of the proposed building.



6. Structure Settlement

We used the pressuremeter test results to compute the estimated settlement due to the proposed footing loadings and due to the increase in loading due to the proposed site fill and floor loads for each of the four building areas.

Based on the computations performed, we estimate the total footing and building settlement for the drive thru, compactor, and hazardous household areas of the proposed structure to be less than 1 inch.

Based on the computations performed, we estimate the total footing and building settlement for the tipping slab area of the proposed structure to be between 1 inch and 2 inches.

7. Foundation Backfill

We recommend the interior and exterior of all foundations for the proposed construction be backfilled using compacted granular fill material or compacted cohesive/granular mixed fill material. The selected backfill material should be placed and compacted as specified above in Section 3.

8. Building Floor Slab Recommendations

We recommend a minimum of 10 inches of a free-draining granular fill material be placed below the slab-on-grade. To be free-draining, the granular fill material should have a maximum of 8 percent of the particles passing the No. 200-mesh sieve, a maximum of 65 percent of the particles passing the 1-inch sieve and 100 percent of the particles passing the 1½-inch sieve. The free-draining fill material should be compacted as described for compacted granular fill material in Section 3.b.

9. Recommendations for Below-Grade Walls and Lateral Earth Pressure

Below-grade walls and retaining walls should be designed to resist lateral pressure when backfill material is placed against the exterior side of the walls. Backfilling against the below-grade walls should not be allowed until the design strength of the concrete has been achieved. Also, if the below-grade wall is not designed to act as a cantilever beam, backfilling should not be performed until lateral restraint is provided at the bottom and top portions of the wall.

The soil parameters needed to determine lateral earth pressure acting against below-grade walls include the density and strength characteristics of the soil that will be



retained. The strength properties consist of the angle of internal friction and cohesion. In addition, the lateral earth coefficient for the active, passive, and at-rest case are needed to estimate the magnitude of applied lateral pressure.

We are providing estimated values of density, friction angle, cohesion, and lateral earth pressure coefficients for various materials that could be used for backfill behind the proposed walls.

Retained Material	Estimated Soil Parameters			Earth Pressure Coefficient		
	Moist Density (lb/ft ³)	Friction Angle, φ (degrees)	Cohesion (lb/ft ²)	Passive (K _p)	Active (K _a)	At-Rest (K _o)
Compacted granular fill material consisting of silty fine sand and gravel or similar ²	135	32	0	3.25	0.31	0.47
Compacted cohesive/granular fill material ³	135	25	2000	2.46	0.41	0.58

The above parameters are based on compacting the backfill material to the specified minimum density. If a soil type other than those indicated will be used as backfill material, we should be notified to change the above parameters, if necessary.

For walls that are not designed to move, such as below-grade walls that are restrained at the top and bottom portions of the walls, we recommend the at-rest earth pressure coefficient, K_o, be used to calculate lateral earth pressure. The active earth pressure coefficient, K_a, and passive earth pressure coefficient, K_p, should be used for walls that are allowed to move or translate for a sufficient distance to achieve the active or passive state of stress in the soil behind the wall.

We recommend proper drainage of water be included in the design of any proposed below-grade wall or retaining wall. A minimum 12-inch-wide vertical drainage layer should be installed directly behind the wall. The vertical drainage layer should extend from 6 inches below the top of the wall to the bottom of the wall. The drainage layer should consist of ½-inch- to 1-inch-size crushed stone particles

²Compacted to a density at least 95 percent of the maximum dry density determined for the backfill material in accordance with ASTM Designation D 1557. See Section 3.b.

³Compacted to a density at least 90 percent of the maximum dry density determined for the backfill material in accordance with ASTM Designation D 1557 at a moisture content of approximately 2 percent above optimum moisture. See Section 3.a



without “fines.” The drainage layer and the rest of the soil backfill should be separated by a woven geotextile such as Mirafi 500X.

To reduce the potential for infiltration of surface water into the soil backfill of the wall, a minimum of 6 inches of soil directly below the surface should consist of a semi-impermeable layer such as compacted clay soil or a hard surface pavement. The ground surface should be graded to provide positive drainage away from the wall.

10. Seismic Classification

For use in the seismic design of this structure, we used the information from the soil borings and determined the soils beneath the subject project site meet the criteria for Site Class E, “soft soil profile,” as presented in the 2002 Wisconsin Commercial Building Code.

11. Suitability of On-Site Soils

The existing topsoil and fill material should not be used as fill material in proposed building or paved areas.

12. Surface Water Management

During construction, surface water runoff due to precipitation should be properly diverted away from the project construction areas to reduce infiltration of water into subgrade excavations and to the subsoil. The existing fill material and underlying native soils may experience erosion and loss of strength if water is allowed to accumulate and flow on the subgrade soils. Any subgrade soil which is softened, loosened, or otherwise adversely affected by water should be excavated and replaced with compacted granular fill material or crushed stone. Water which accumulates in excavation areas may be as much of a problem as groundwater if not managed properly.

The finished exterior grades should provide permanent drainage of surface water runoff due to precipitation away from the subject structure.

13. Job Site Safety

Safety precautions, such as those required by OSHA and the Wisconsin Department of Commerce, should be followed throughout the time of construction of the various individual portions of the proposed building improvements. They include, but are



not limited to, the proper sloping and/or support of excavation sidewalls, roadways, and utilities that exist, or will exist, in the area of the proposed project.

CLOSING COMMENTS

This geotechnical engineering report has been prepared for the exclusive use of Dane County Dept. of Public Works, Highway & Transportation and GRAEF to aid in the evaluation of the subject property and for the intended uses described herein. The recommendations in this report are based on the project information provided to our office. Soils & Engineering Services, Inc. should review any changes in the nature, design, or location of the proposed replacement bridge and associated roadway after submittal of our *Geotechnical Exploration and Analyses Report* to revise the recommendations in this report, if necessary. The nature and extent of soil variations at the project site may not become evident until the time of excavation or construction of the proposed project. If soil variations are evident then, we should reevaluate the soil, groundwater, and other site conditions which could result in the revision of our recommendations in this report.

Soils & Engineering Services, Inc. should review the final design plans and specifications for the proposed project to verify that our recommendations regarding the proposed project are interpreted correctly and implemented in the design of the project as intended. We further recommend that Soils & Engineering Services, Inc. be present at the project site at the time of earthwork for the proposed project to perform observations and tests to confirm compliance with the design concepts and specifications, and to provide recommendations to modify the design if subsurface soil or groundwater conditions differ from those anticipated before construction. It is important that soil composition, strengths, densities, allowable bearing pressures, other soil parameters, and degree of compaction required be confirmed and/or determined at the time of construction.

Our recommendations in this report are based on our classification and interpretation of the soils and information given on the Soil Boring Records, and may not be based solely on the contents of the driller's field logs.

Soils & Engineering Services, Inc. prepared this report for the subject project in accordance with generally accepted geotechnical engineering practices at this time. Soils & Engineering Services, Inc. offers no other expressed or implied warranty.

We recommend our *Geotechnical Exploration and Analyses Report*, in its entirety, be made available to bidding contractors or subcontractors for information purposes. The Soil Boring Records should not be separated from the text of this report. This report should be considered invalid if used for purposes other than those described herein.



Soils & Engineering Services, Inc. will store the soil samples for 60 calendar days after the date of this report. Please advise us if the storage period of 60 days should be extended.

We backfilled the boreholes with bentonite as required by the State of Wisconsin Department of Natural Resources, NR 112 Wisconsin Administrative Code. We have submitted proper documentation to the WDNR district office.

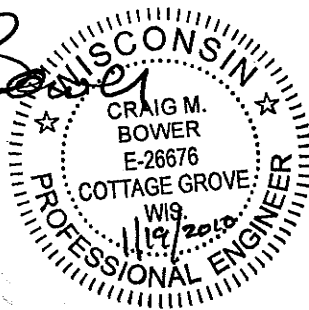
If you have any questions concerning this submittal, or if we can be of further assistance, please contact us.

Respectfully submitted,

SOILS & ENGINEERING SERVICES, INC.

Craig M. Bower

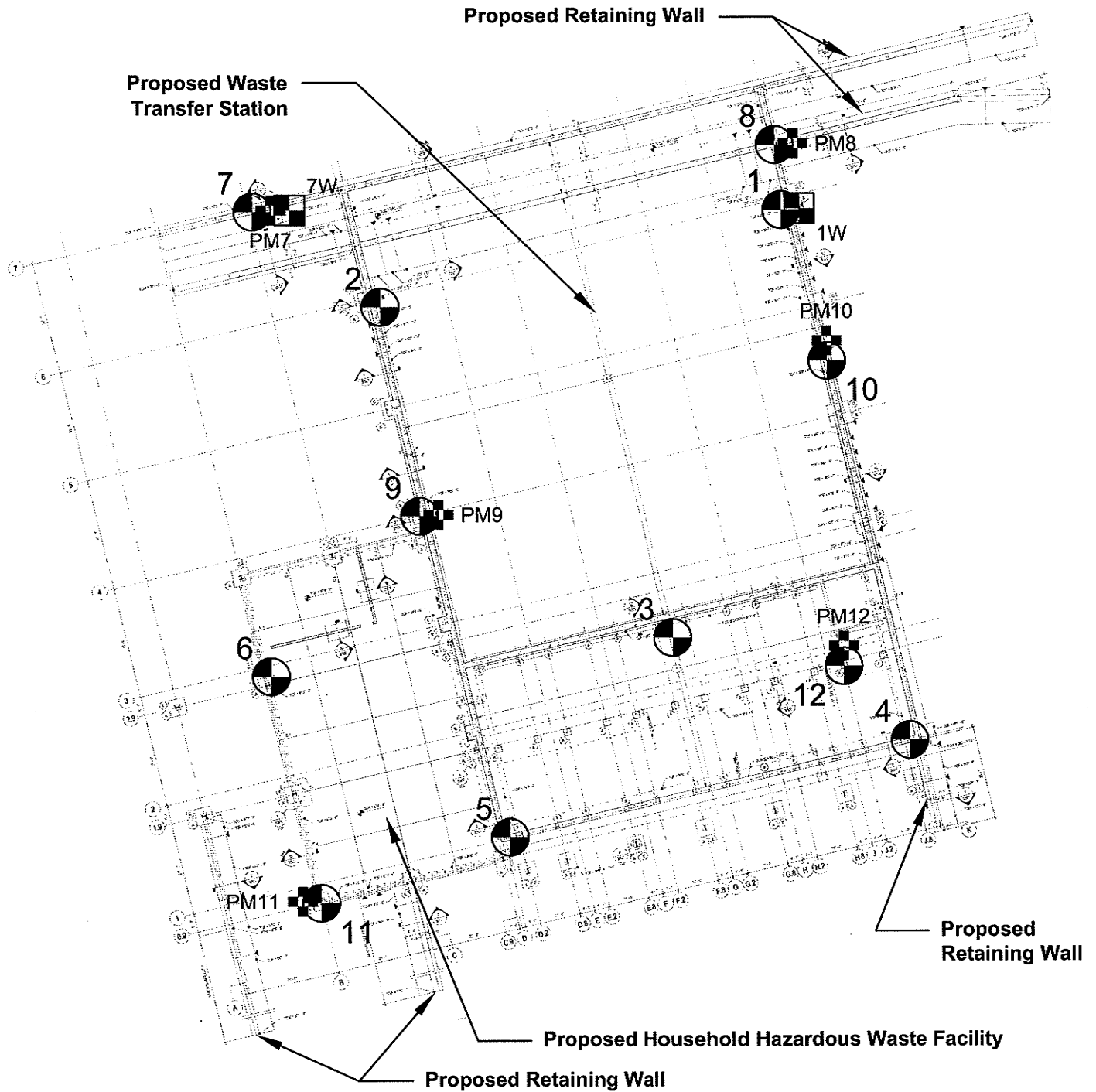
Craig M. Bower, P.E.
CMB:OTG:cmb



Enclosures (48)

xc: Mr. John H. Kannall, P.E., GRAEF (via email)
Mr. Daniel F. Windorski, P.E., GRAEF (via email)

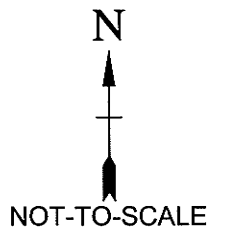




PM7
 = Auger Boring PM7 (typical)


 ^{1W} = Auger Boring 1W (typical)

 ² = Boring 2 (typical)



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LOCATION SKETCH
 New Waste Transfer Station
 Rodefeld Landfill
 7102 US Highway 12
 Dane County, Wisconsin



DRAWING
 12844-0.5

NOTES

1. The drilling for Borings 1 through 7 and 9 through 12 and Auger Borings 1W and 7W was performed using 2¼-inch-inside-diameter, continuous flight, hollow-stem augers. The drilling for Boring 8 was performed using 3¼-inch-inside-diameter, continuous flight, hollow-stem augers. The drilling for Auger Borings PM7 through PM12 was performed using a 4-inch-diameter, tri-cone roller bit and drilling mud to remove the drill cuttings. The drilling for Boring 8 was extended using 3-inch-diameter, temporary, steel casing, a tri-cone roller bit, and drilling mud to remove the drill cuttings. The drilling for Borings 7 and 9 through 12 was extended using a 4-inch-diameter, tri-cone roller bit and drilling mud to remove the drill cuttings.
2. The soil sampling for the borings was performed in accordance with ASTM Designation D 1586. The number of blows required to drive a 2-inch-outside-diameter, split-barrel sampler 12 inches, or fraction thereof when so noted, with a 140-pound hammer falling 30 inches is recorded in the "N-Value" column at the approximate middle elevation of the sample. This number of blows is the "standard penetration resistance."
3. Auger Borings 1W and 7W were converted into temporary monitoring wells upon completion of the drilling operations. The remaining boreholes were backfilled with bentonite after determining the depth to water.
4. The boundary lines between different soil strata, as shown on the Soil Boring Records and Auger Boring Records, are approximate and may be gradual. The recovered soils were visually identified in accordance with the Unified Soil Classification System (USCS) as defined in ASTM Designation D 2487. The drillers' field logs contain a description of the soil conditions between samples based on the equipment performance and the soil cuttings. The Soil Boring Records and Auger Boring Records contain the description of the soil conditions as interpreted by a geotechnical engineer and/or a geologist after review of the drillers' field logs and soil samples and/or laboratory test results.
5. The Soil Boring Records and Auger Boring Records are a part of the geotechnical report. The geotechnical report should be included in the bidding or reference documents.

N-VALUE LEGEND

PS = Pushed Stone

TEST RESULTS LEGEND

<p>q_p = Penetrometer reading, $\frac{\text{ton}}{\text{ft}^2}$ NM = Natural moisture, % moisture by weight q_u = Unconfined compressive strength, $\frac{\text{ton}}{\text{ft}^2}$ γ_s = Saturated density, $\frac{\text{lb}}{\text{ft}^3}$ γ_w = Wet density, $\frac{\text{lb}}{\text{ft}^3}$ γ_d = Dry density, $\frac{\text{lb}}{\text{ft}^3}$ LI = Loss on ignition, % organic content by weight</p>	<p>LL = Liquid limit, % moisture by weight PL = Plastic limit, % moisture by weight P_{200} = % passing the No. 200-mesh sieve ML = percentage of particles between 75 and 5 μm CL = percentage of particles finer than 5 μm</p>
--	---

REMARKS LEGEND

<p>NR = No Recovery D = Damp relative moisture condition M = Moist relative moisture condition W = Wet relative moisture condition S = Saturated relative moisture condition</p>	<p>D-M = Damp to Moist relative moisture condition D-S = Damp to Saturated relative moisture condition M-W = Moist to Wet relative moisture condition M-S = Moist to Saturated relative moisture condition TO = Topsoil/Organic Odor SIPO = Slight Petroleum-like Odor PO = Petroleum-like Odor</p>
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SAMPLER TYPE LEGEND

2-inch-outside-diameter, split-barrel sampler

Pressuremeter test

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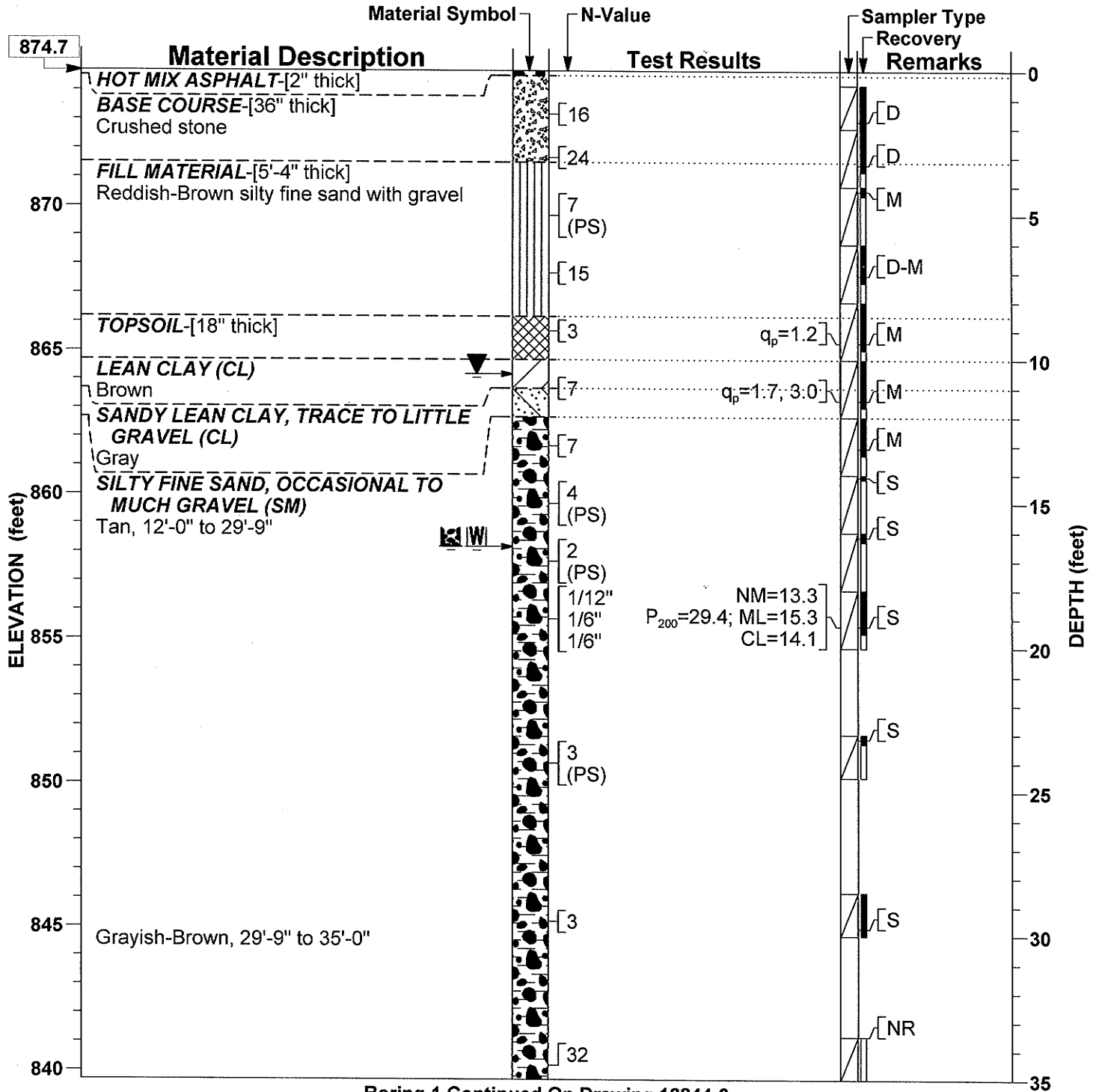
NOTES AND LEGEND
 New Waste Transfer Station
 Rodefeld Landfill
 7102 US Highway 12
 Dane County, Wisconsin



DRAWING
12844-1

Location: (N472759, E853401)

Boring 1
 Completed October 7, 2009
 Total Depth = 35'-0" (Page 1/2)




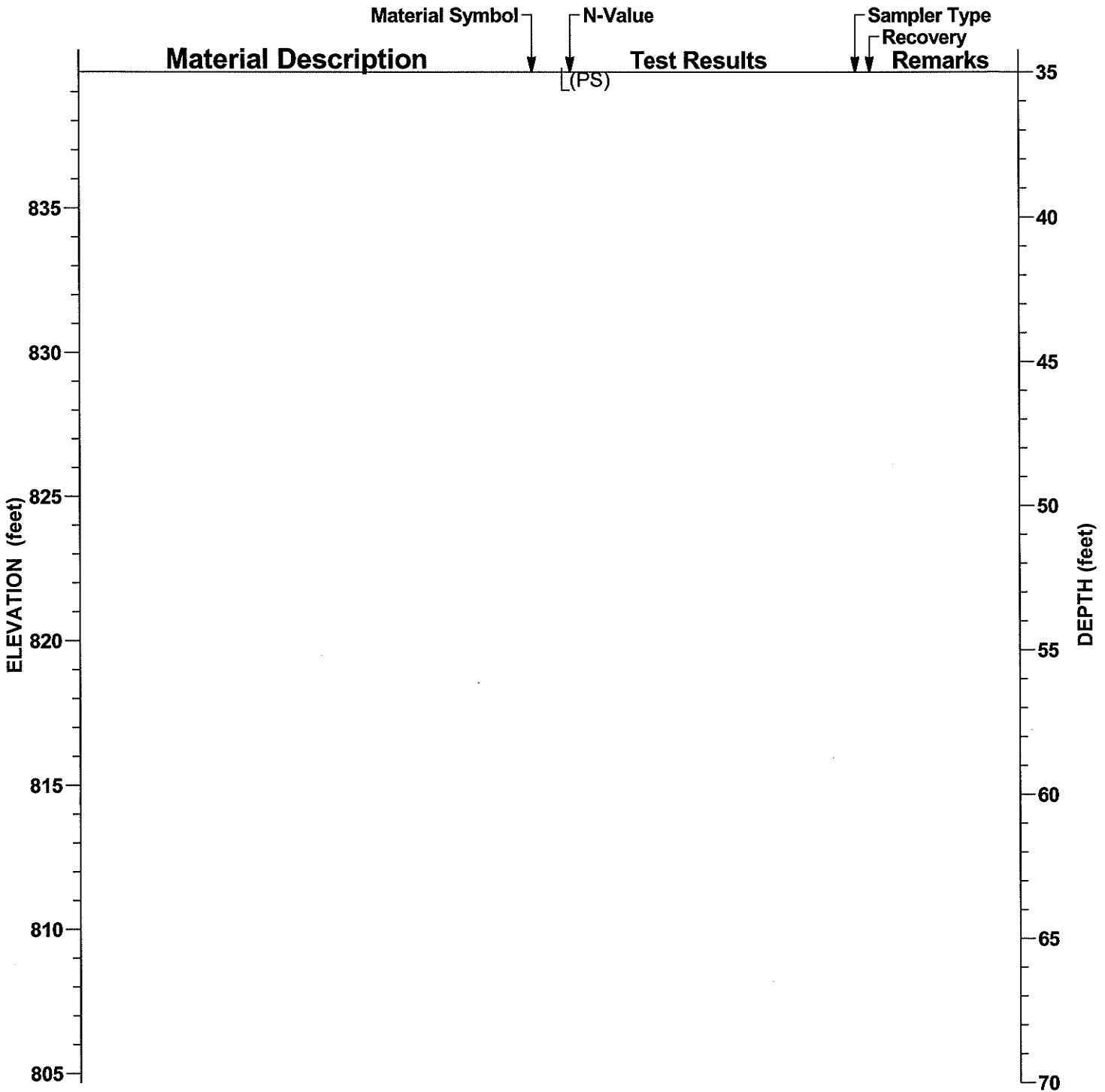
Boring 1 Continued On Drawing 12844-3

WATER LEVEL LEGEND
 ▼ 10'-6" at 1/2 hour
 [W] Wet 16'-6" at completion


OTHER LEVEL LEGEND
 [C] (caved) 16'-6" at completion

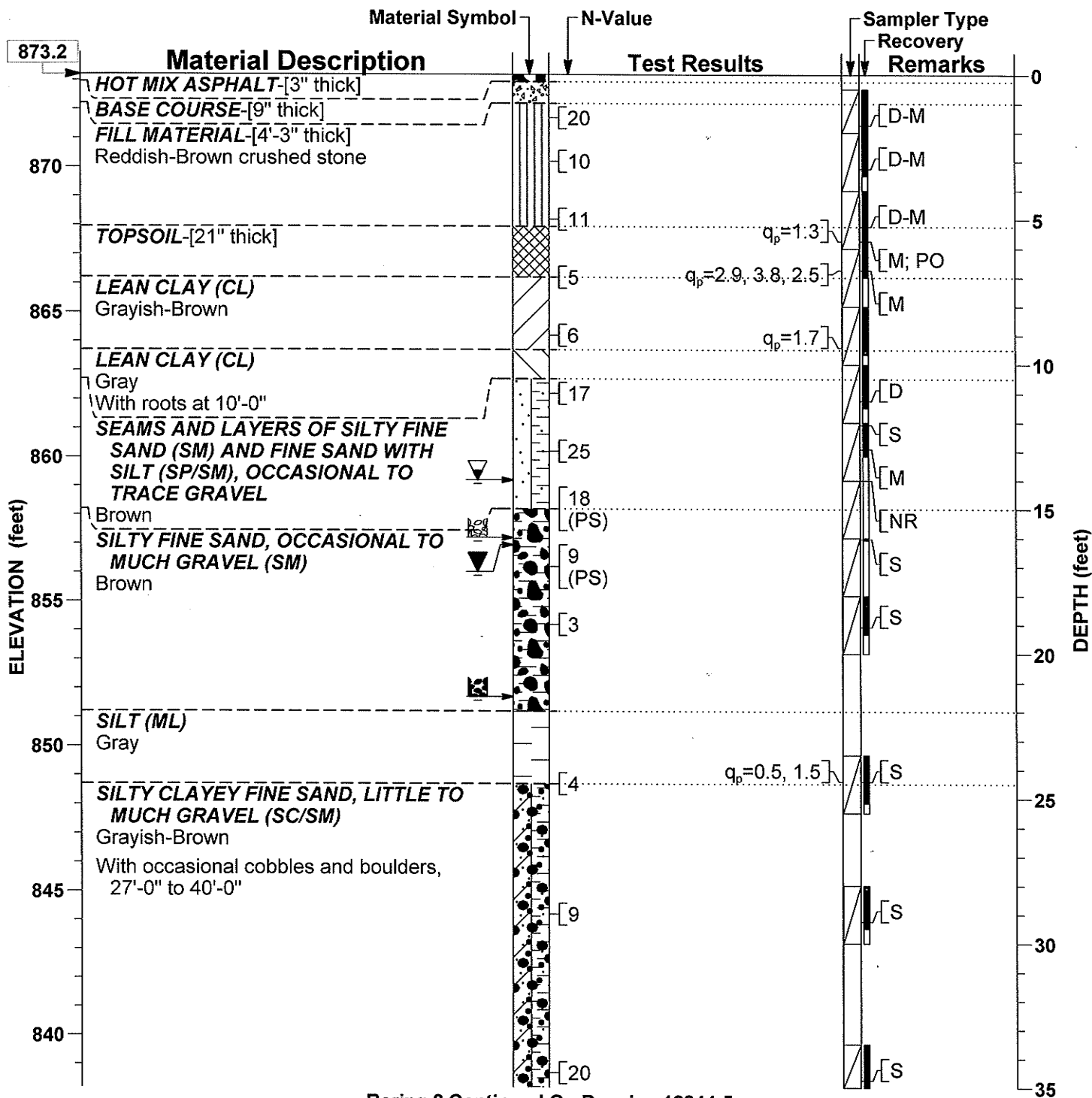
For Notes and Legend, see Drawing 12844-1.

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For Notes and Legend, see Drawing 12844-1.

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Boring 2 Continued On Drawing 12844-5

WATER LEVEL LEGEND

- ▽ 14'-0" at 1 1/2 hours
- ▽ 16'-3" at completion

OTHER LEVEL LEGEND

- [Symbol] (caved) 16'-0" at 1 1/2 hours
- [Symbol] (caved) 21'-6" at completion

For Notes and Legend, see Drawing 12844-1.

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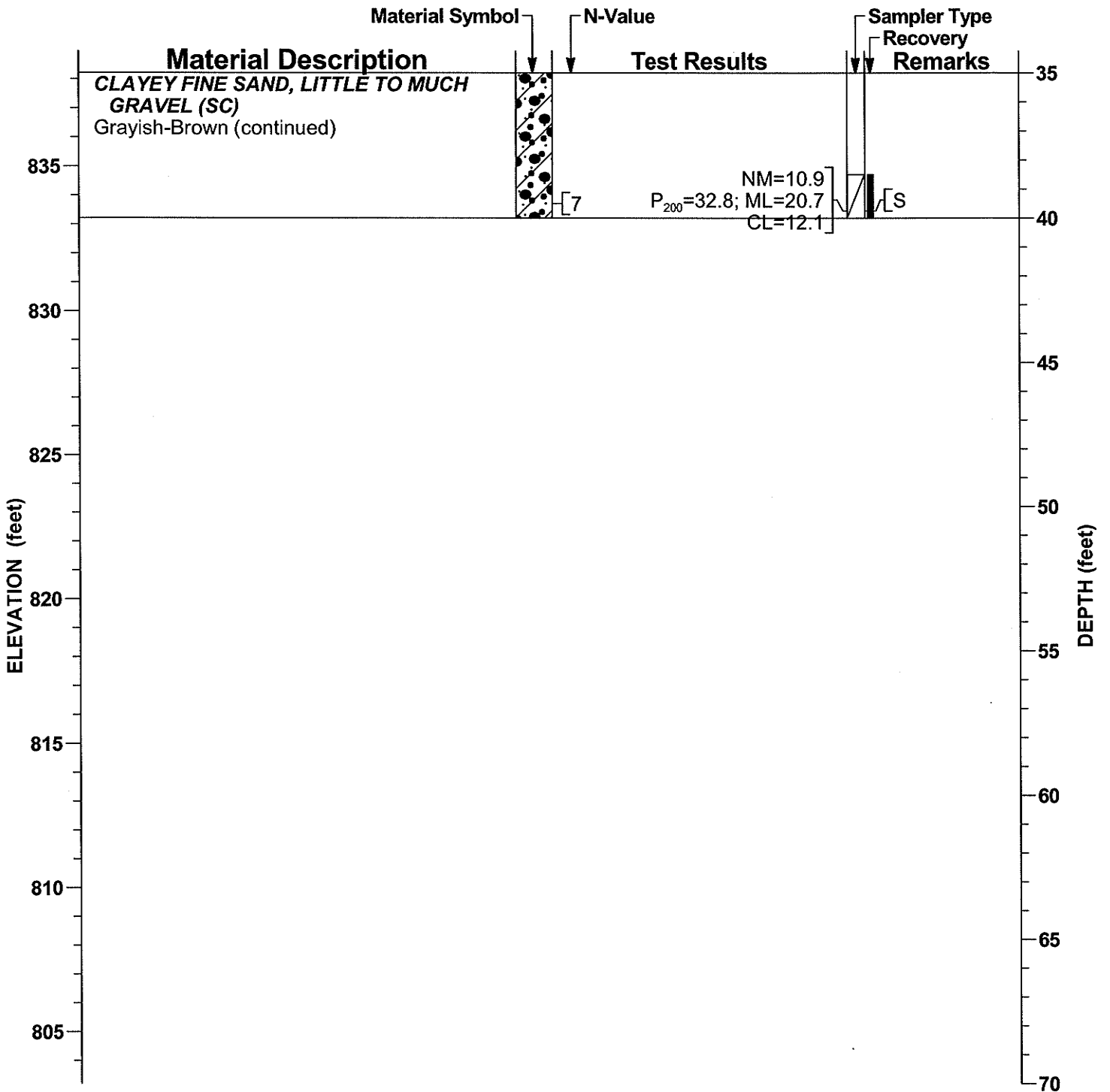
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SOIL BORING RECORD


New Waste Transfer Station
 Rodefild Landfill
 7102 US Highway 12
 Dane County, Wisconsin

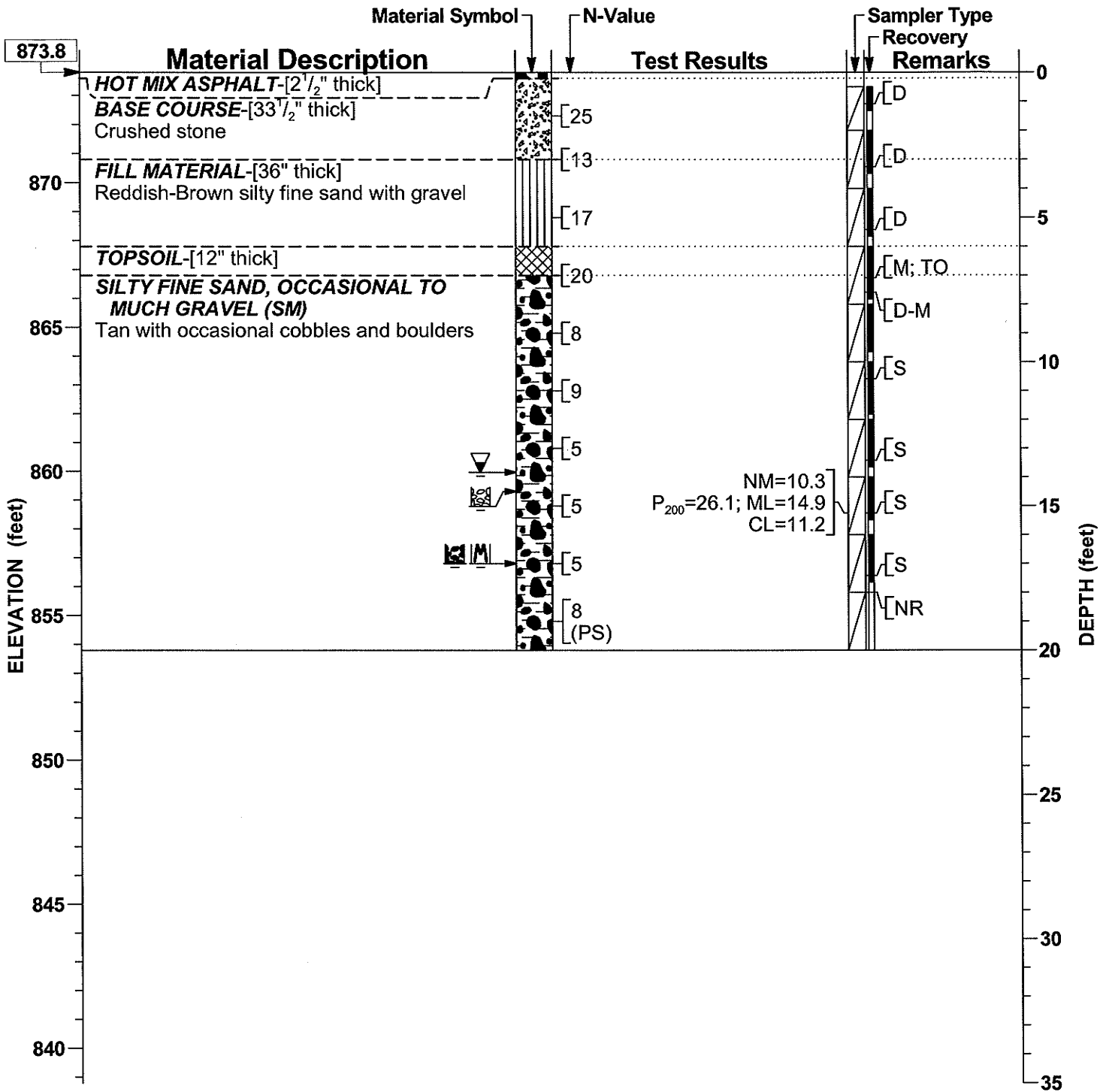


DRAWING
 12844-4



For Notes and Legend, see Drawing 12844-1.

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WATER LEVEL LEGEND

▽ 13'-10" at 6 hours

Moist 17'-0" at completion

OTHER LEVEL LEGEND

(caved) 14'-6" at 6 hours

(caved) 17'-0" at completion

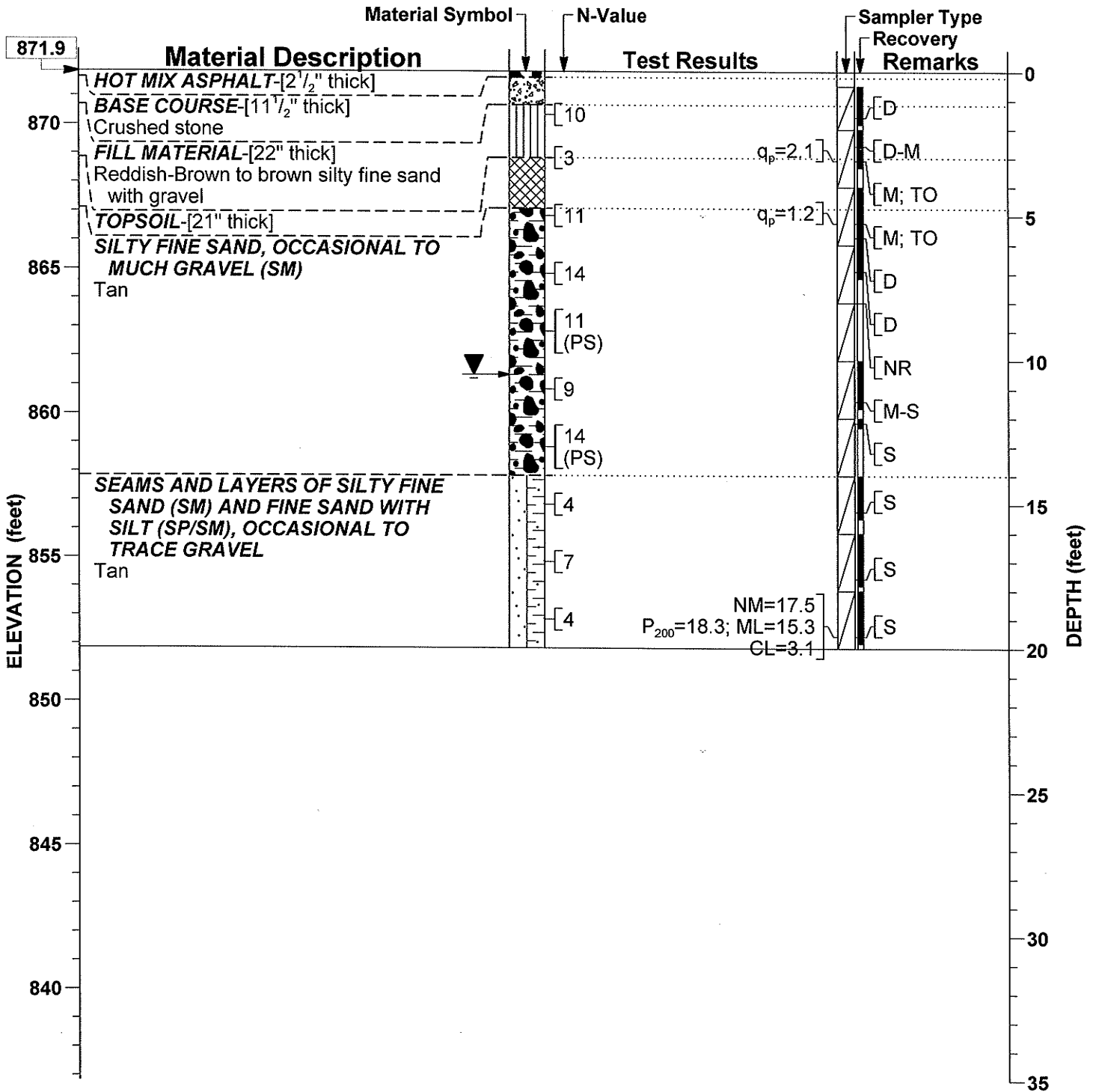
For Notes and Legend, see Drawing 12844-1.

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SOIL BORING RECORD
 New Waste Transfer Station
 Rodefild Landfill
 7102 US Highway 12
 Dane County, Wisconsin

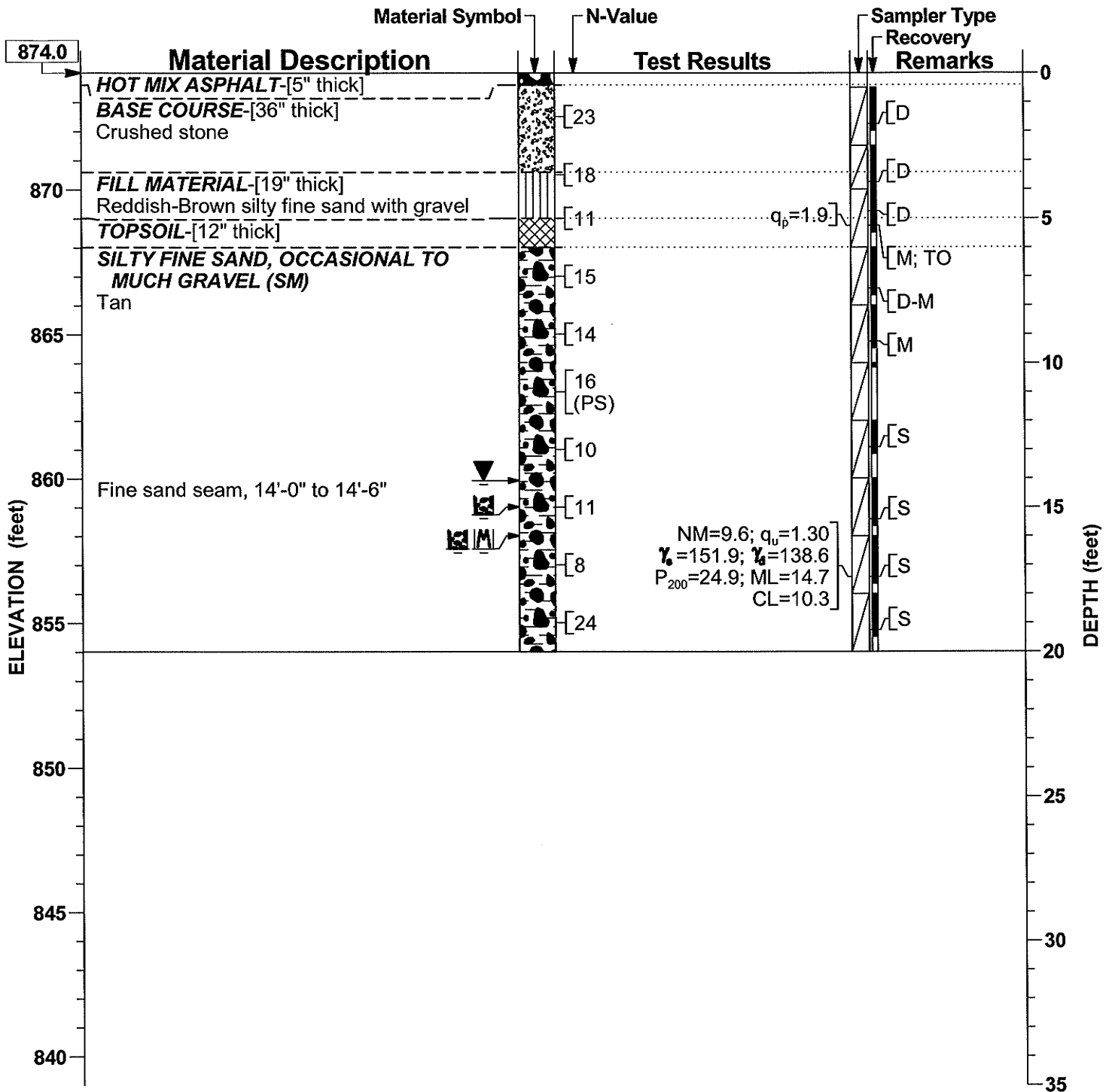
DRAWING
 12844-6

Revised on 1/8/2010



For Notes and Legend, see Drawing 12844-1.

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WATER LEVEL LEGEND

▼ 14'-1" at 5 hours


Moist 16'-0" at completion

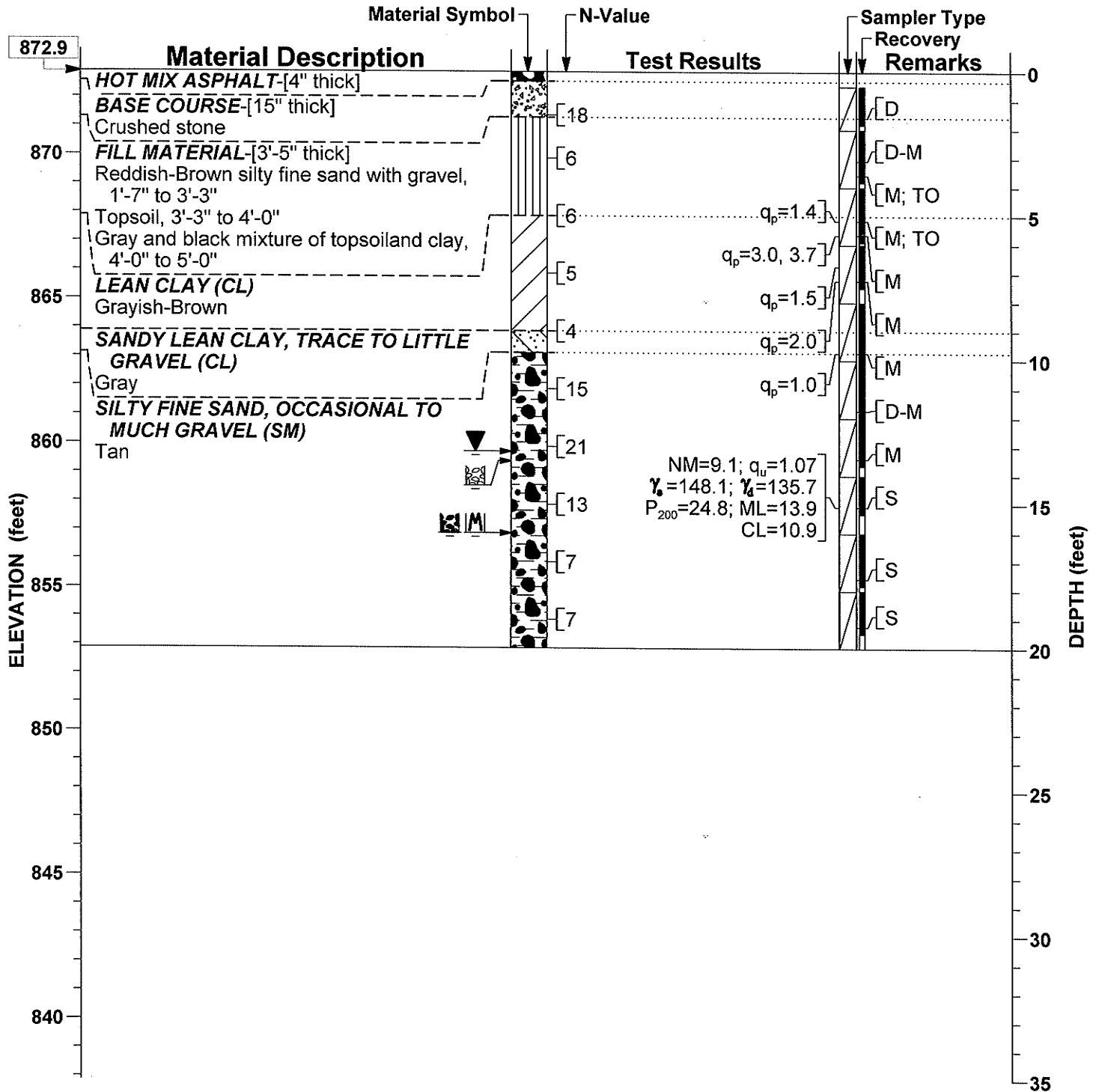
OTHER LEVEL LEGEND

(caved) 15'-0" at 5 hours

(caved) 16'-0" at completion

For Notes and Legend, see Drawing 12844-1.


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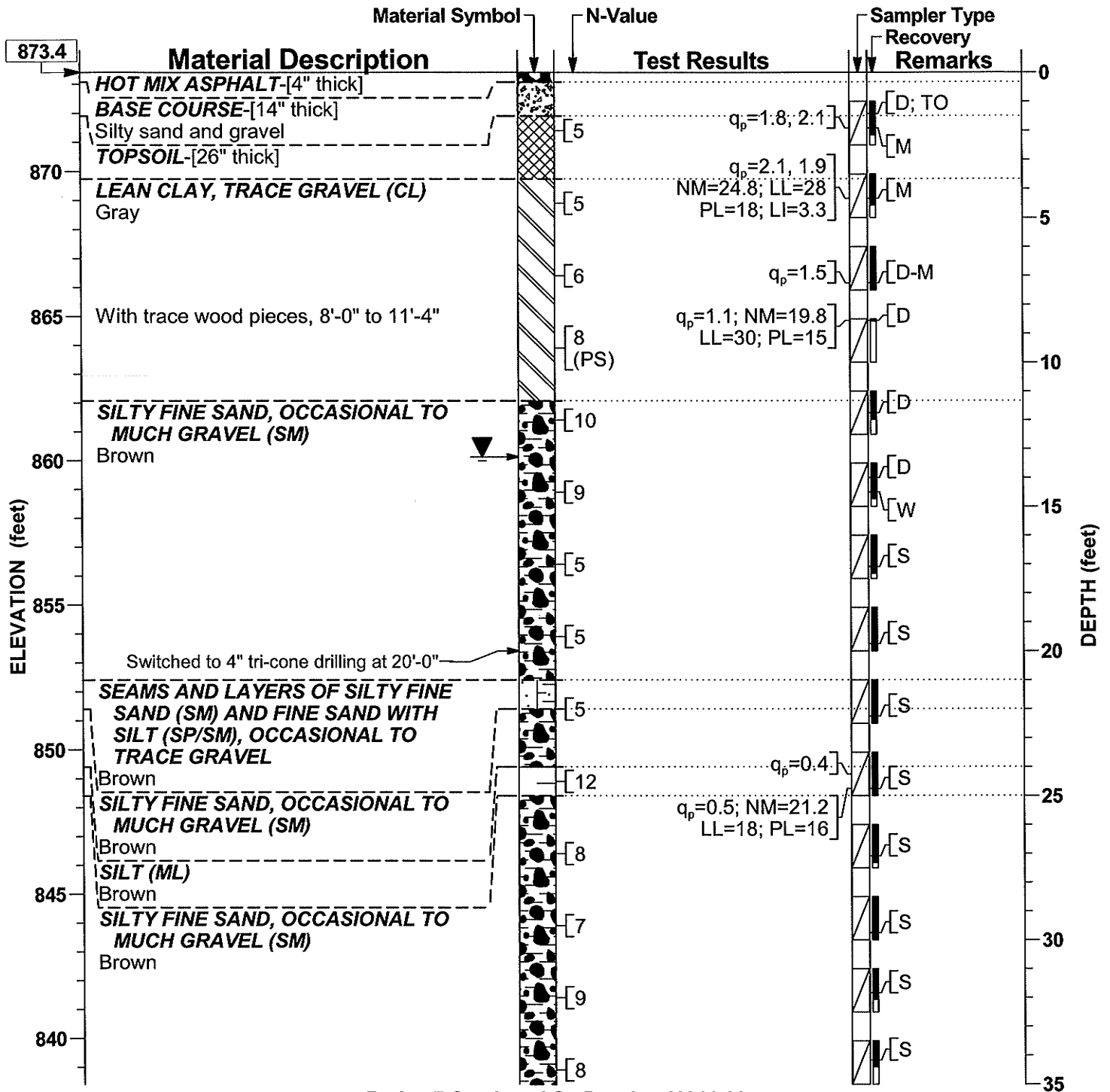
WATER LEVEL LEGEND
 ▼ 13'-2" at 3 1/2 hours
 [Symbol] Moist 16'-0" at completion

OTHER LEVEL LEGEND
 [Symbol] (caved) 13'-6" at 3 1/2 hours
 [Symbol] (caved) 16'-0" at completion

For Notes and Legend, see Drawing 12844-1.

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Revised on 1/14/2010

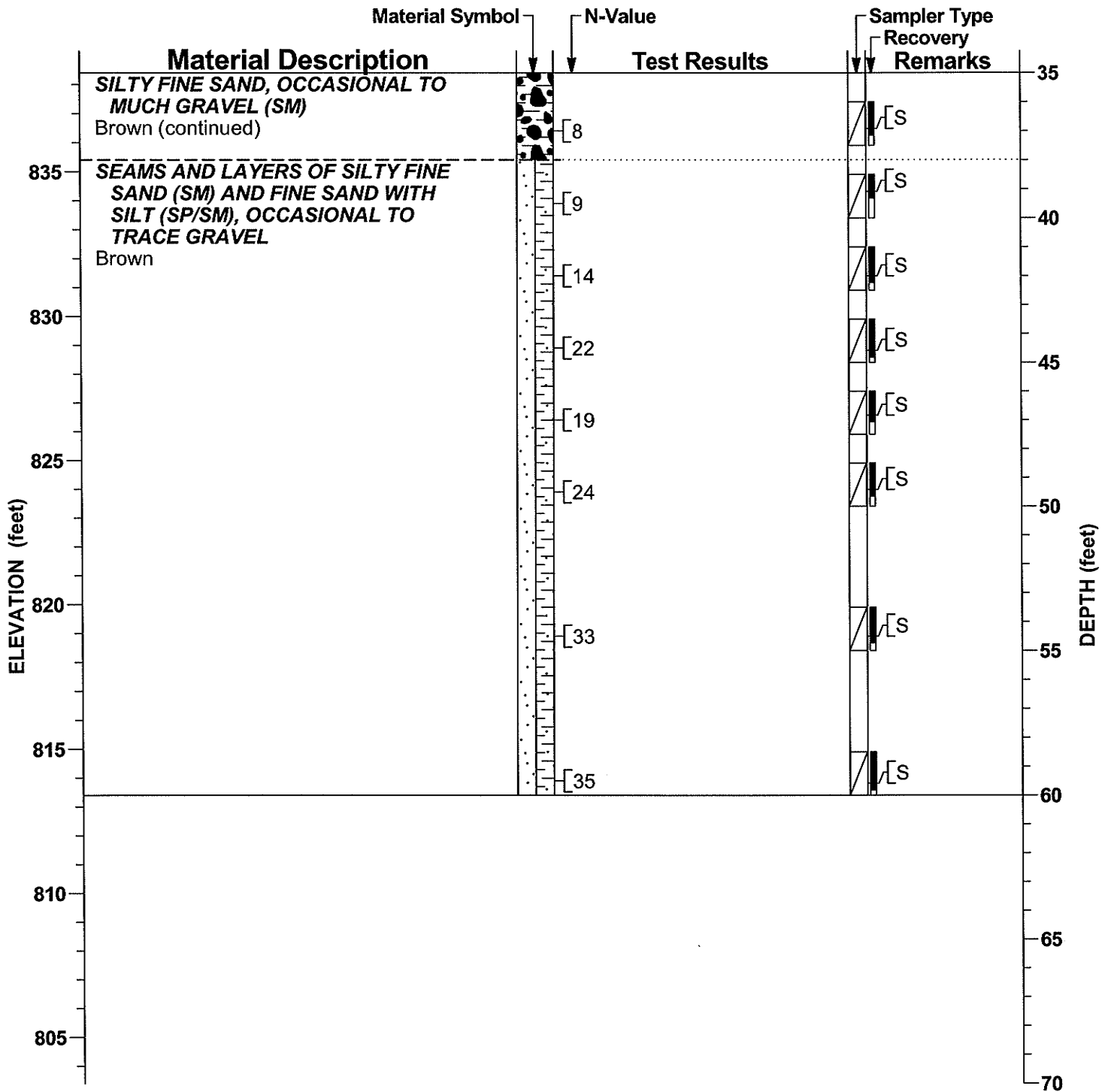


Boring 7 Continued On Drawing 12844-11


WATER LEVEL LEGEND
 ▽ 13'-3³/₈" (estimated)

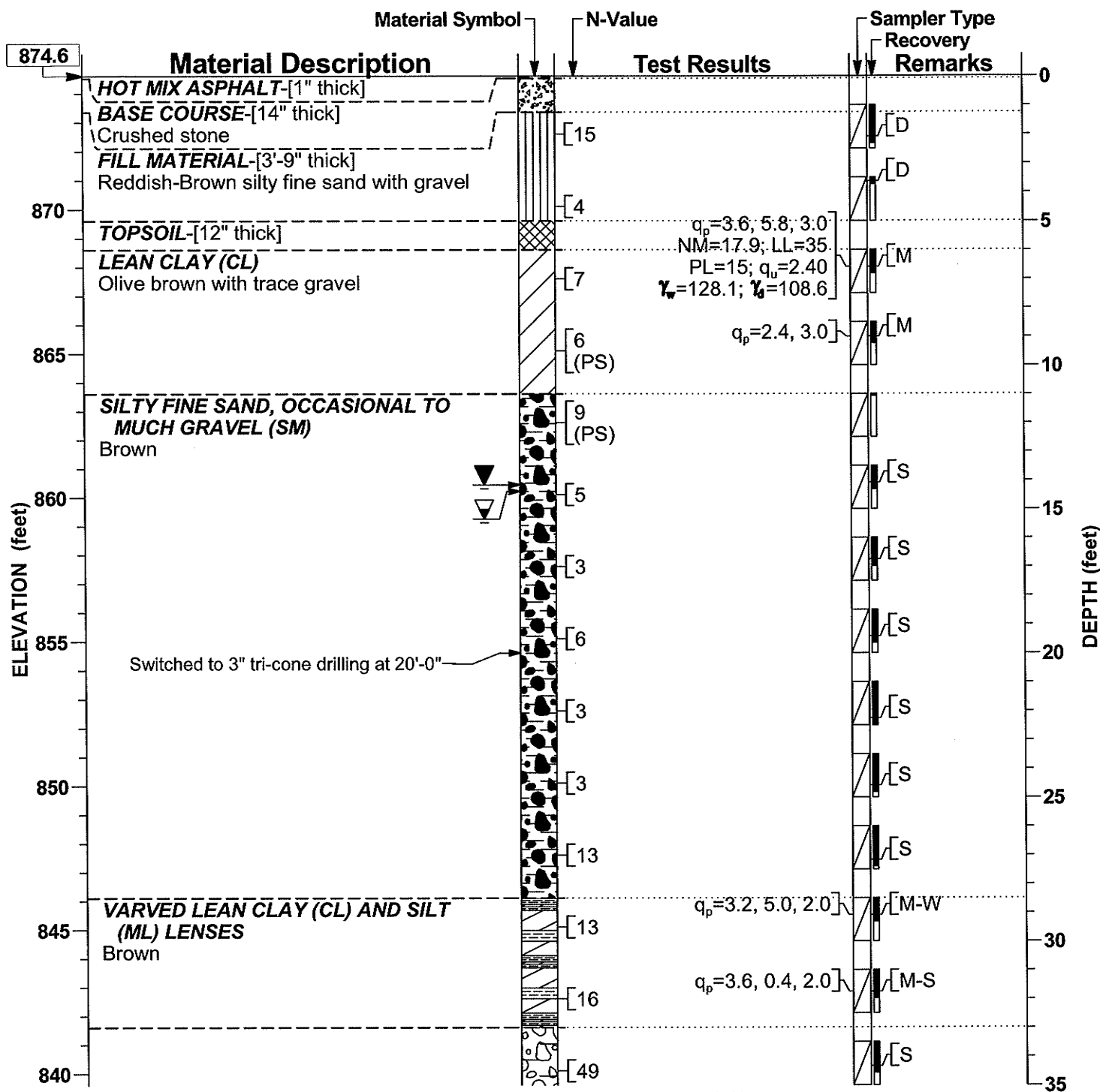
For Notes and Legend, see Drawing 12844-1.

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For Notes and Legend, see Drawing 12844-1.

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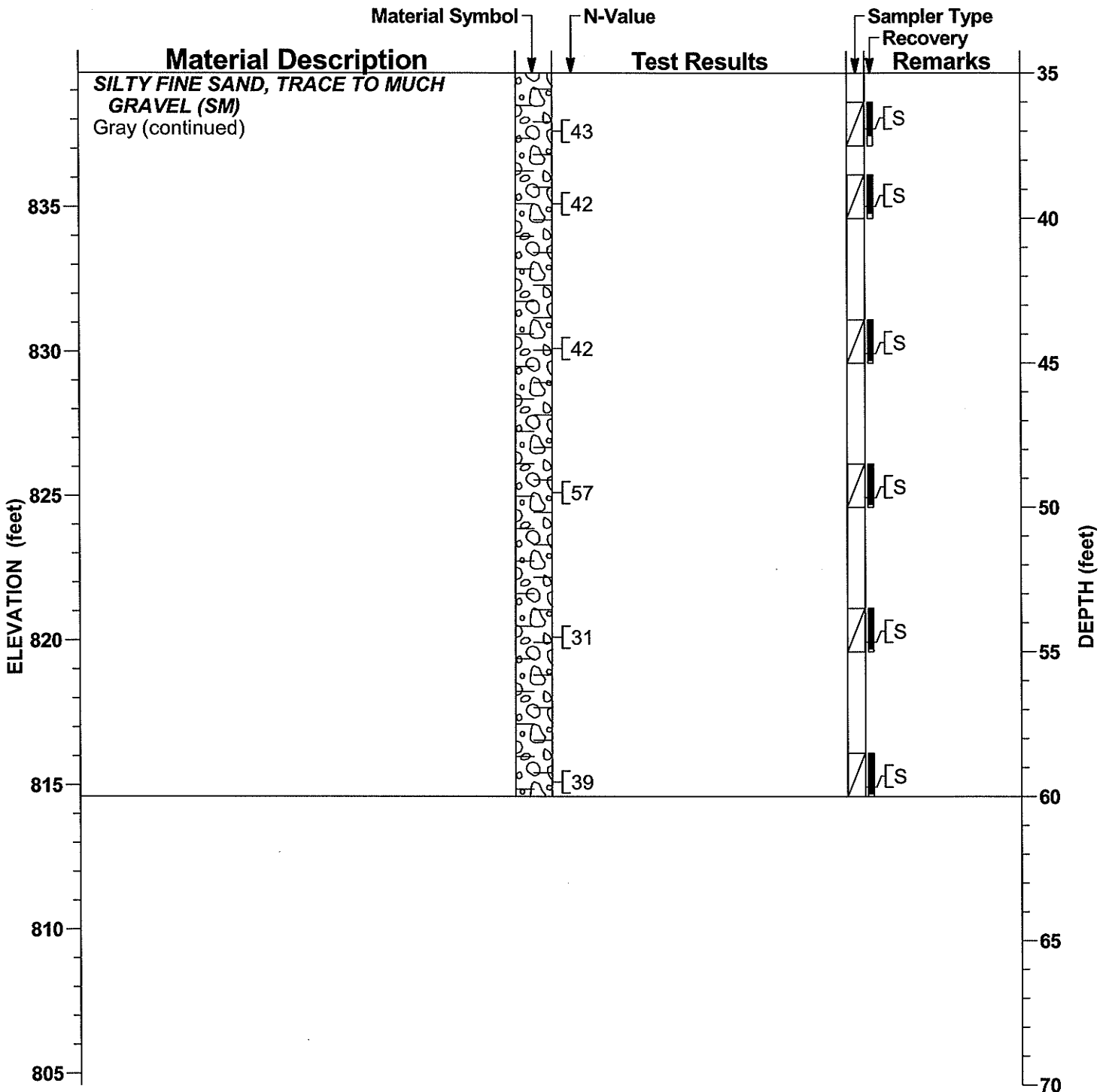
Boring 8 Continued On Drawing 12844-13

WATER LEVEL LEGEND


- ▼ 14'-2" at completion
- ▼ 14'-4^{3/4}" (estimated)

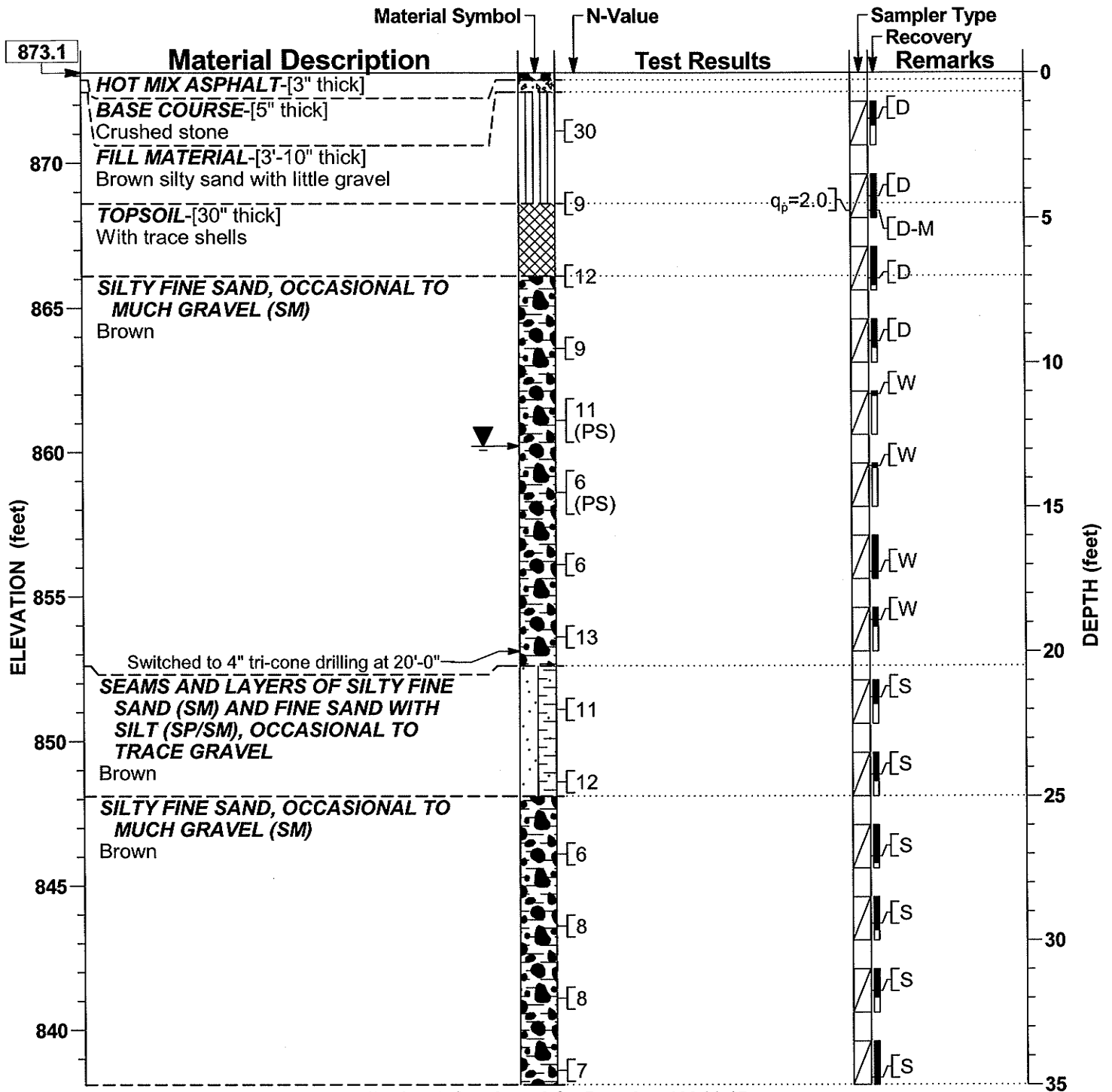
For Notes and Legend, see Drawing 12844-1.

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For Notes and Legend, see Drawing 12844-1.

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Boring 9 Continued On Drawing 12844-15

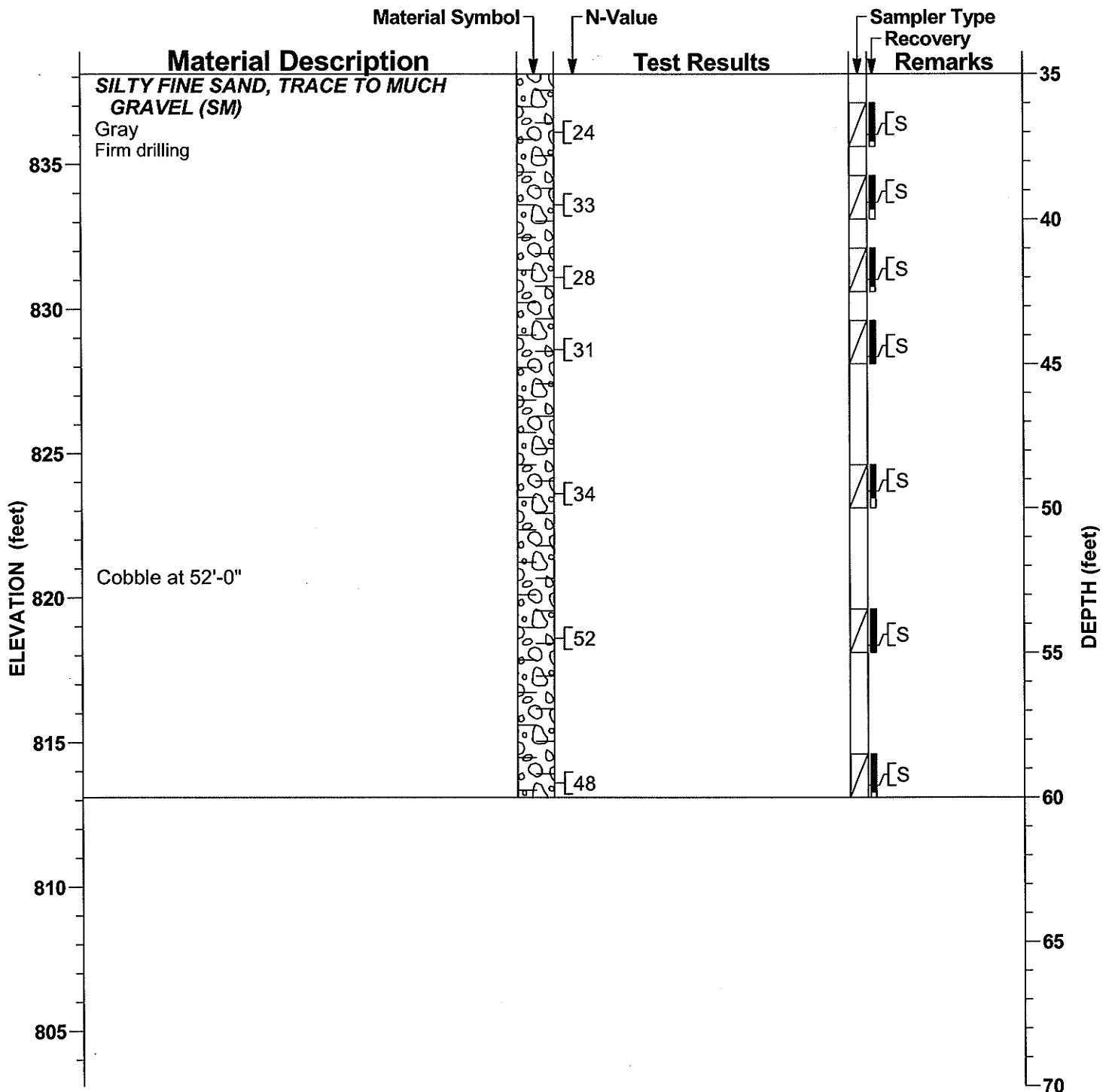
WATER LEVEL LEGEND

▼ 12'-10³/₄" (estimated)

For Notes and Legend, see Drawing 12844-1.

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Revised on 1/8/2010



For Notes and Legend, see Drawing 12844-1.

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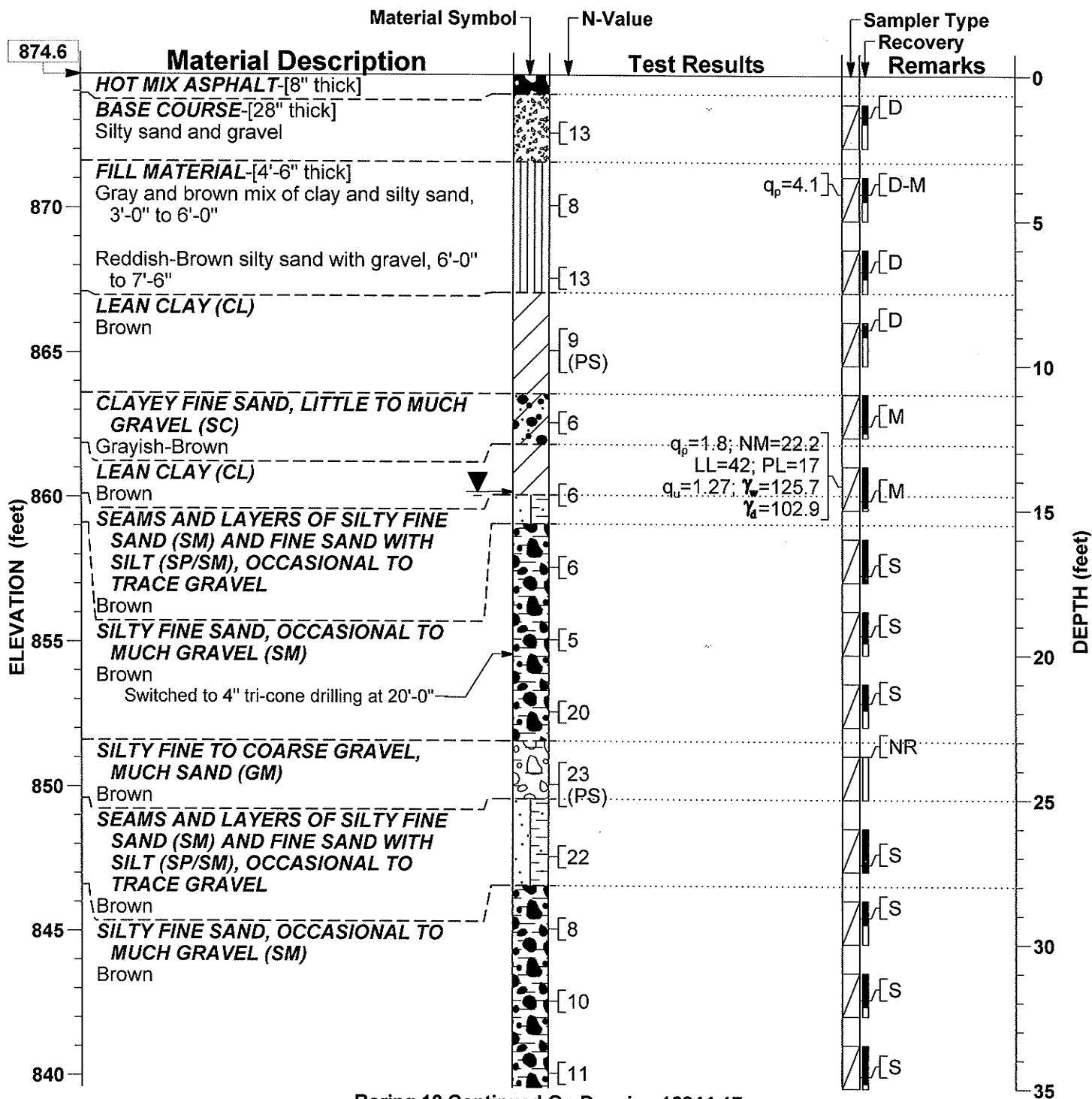
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SOIL BORING RECORD
 New Waste Transfer Station
 Rodefild Landfill
 7102 US Highway 12
 Dane County, Wisconsin



DRAWING
 12844-15



Boring 10 Continued On Drawing 12844-17

WATER LEVEL LEGEND

▼ 14'-4 3/4" (estimated)

For Notes and Legend, see Drawing 12844-1.

Soils & Engineering Services, Inc.

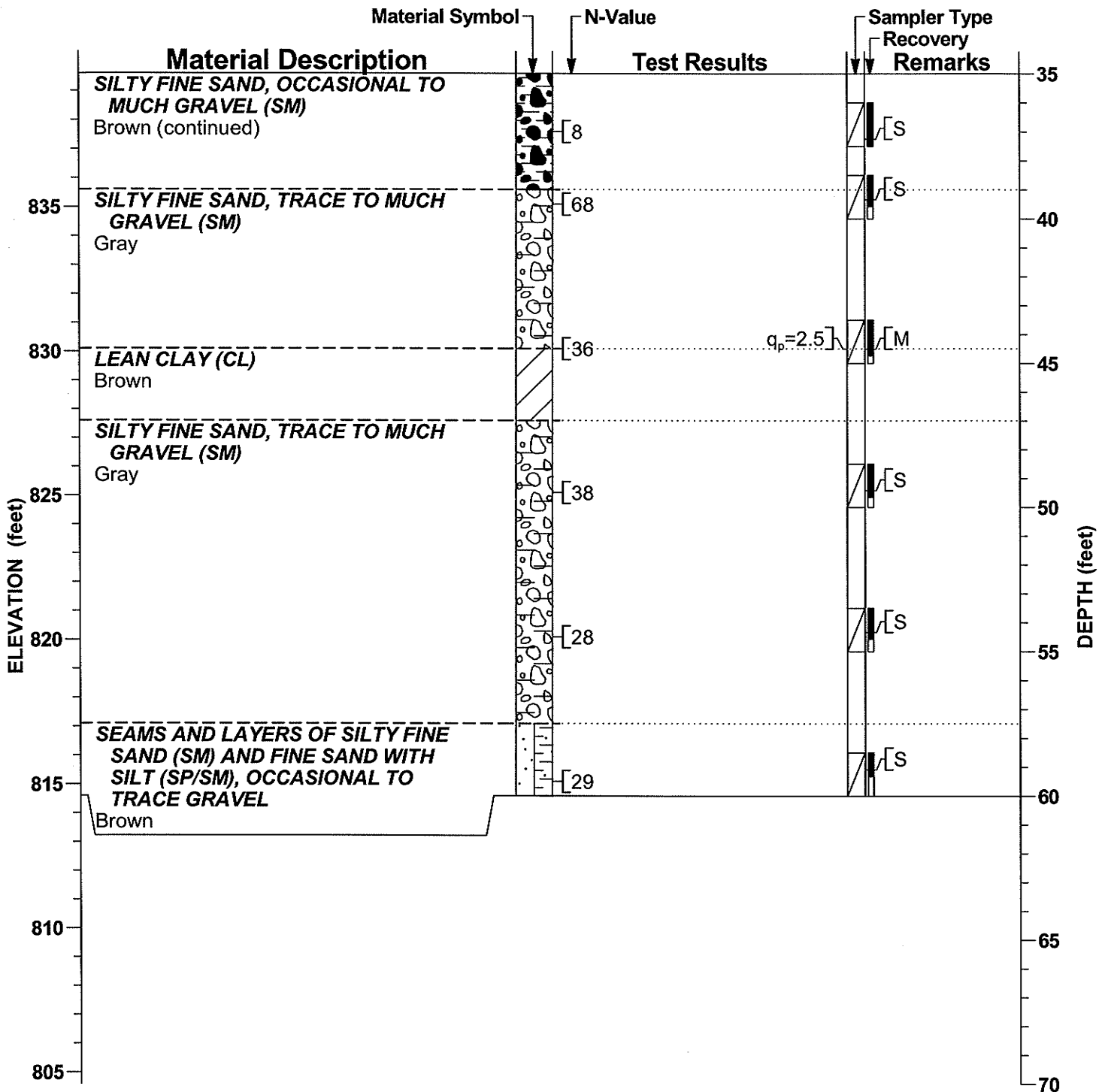
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CONSULTING CIVIL ENGINEERS SINCE 1966


SOIL BORING RECORD
 New Waste Transfer Station
 Rodefald Landfill
 7102 US Highway 12
 Dane County, Wisconsin



DRAWING
 12844-16



For Notes and Legend, see Drawing 12844-1.

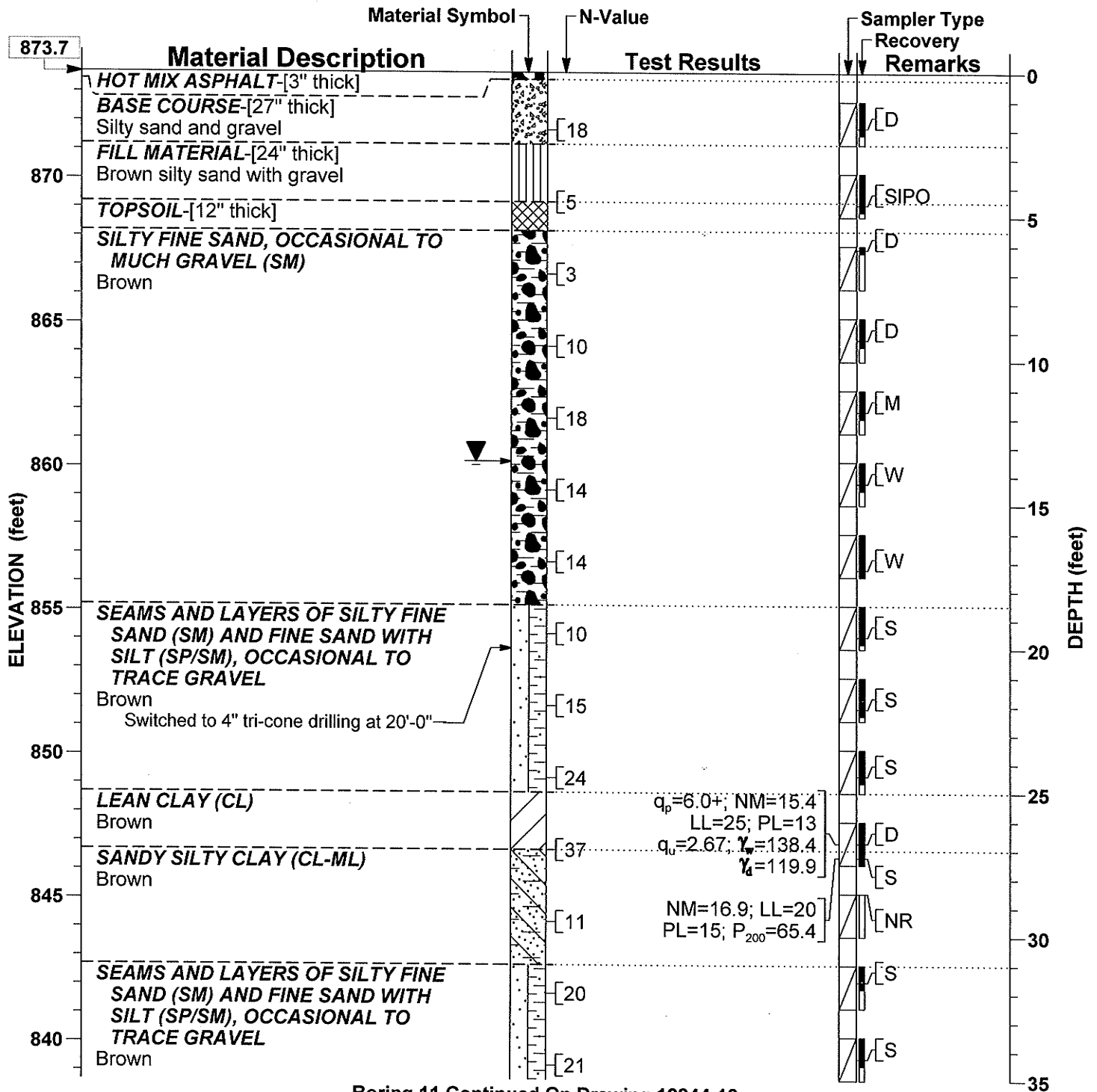
<p>Soils & Engineering Services, Inc. 1102 STEWART STREET • MADISON, WISCONSIN 53713 Phone: 608-274-7600 • 888-866-SOIL (7645) Fax: 608-274-7511 • Email: soils@soils.ws CONSULTING CIVIL ENGINEERS SINCE 1966</p>	<p>SOIL BORING RECORD New Waste Transfer Station Rodefild Landfill 7102 US Highway 12 Dane County, Wisconsin</p>	 DRAWING 12844-17
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Location: (N472573, E853277)

Boring 11

Completed December 15, 2009

Total Depth = 60'-0" (Page 1/2)



Boring 11 Continued On Drawing 12844-19

WATER LEVEL LEGEND

▼ 13'-6" (estimated)

For Notes and Legend, see Drawing 12844-1.

Soils & Engineering Services, Inc.

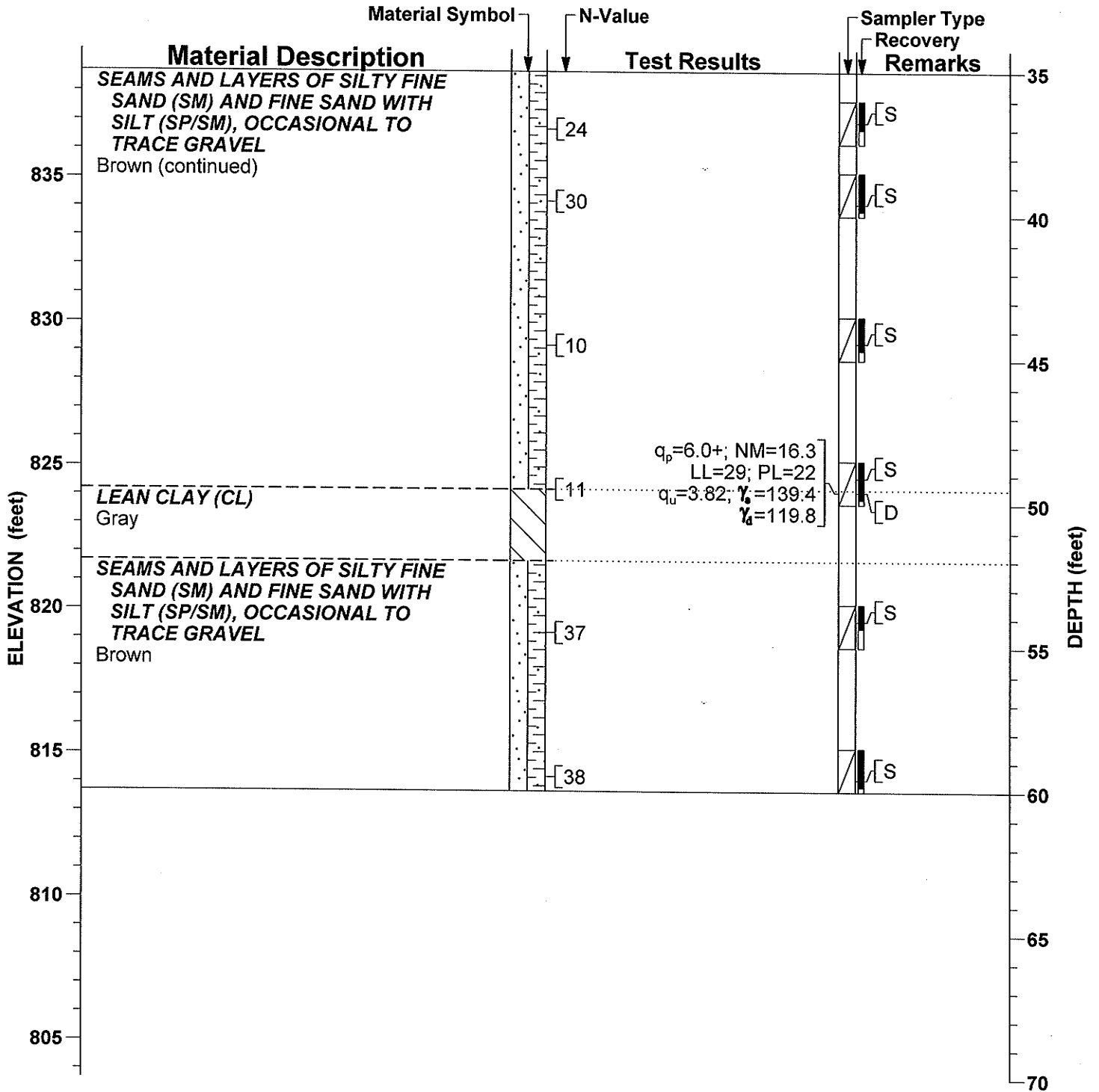
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CONSULTING CIVIL ENGINEERS SINCE 1966


SOIL BORING RECORD
 New Waste Transfer Station
 Rodefeld Landfill
 7102 US Highway 12
 Dane County, Wisconsin



DRAWING
12844-18



For Notes and Legend, see Drawing 12844-1.

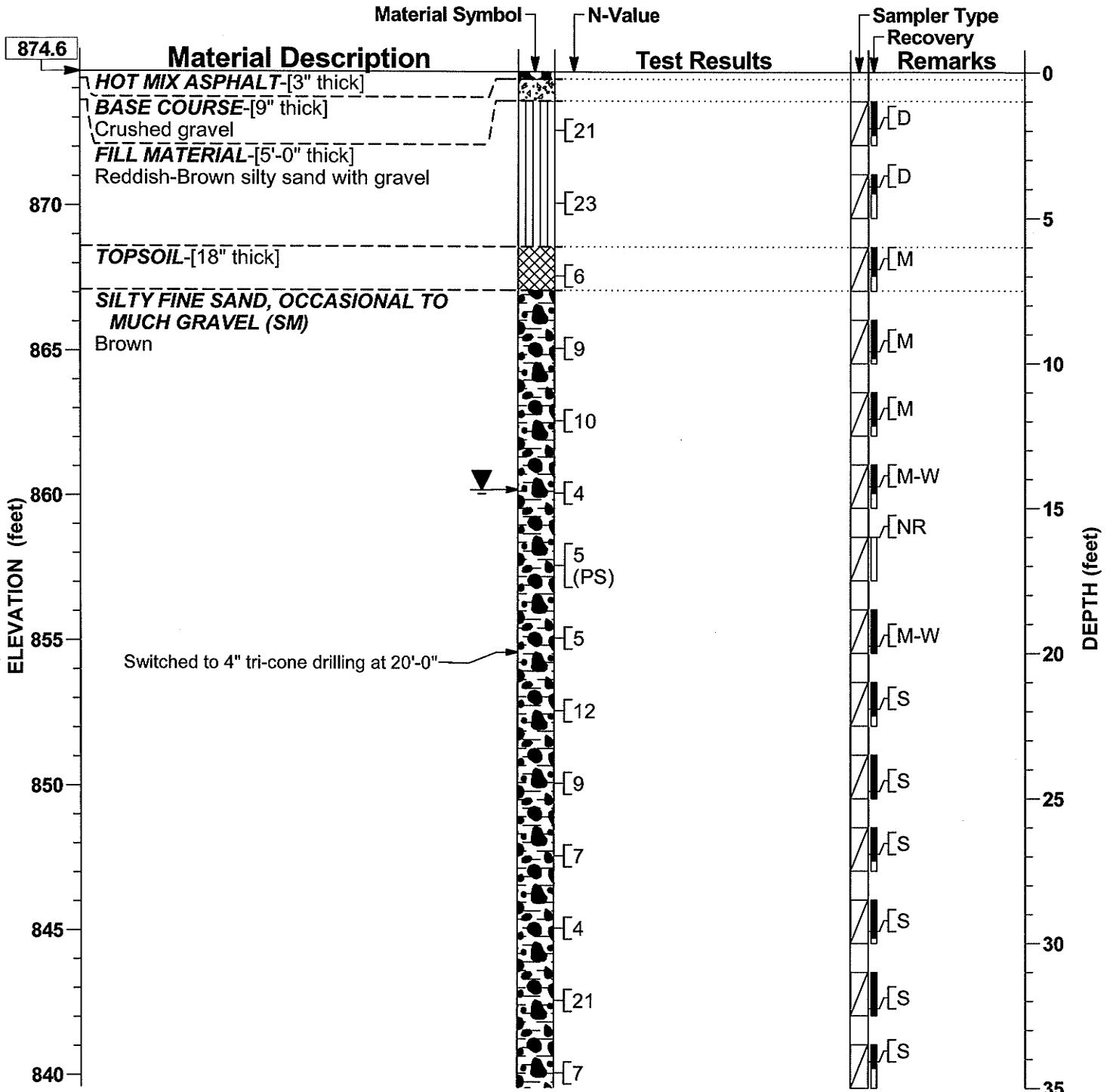
<p>Soils & Engineering Services, Inc. 1102 STEWART STREET • MADISON, WISCONSIN 53713 Phone: 608-274-7600 • 888-866-SOIL (7645) Fax: 608-274-7511 • Email: soils@soils.ws CONSULTING CIVIL ENGINEERS SINCE 1966</p>	<p>SOIL BORING RECORD New Waste Transfer Station Rodefeld Landfill 7102 US Highway 12 Dane County, Wisconsin</p>	 DRAWING 12844-19
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Location: (N472636, E853418)

Boring 12

Completed December 7, 2009

Total Depth = 60'-0" (Page 1/2)




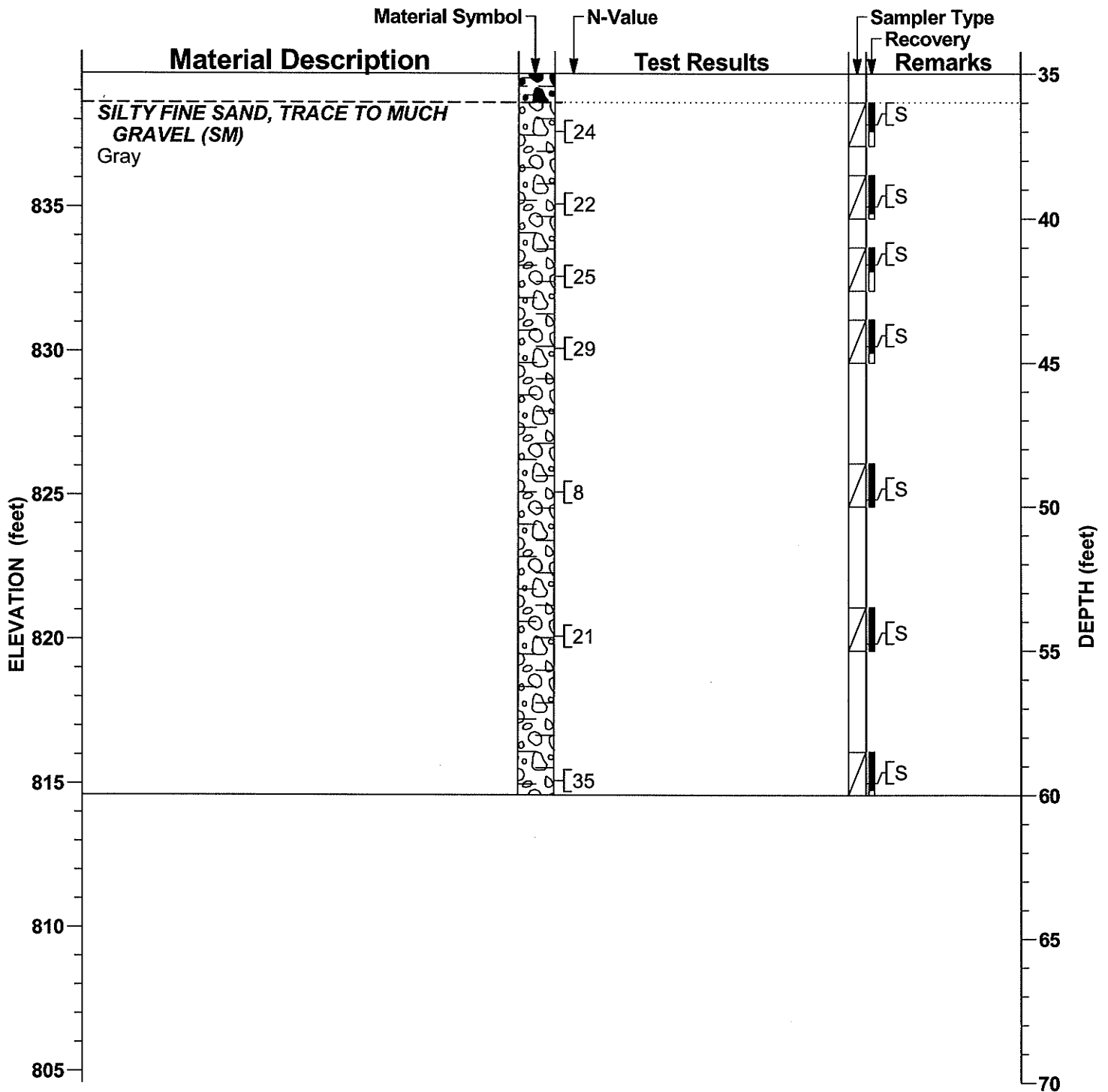
Boring 12 Continued On Drawing 12844-21

WATER LEVEL LEGEND

▼ 14'-4³/₄" (estimated)

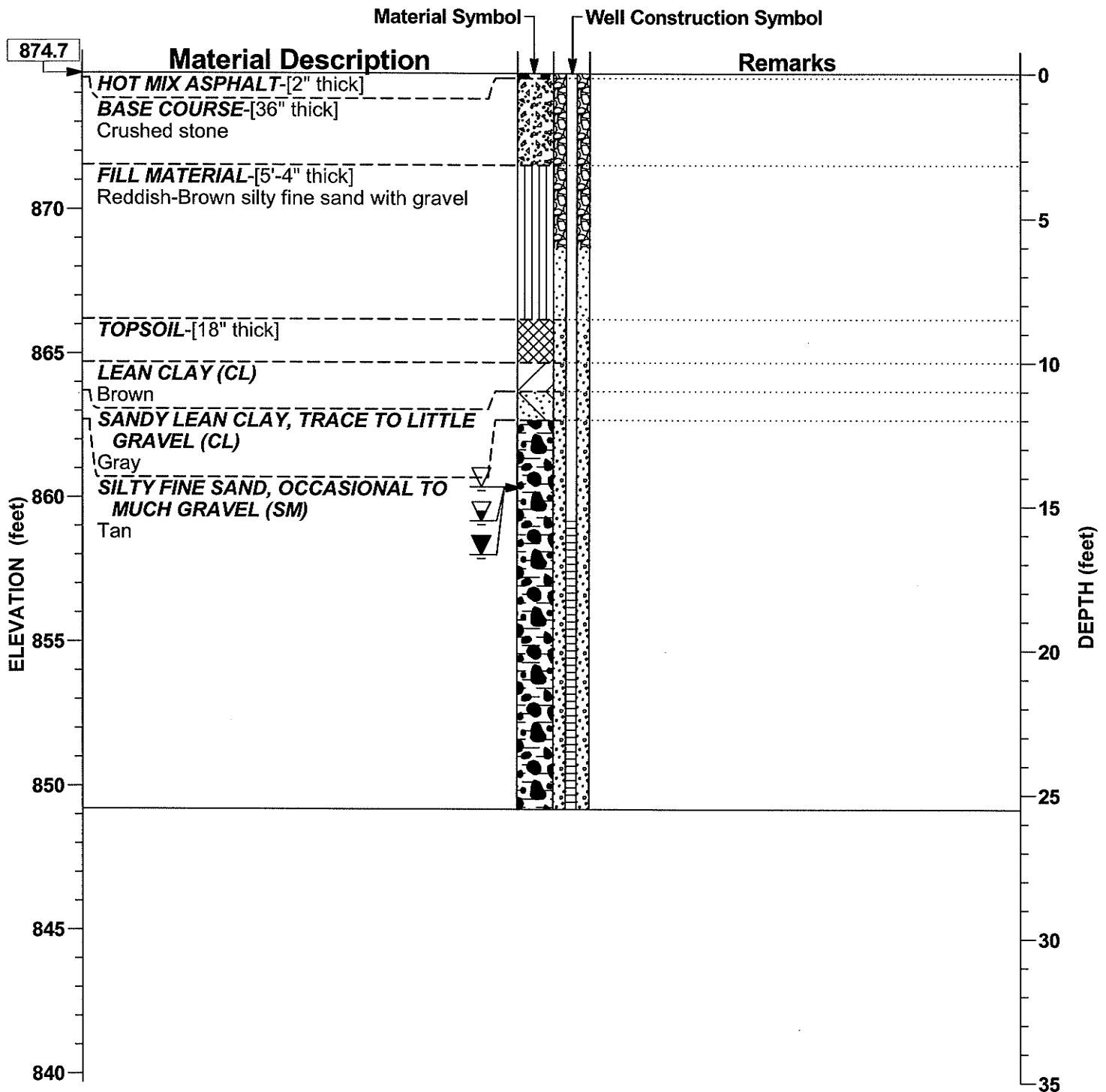
For Notes and Legend, see Drawing 12844-1.

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For Notes and Legend, see Drawing 12844-1.

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WATER LEVEL LEGEND

- ▽ 14'-3⁷/₈" at 7 days
- ▽ 14'-4¹/₄" at 48 hours
- ▽ 14'-4³/₄" at 24 hours

NOTE: Installed temporary 1"-diameter PVC screen and riser in borehole. Well removed on December 22, 2009.

For Notes and Legend, see Drawing 12844-1.

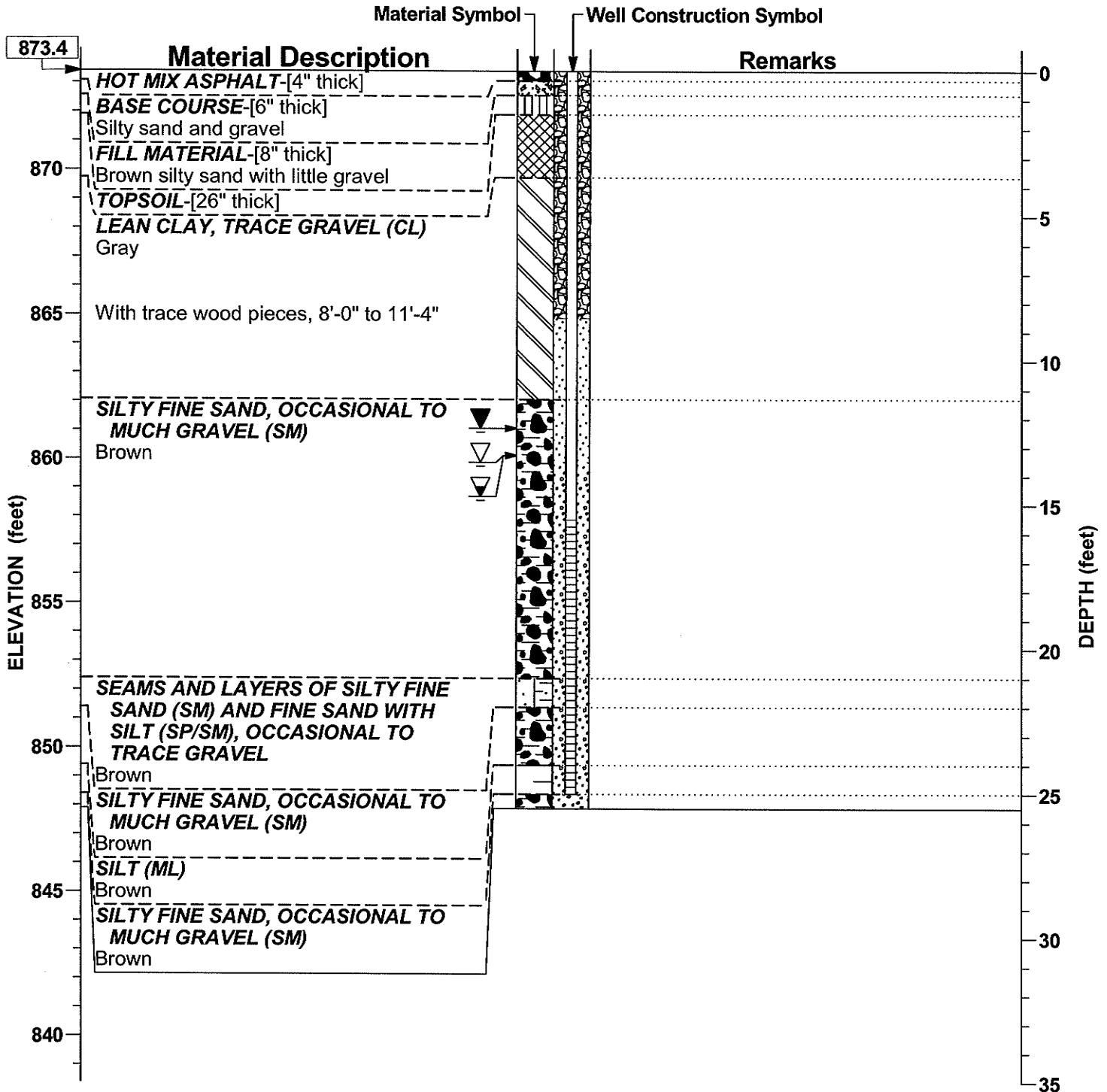
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WATER LEVEL LEGEND

▽	12'-4 ¹ / ₈ " at 24 hours
▽	13'-3 ³ / ₈ " at 7 days
▽	13'-3 ¹ / ₂ " at 48 hours

NOTE: Installed temporary 1"-diameter PVC screen and riser in borehole. Well removed on December 22, 2009.

For Notes and Legend, see Drawing 12844-1.

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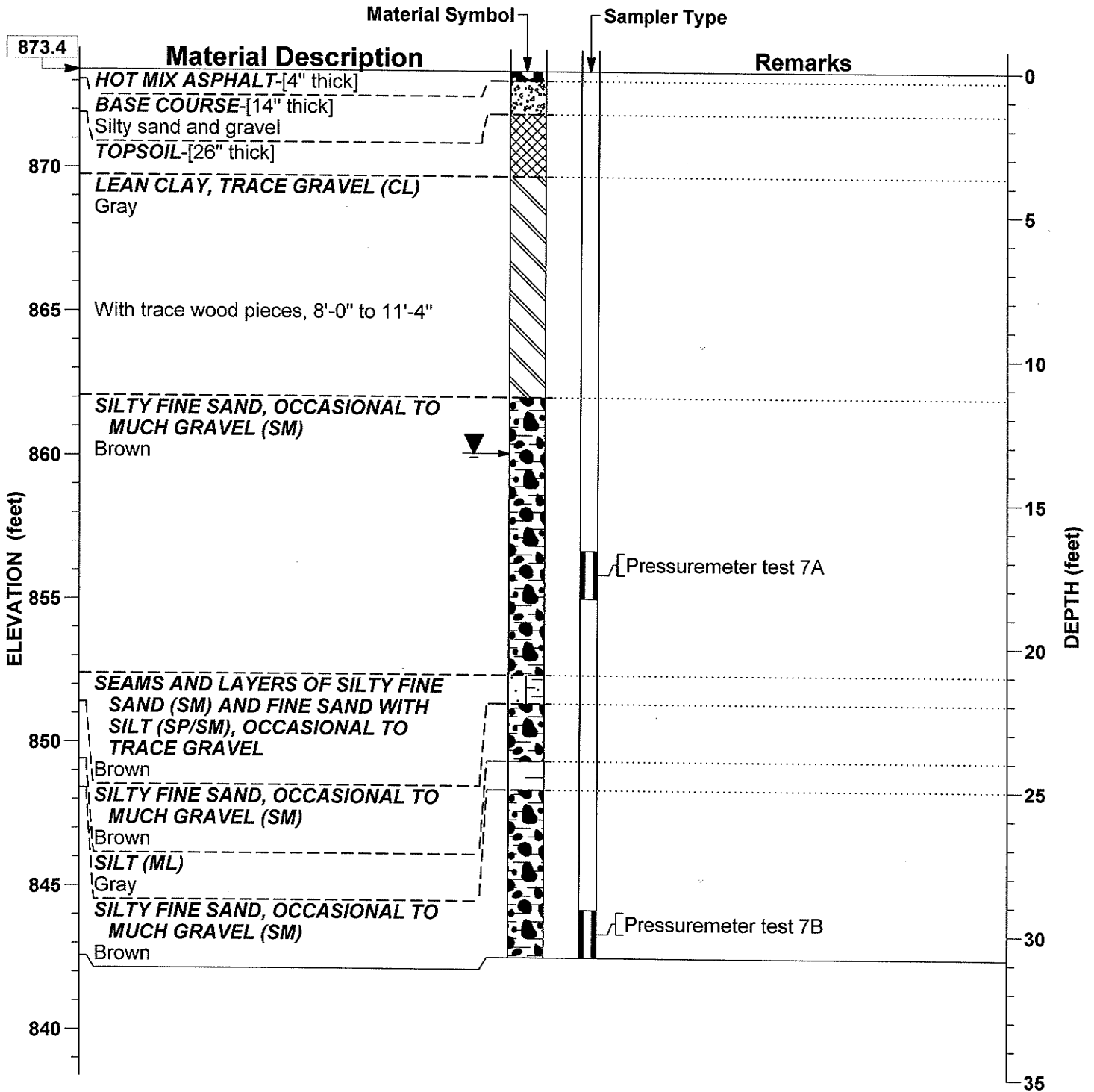
DRAWING
 12844-23

Auger Boring PM7

Completed December 16, 2009

Total Depth = 30'-10" (Page 1/1)

Location: (N472759, E853278)



WATER LEVEL LEGEND

▼ 13'-3³/₈" (estimated)

For Notes and Legend, see Drawing 12844-1.

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AUGER BORING RECORD
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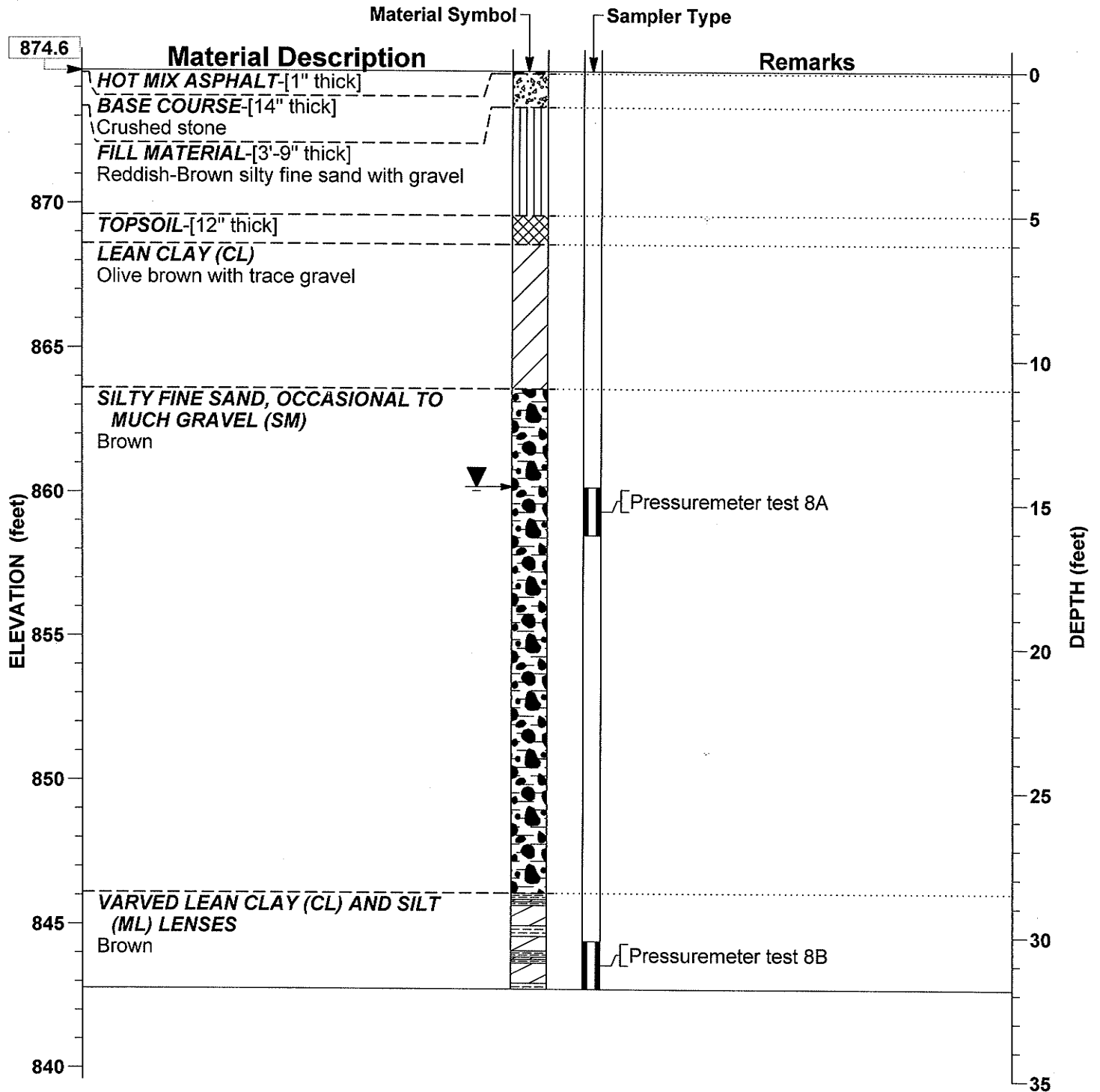
DRAWING
 12844-24

Auger Boring PM8

Completed December 7, 2009

Total Depth = 31'-10" (Page 1/1)

Location: (N472777, E853404)



WATER LEVEL LEGEND

▼ 14'-4³/₄" (estimated)

For Notes and Legend, see Drawing 12844-1.

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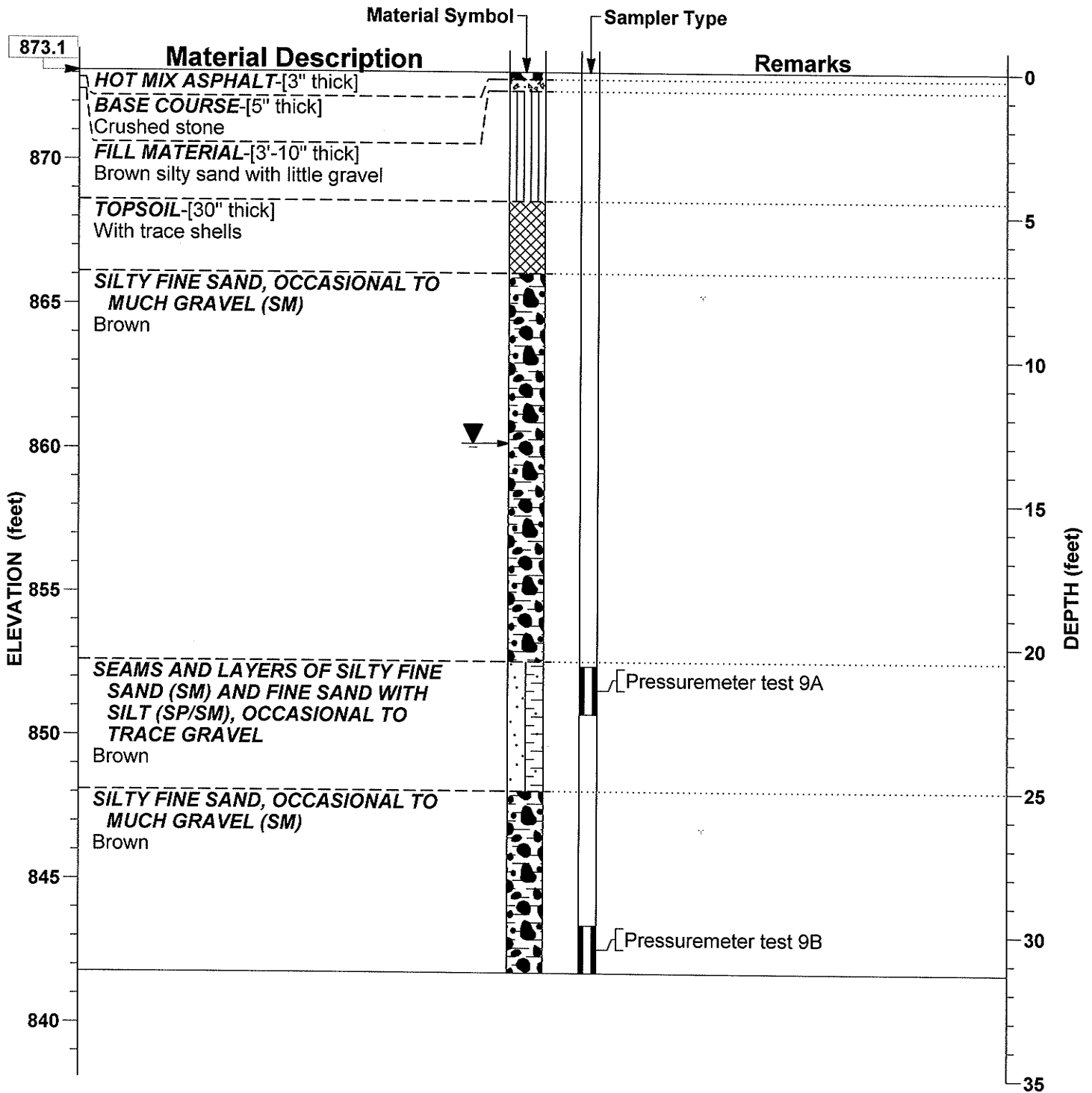
DRAWING
 12844-25

Location: (N472677, E853309)

Auger Boring PM9

Completed December 14, 2009

Total Depth = 31'-4" (Page 1/1)



WATER LEVEL LEGEND

▼ 12'-10³/₄" (estimated)

For Notes and Legend, see Drawing 12844-1.

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AUGER BORING RECORD
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Rodefild Landfill
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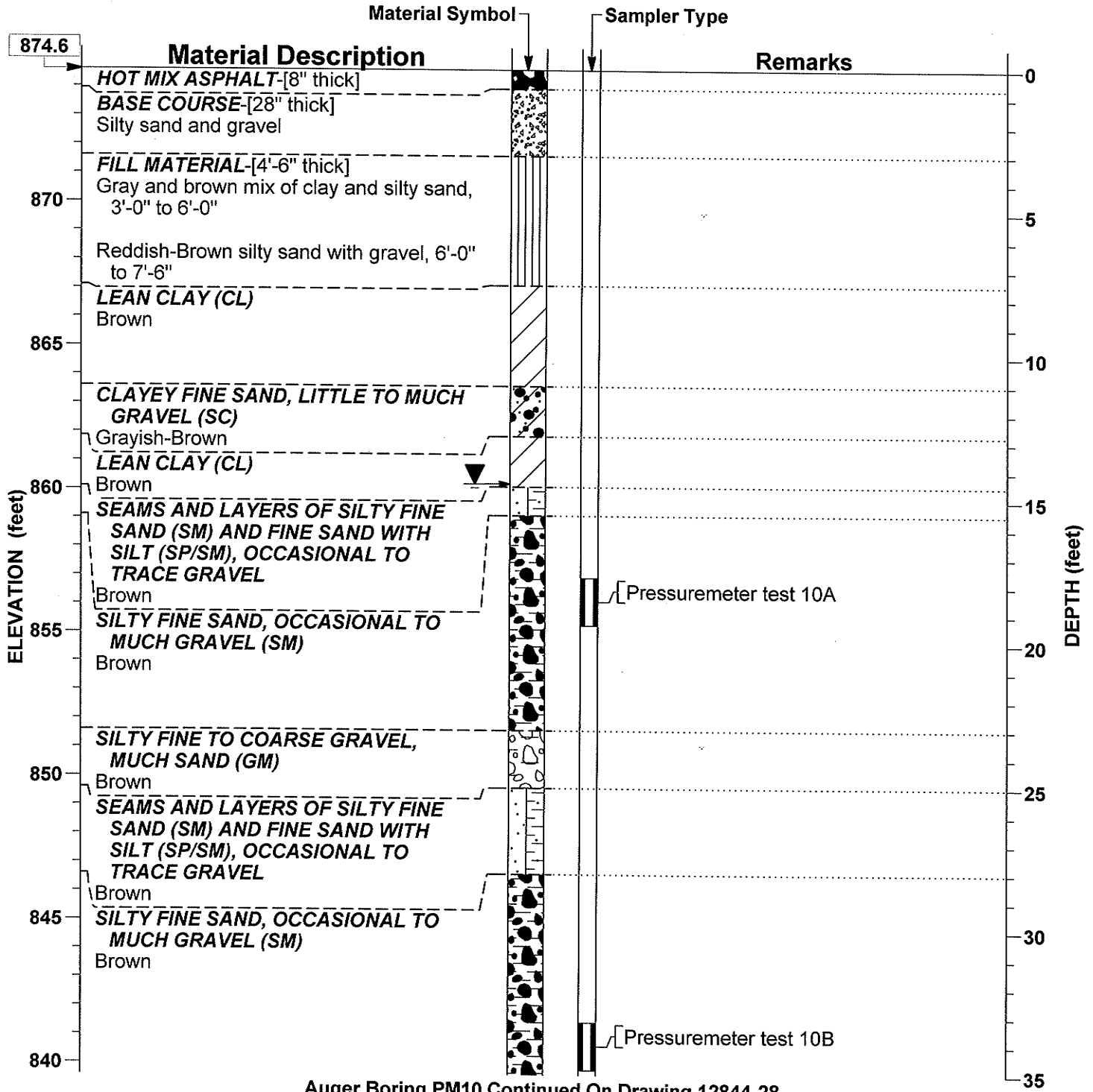
DRAWING
12844-26

Auger Boring PM10

Completed December 15, 2009

Total Depth = 40'-10" (Page 1/2)

Location: (N472724, E853413)




Auger Boring PM10 Continued On Drawing 12844-28

WATER LEVEL LEGEND

▼ 14'-4³/₄" (estimated)

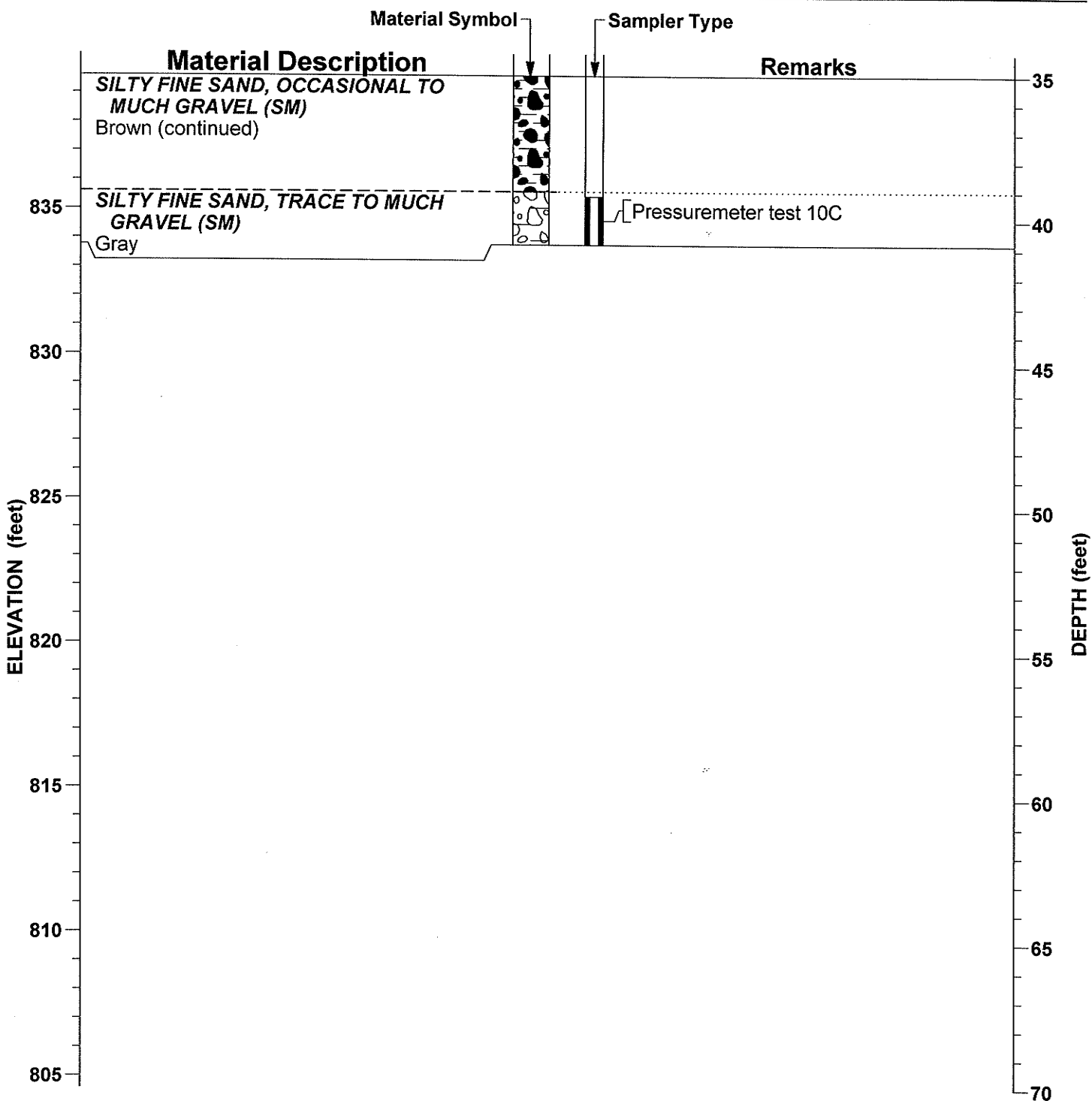
For Notes and Legend, see Drawing 12844-1.

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Auger Boring PM10

Completed December 15, 2009

Total Depth = 40'-10" (Page 2/2)



For Notes and Legend, see Drawing 12844-1.

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AUGER BORING RECORD
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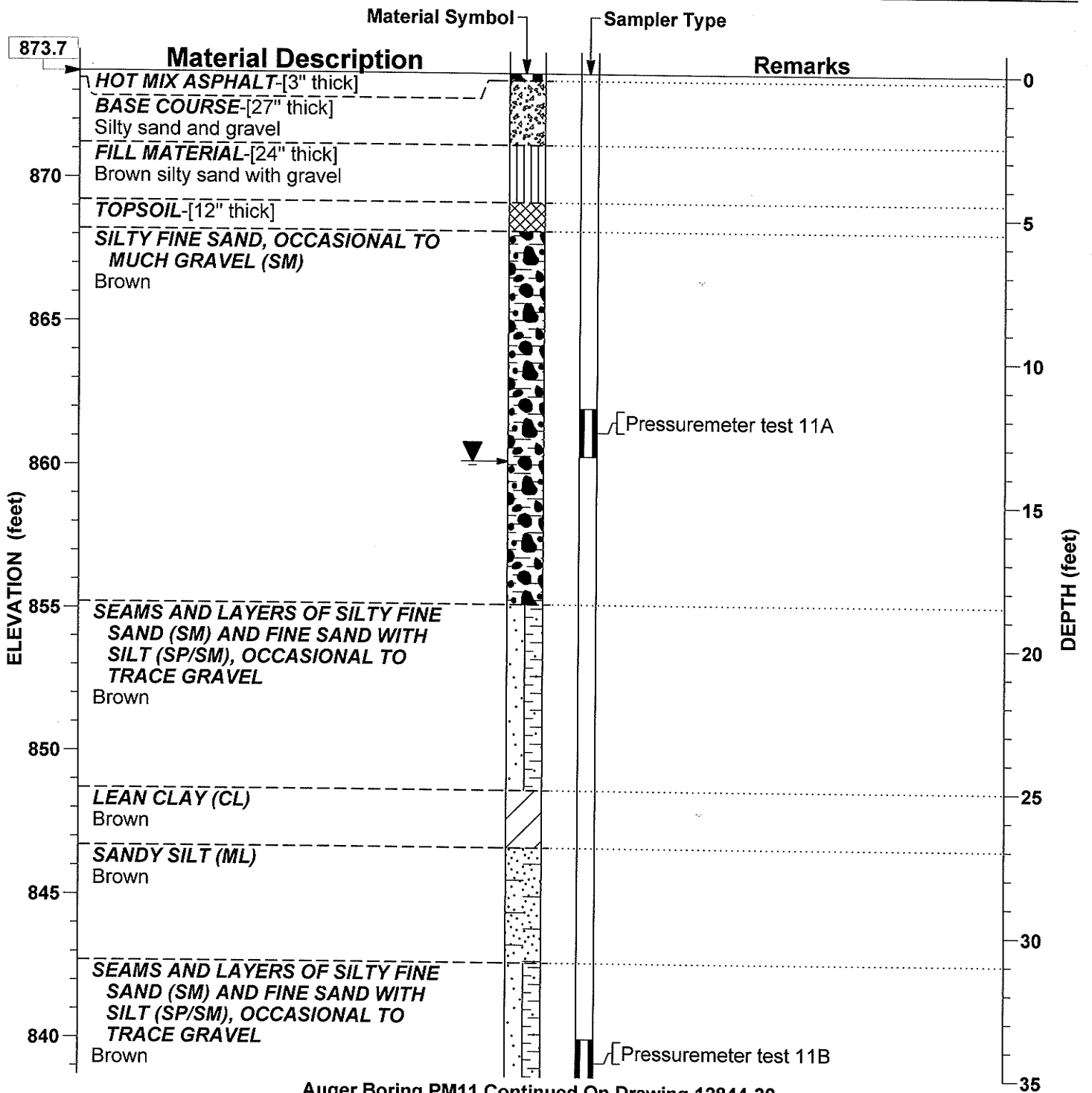
DRAWING
12844-28

Auger Boring PM11

Completed December 17, 2009

Total Depth = 35'-4" (Page 1/2)

Location: (N472573, E853272)



Auger Boring PM11 Continued On Drawing 12844-30

WATER LEVEL LEGEND

▼ 13'-6" (estimated)

For Notes and Legend, see Drawing 12844-1.

Soils & Engineering Services, Inc.

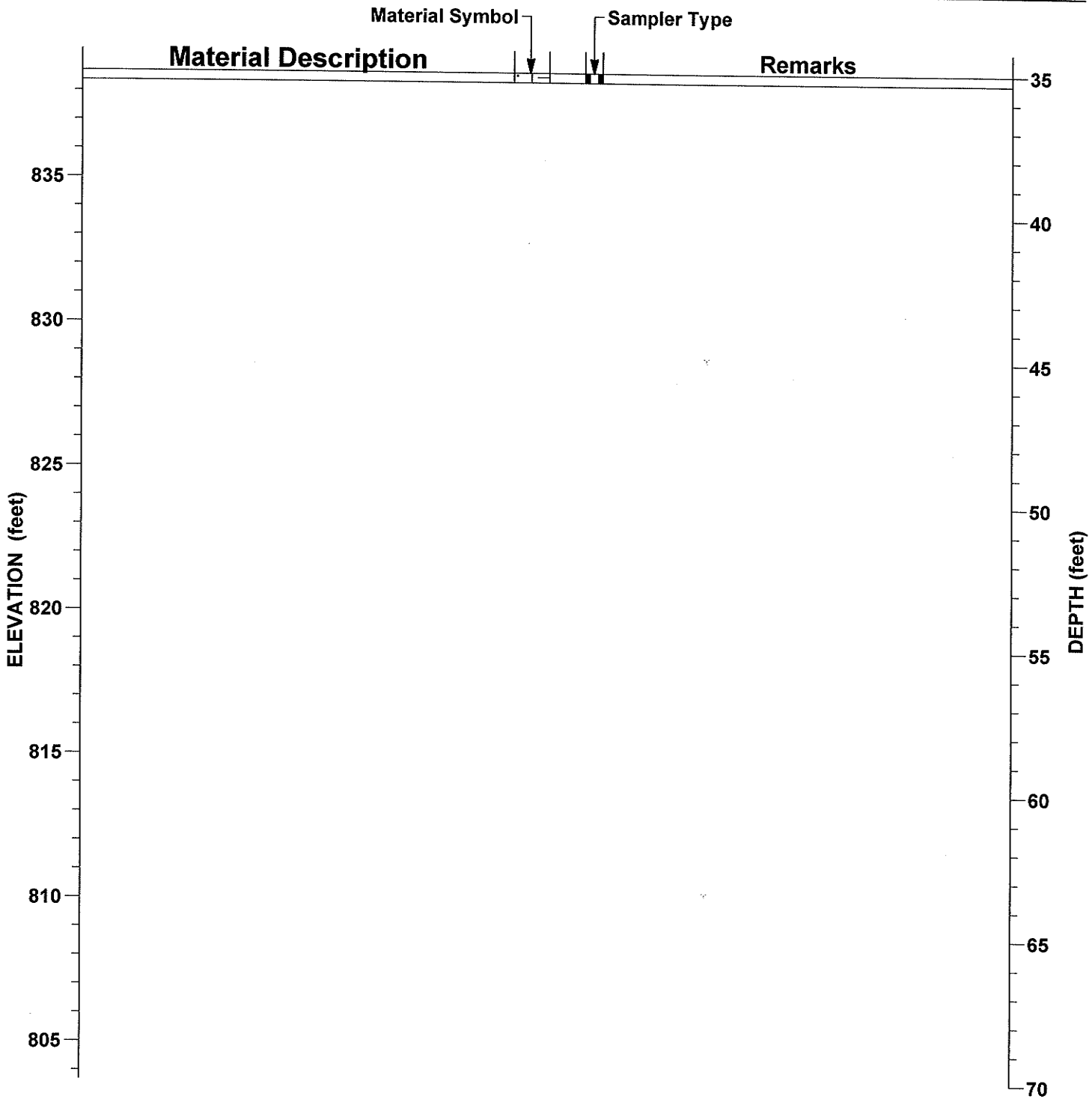
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AUGER BORING RECORD
 New Waste Transfer Station
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DRAWING
 12844-29



For Notes and Legend, see Drawing 12844-1.

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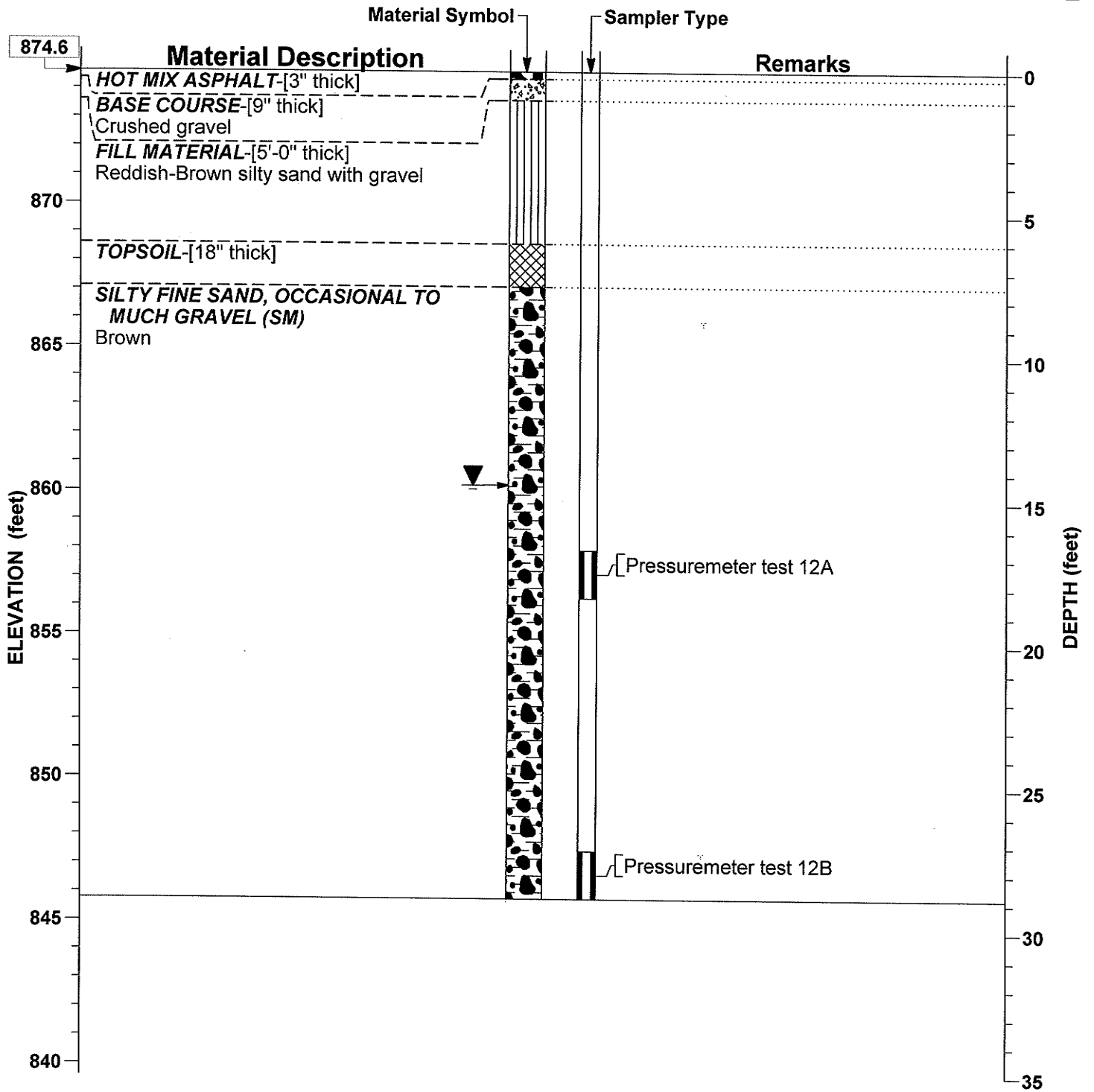
Revised on 1/13/2010

Location: (N472641, E853418)

Auger Boring PM12

Completed December 8, 2009

Total Depth = 28'-10" (Page 1/1)



WATER LEVEL LEGEND
▼ 14'-4³/₄" (estimated)

For Notes and Legend, see Drawing 12844-1.

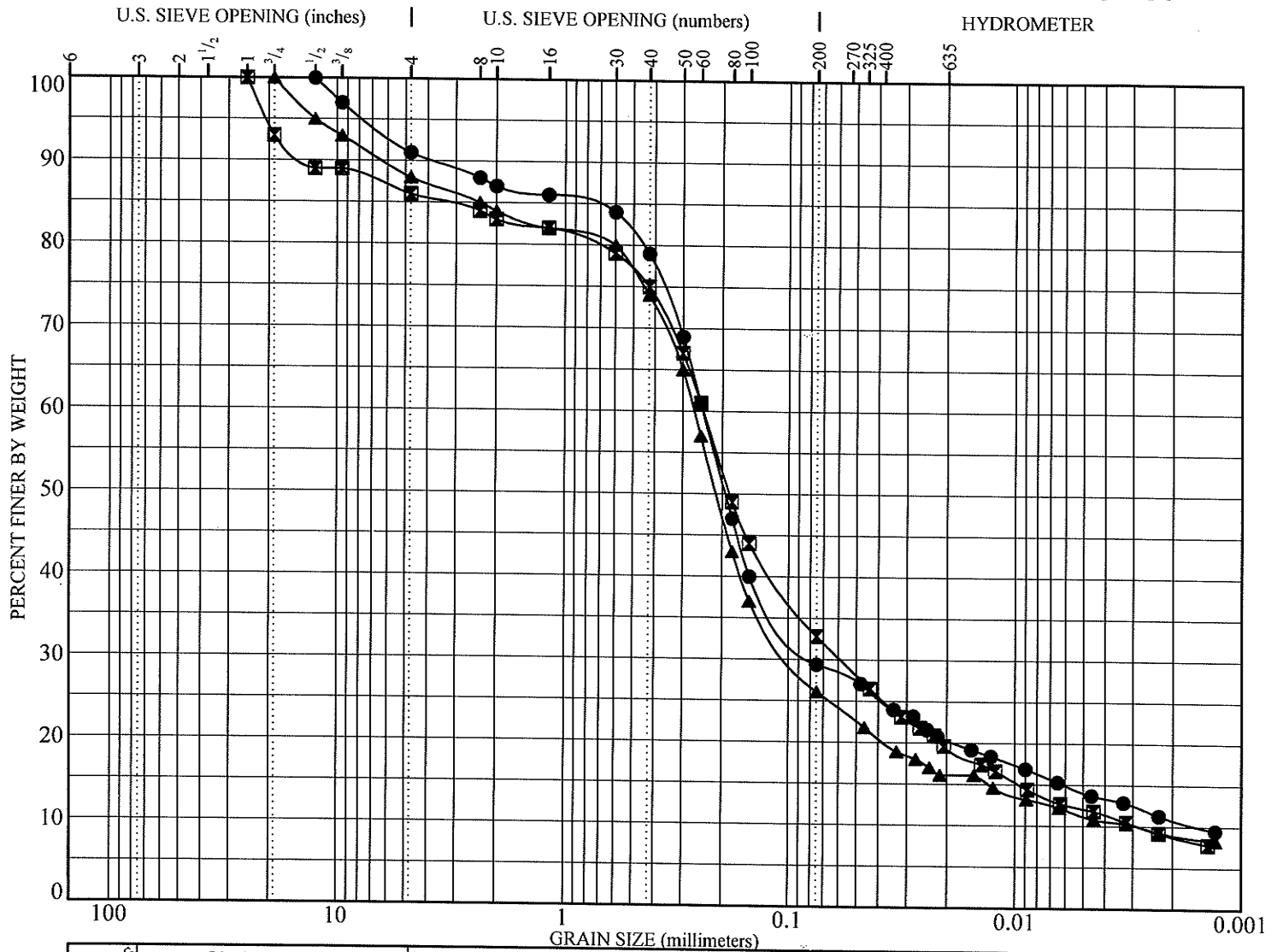
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AUGER BORING RECORD
New Waste Transfer Station
Rodefild Landfill
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DRAWING
12844-31

Revised on 1/13/2010

PARTICLE SIZE DISTRIBUTION ANALYSIS REPORT



COBBLES (%)	GRAVEL (%)		SAND (%)			SILT (%)	CLAY (%)
	coarse	fine	coarse	medium	fine		
● 0.0	8.7			61.9		15.3	14.1
☒ 0.0	13.7			53.5		20.7	12.1
▲ 0.0	12.2			61.7		14.9	11.2

Sieve Size	Percent Finer		
	●	☒	▲
1-inch		100	
3/4-inch		93	100
1/2-inch	100	89	95
3/8-inch	97	89	93
#4	91	86	88
#8	88	84	85
#10	87	83	84
#16	86	82	82
#30	84	79	80
#40	79	75	74
#50	69	67	65

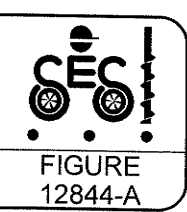
Sieve Size	Percent Finer		
	●	☒	▲
#60	61	61	57
#80	47	49	43
#100	40	44	37
#200	29.4	32.8	26.1

	Grain Size (mm)			Coefficients	
	D ₆₀	D ₃₀	D ₁₀	C _c	C _u
●	0.243	0.0780	0.00153	16.4	159
☒	0.242	0.0589	0.00280	5.12	86.5
▲	0.267	0.0965	0.00291	12.0	91.7

Sample Information	
●	Boring 1, 19'-3" Depth: Silty Fine Sand, little gravel (SM)
☒	Boring 2, 39'-9" Depth: Silty Clayey Fine Sand, little gravel (SC/SM)
▲	Boring 3, 15'-3" Depth: Silty Fine Sand, little gravel (SM)

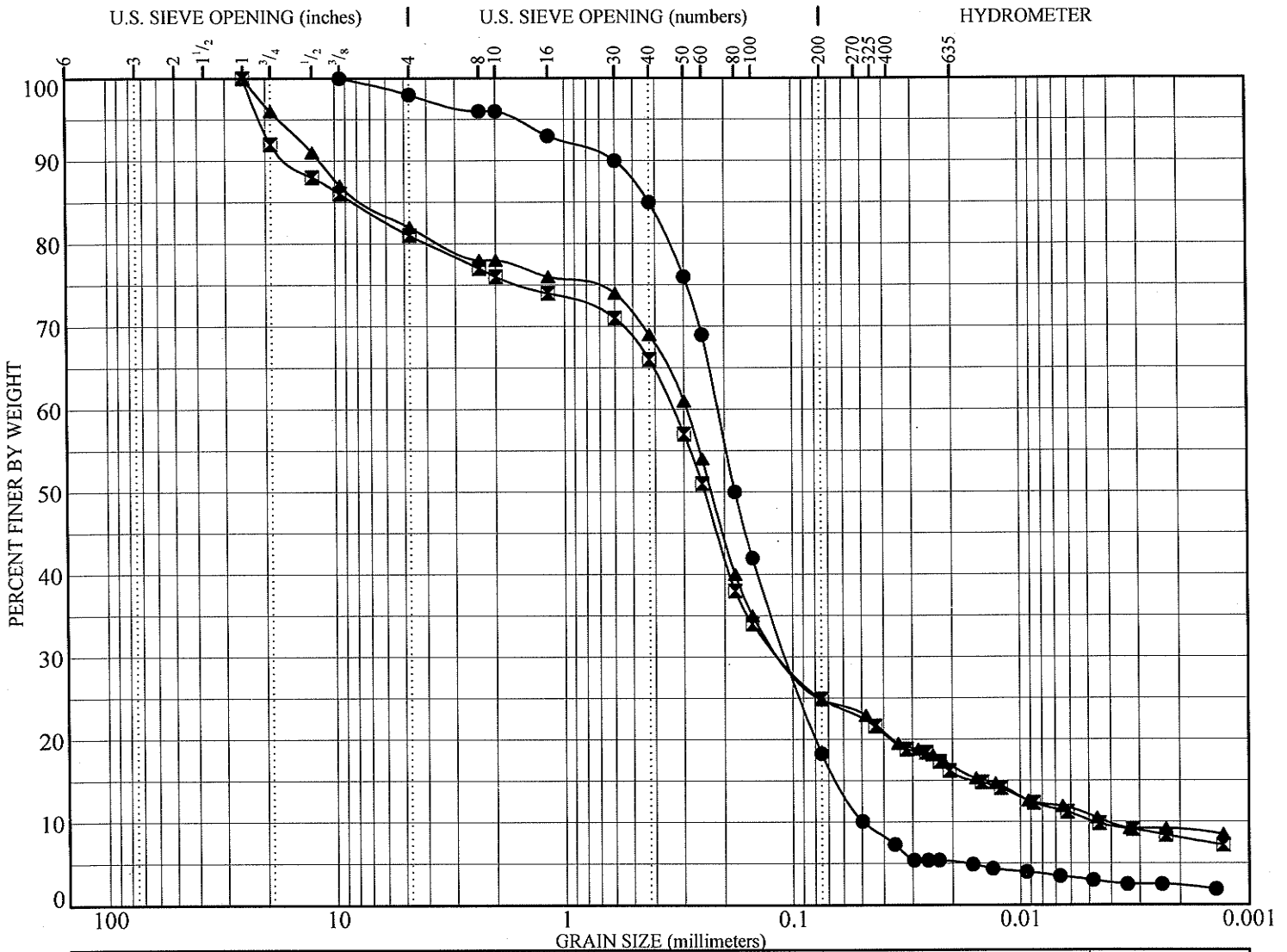
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LABORATORY TEST RESULT RECORD
 New Waste Transfer Station
 Rodefald Landfill
 7102 US Highway 12
 Dane County, Wisconsin



Revised on 1/14/2010

PARTICLE SIZE DISTRIBUTION ANALYSIS REPORT



COBBLES (%)	GRAVEL (%)		SAND (%)			SILT (%)	CLAY (%)
	coarse	fine	coarse	medium	fine		
● 0.0	1.7		80.0			15.2	3.1
⊠ 0.0	19.1		56.0			14.6	10.3
▲ 0.0	18.0		57.2			13.9	10.9

Sieve Size	Percent Finer		
	●	⊠	▲
1-inch		100	100
3/4-inch		92	96
1/2-inch		88	91
3/8-inch	100	86	87
#4	98	81	82
#8	96	77	78
#10	96	76	78
#16	93	74	76
#30	90	71	74
#40	85	66	69
#50	76	57	61

Sieve Size	Percent Finer		
	●	⊠	▲
#60	69	51	54
#80	50	38	40
#100	42	34	35
#200	18.3	24.9	24.8

	Grain Size (mm)			Coefficients	
	D ₆₀	D ₃₀	D ₁₀	C _c	C _u
●	0.214	0.106	0.0490	1.06	4.37
⊠	0.337	0.112	0.00471	7.91	71.5
▲	0.295	0.109	0.00404	9.93	73.1

Sample Information	
●	Boring 4, 19'-7" Depth: Silty Fine Sand, trace gravel (SM)
⊠	Boring 5, 17'-5" Depth: Silty Fine Sand, some gravel (SM)
▲	Boring 6, 15'-1" Depth: Silty Fine Sand, some gravel (SM)

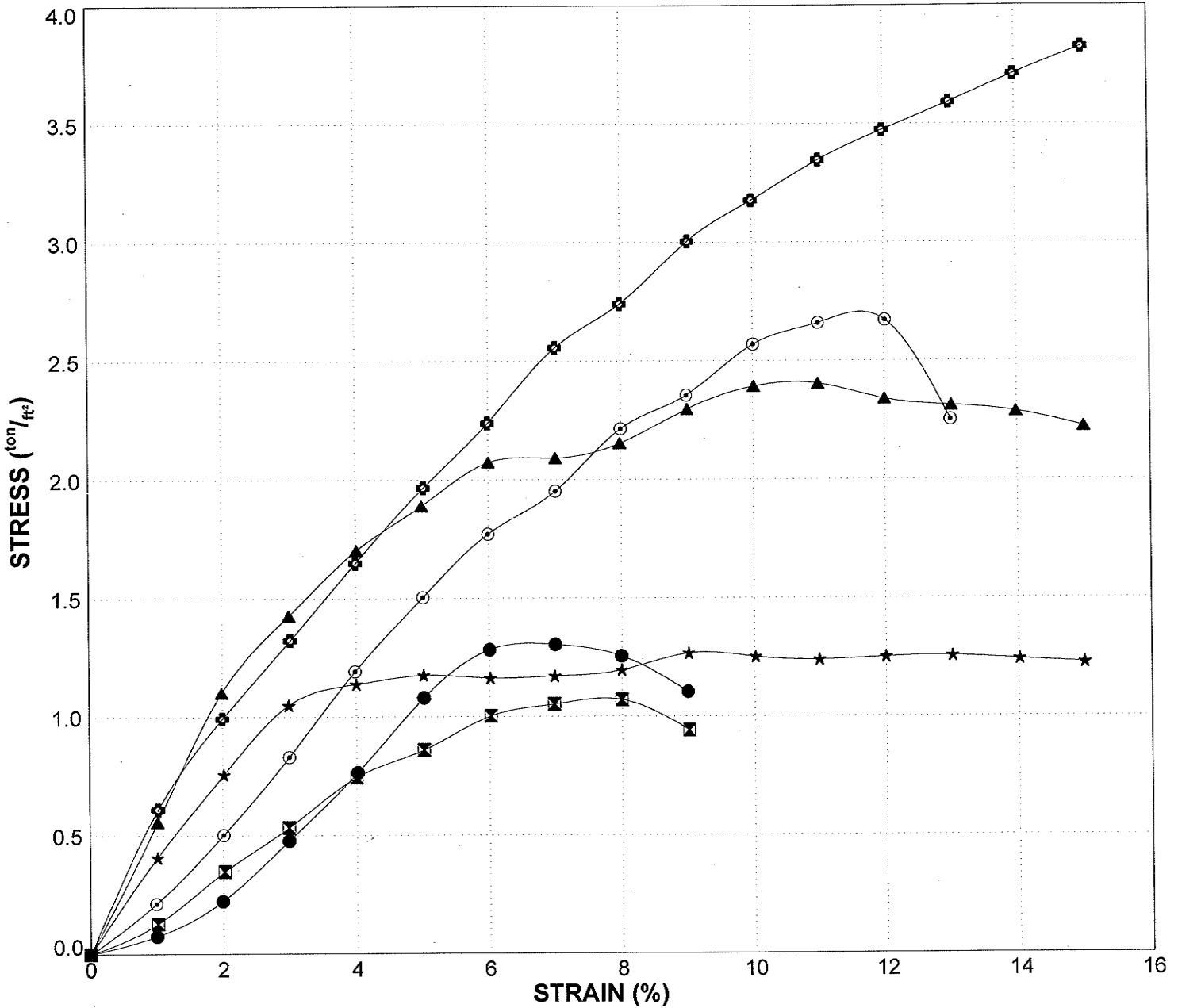
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LABORATORY TEST RESULT RECORD
 New Waste Transfer Station
 Rodefild Landfill
 7102 US Highway 12
 Dane County, Wisconsin



UNCONFINED COMPRESSION TEST REPORT

ASTM Test Designation D2166



Specimen Identification	Diameter (inches)	Height (inches)	H:D Ratio	γ_w (lb/ft^3)	γ_d (lb/ft^3)	NM (%)	Failure	
							Stress (ton/ft^2)	Strain (%)
● Boring 5, 17'-5" Depth	1.475	2.914	2.0	151.9	138.6	9.6	1.30	7
■ Boring 6, 15'-1" Depth	1.597	2.076	1.3	148.1	135.7	9.1	1.07	8
▲ Boring 8, 6'-7" Depth	1.381	2.567	1.9	128.1	108.6	17.9	2.40	11
★ Boring 10, 14'-2" Depth	1.265	2.876	2.3	125.7	102.9	22.2	1.27	9
○ Boring 11, 26'-9" Depth	1.388	3.038	2.2	138.4	119.9	15.4	2.67	12
⊕ Boring 11, 49'-7" Depth	1.369	2.353	1.7	139.4	119.8	16.3	3.82	15

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LABORATORY TEST RESULT RECORD

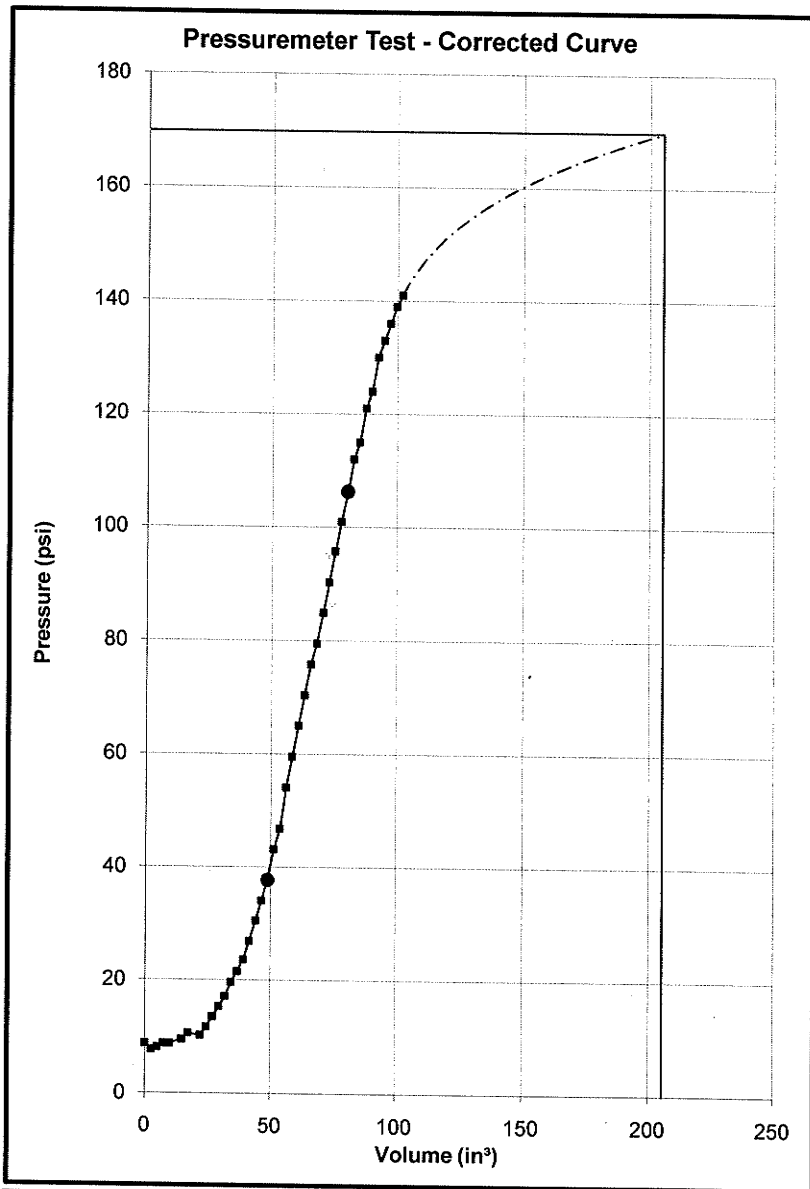
New Waste Transfer Station
 Rodefild Landfill
 7102 US Highway 12
 Dane County, Wisconsin



FIGURE
12844-C

TEXAM Pressuremeter Test

Raw Readings		Corrected Readings	
Pressure psi	Volume in ³	Pressure psi	Volume in ³
0.00	0.00	8.76	0.00
1.81	5.80	7.67	2.44
2.90	11.6	8.04	4.87
3.63	17.4	8.76	7.31
3.63	23.2	8.76	9.75
4.35	34.8	9.49	14.6
5.44	40.6	10.6	17.1
5.80	52.2	10.2	22.0
7.25	58.0	11.7	24.4
9.06	63.8	13.5	26.8
10.9	69.6	15.3	29.3
12.7	75.4	17.1	31.7
16.3	81.2	19.6	34.1
18.1	87.0	21.5	36.6
20.3	92.8	23.6	39.0
23.6	98.6	26.9	41.4
27.2	104	30.5	43.9
30.8	110	34.1	46.3
34.4	116	37.8	48.7
39.9	122	43.2	51.2
43.5	128	46.8	53.6
50.8	133	54.1	56.0
56.2	139	59.5	58.4
61.6	145	65.0	60.9
67.1	151	70.4	63.3
72.5	157	75.8	65.7
76.1	162	79.5	68.1
81.6	168	84.9	70.6
87.0	174	90.3	73.0
92.8	180	95.8	75.4
97.9	186	101	77.8
103	191	106	80.3
109	197	112	82.7
112	203	115	85.1
118	209	121	87.6
121	215	124	90.0
127	220	130	92.4
131	226	133	94.8
134	232	136	97.3
138	238	139	99.7
140	244	141	102



Test Results	
Pressuremeter modulus (E):	997 psi
Ultimate pressure (P _L):	170 psi
Ratio of E / P _L :	5.86
Yield pressure (P _F):	106 psi
Ratio of P _L / P _F :	1.60

Remarks

Test Results	
Borehole name: PM7	
Test date: (mm/dd/yyyy) 12/16/2009	
Test number: 7A	
Test depth:	17.50 ft
Material Description: Brown Silty Fine Sand, occasional to much gravel (SM)	
Gauge height above ground:	1.25 ft
Poisson's coefficient:	0.33
Fluid density:	1.078 g/cc
Probe size:	N
Slotted casing Used:	No

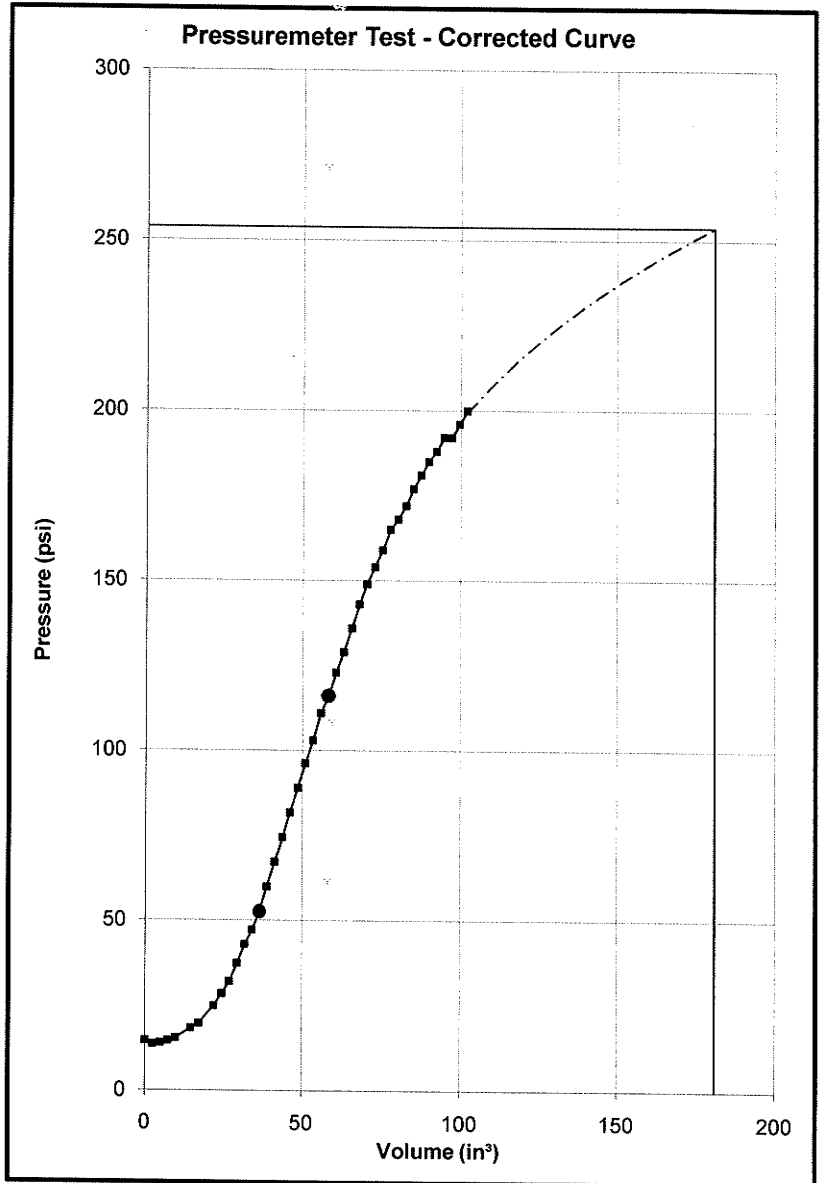
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FIELD TEST RESULT RECORD
 New Waste Transfer Station
 Rodefeld Landfill
 7102 US Highway 12
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FIGURE
12844-D

TEXAM Pressuremeter Test

Raw Readings		Corrected Readings	
Pressure psi	Volume in ³	Pressure psi	Volume in ³
0.00	0.00	14.6	0.00
1.81	5.80	13.5	2.44
2.90	11.6	13.9	4.87
3.63	17.4	14.6	7.31
4.35	23.2	15.3	9.75
7.25	34.8	18.2	14.6
8.70	40.6	19.7	17.1
14.5	52.2	24.8	21.9
18.1	58.0	28.4	24.4
21.8	63.8	32.0	26.8
27.2	69.6	37.4	29.2
32.6	75.4	42.9	31.6
38.1	81.2	47.2	34.1
43.5	87.0	52.7	36.5
50.8	92.8	59.9	38.9
58.0	98.6	67.2	41.3
65.3	104	74.4	43.8
72.5	110	81.7	46.2
79.8	116	88.9	48.6
87.0	122	96.2	51.0
94.3	128	103	53.4
102	133	111	55.9
107	139	116	58.3
114	145	123	60.7
120	151	129	63.1
127	157	136	65.6
134	162	143	68.0
140	168	149	70.4
145	174	154	72.8
150	180	159	75.3
156	186	165	77.7
160	191	168	80.1
163	197	172	82.6
169	203	177	85.0
172	209	181	87.4
176	215	185	89.8
179	220	188	92.3
183	226	192	94.7
185	232	192	97.1
189	238	196	99.6
192	244	200	102



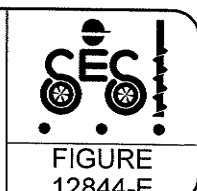
Test Results	
Pressuremeter modulus (E):	1,200 psi
Ultimate pressure (P _L):	254 psi
Ratio of E / P _L :	4.72
Yield pressure (P _F):	116 psi
Ratio of P _L / P _F :	2.19

Test Results	
Borehole name: PM7	
Test date: (mm/dd/yyyy) 12/16/2009	
Test number: 7B	
Test depth:	30.00 ft
Material Description: Brown Silty Fine Sand, occasional to much gravel (SM)	
Gauge height above ground:	1.25 ft
Poisson's coefficient:	0.33
Fluid density:	1.078 g/cc
Probe size:	N
Slotted casing Used:	No

Remarks

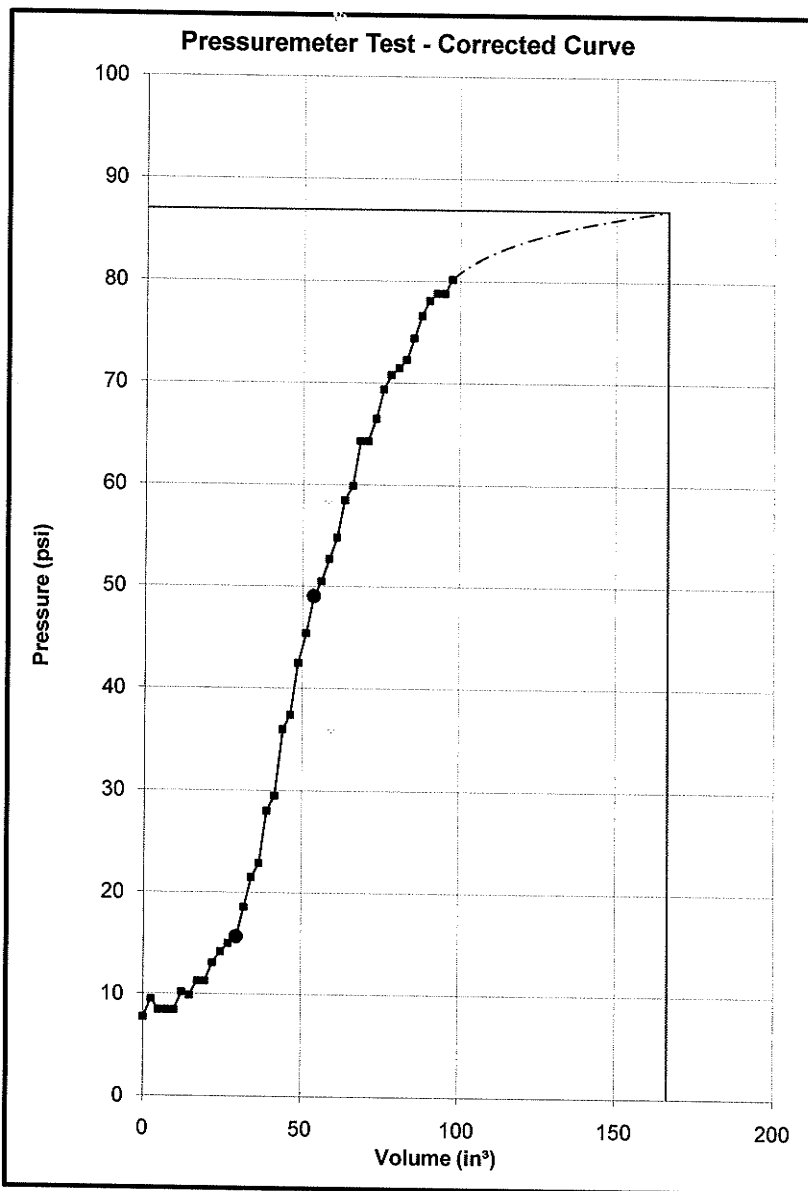
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FIELD TEST RESULT RECORD
 New Waste Transfer Station
 Rodefeld Landfill
 7102 US Highway 12
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TEXAM Pressuremeter Test

Raw Readings		Corrected Readings	
Pressure psi	Volume in ³	Pressure psi	Volume in ³
0.00	0.00	7.71	0.00
3.63	5.80	9.52	2.43
3.63	11.6	8.44	4.87
3.63	17.4	8.44	7.31
3.63	23.2	8.44	9.75
5.44	29.0	10.2	12.2
5.80	34.8	9.89	14.6
7.25	40.6	11.3	17.1
7.25	46.4	11.3	19.5
9.06	52.2	13.1	21.9
10.2	58.0	14.2	24.4
10.9	63.8	15.0	26.8
11.6	69.6	15.7	29.3
14.5	75.4	18.6	31.7
17.4	81.2	21.5	34.1
18.9	87.0	22.9	36.6
23.9	92.8	28.0	39.0
25.4	98.6	29.5	41.4
31.9	104	36.0	43.9
33.4	110	37.4	46.3
38.4	116	42.5	48.7
41.3	122	45.4	51.2
45.0	128	49.0	53.6
47.1	133	50.5	56.0
49.3	139	52.7	58.5
51.5	145	54.8	60.9
55.1	151	58.5	63.3
56.6	157	59.9	65.8
60.9	162	64.3	68.2
61.6	168	64.3	70.6
63.8	174	66.5	73.1
66.7	180	69.4	75.5
68.2	186	70.8	77.9
68.9	191	71.5	80.4
69.6	197	72.3	82.8
71.8	203	74.4	85.2
74.0	209	76.6	87.7
75.4	215	78.1	90.1
76.1	220	78.8	92.6
76.9	226	78.8	95.0
78.3	232	80.2	97.4



Test Results	
Pressuremeter modulus (E):	545 psi
Ultimate pressure (P _L):	87.0 psi
Ratio of E / P _L :	6.26
Yield pressure (P _F):	49.0 psi
Ratio of P _L / P _F :	1.78

Remarks

Test Results	
Borehole name: PM8	
Test date: (mm/dd/yyyy) 12/07/2009	
Test number: 8A	
Test depth:	15.25 ft
Material Description: Brown Silty Fine Sand, occasional to much gravel (SM)	
Gauge height above ground:	1.25 ft
Poisson's coefficient:	0.33
Fluid density:	1.078 g/cc
Probe size: N	
Slotted casing Used:	No

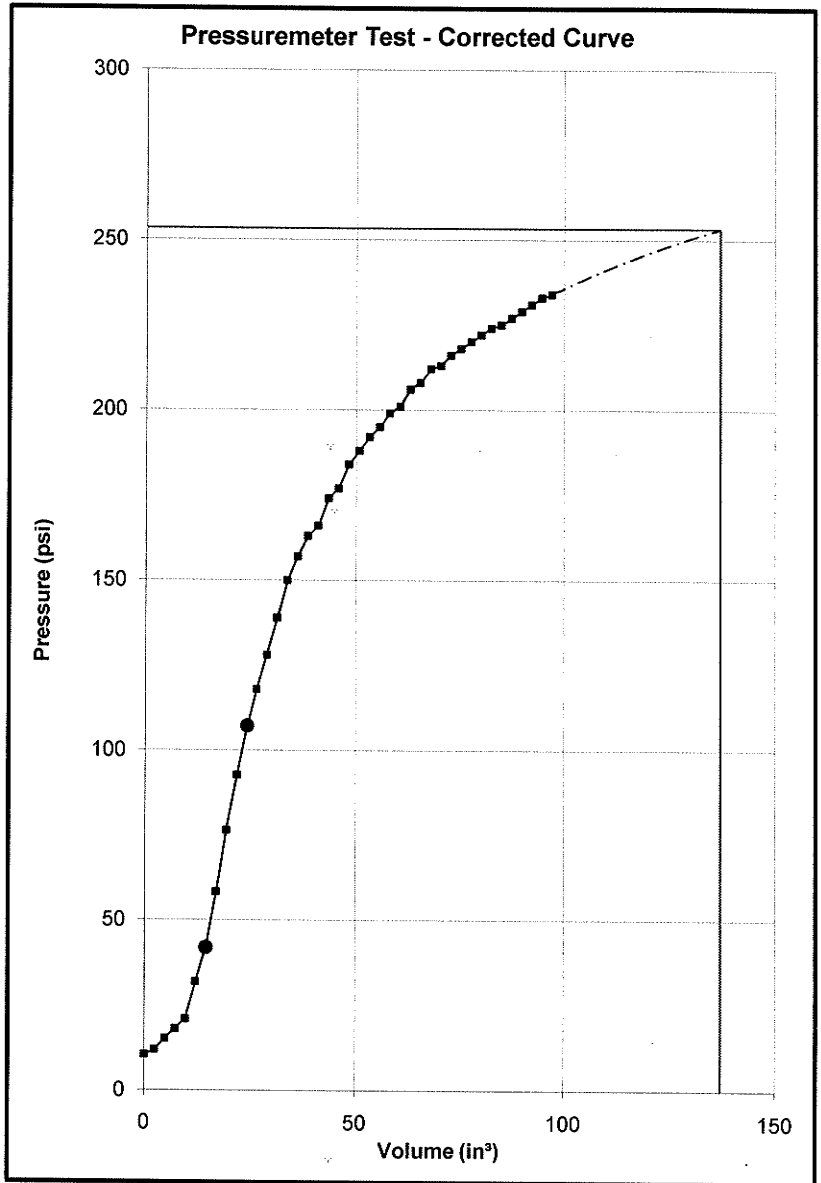
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FIGURE
12844-F

TEXAM Pressuremeter Test

Raw Readings		Corrected Readings	
Pressure psi	Volume in ³	Pressure psi	Volume in ³
0.00	0.00	10.4	0.00
3.63	5.80	11.8	2.43
6.89	11.6	15.1	4.86
9.79	17.4	18.0	7.30
12.7	23.2	20.9	9.73
24.3	29.0	31.8	12.1
34.4	34.8	41.9	14.5
50.8	40.6	58.3	16.9
68.9	46.4	76.4	19.3
85.2	52.2	92.7	21.7
99.7	58.0	107	24.1
111	63.8	118	26.5
121	69.6	128	29.0
132	75.4	139	31.4
143	81.2	150	33.8
150	87.0	157	36.2
156	92.8	163	38.6
160	98.6	166	41.1
167	104	174	43.5
170	110	177	45.9
178	116	184	48.3
181	122	188	50.8
185	128	192	53.2
189	133	195	55.6
192	139	199	58.0
194	145	201	60.5
199	151	206	62.9
201	157	208	65.3
205	162	212	67.8
207	168	213	70.2
210	174	216	72.6
212	180	218	75.1
214	186	220	77.5
216	191	222	79.9
218	197	224	82.4
219	203	225	84.8
221	209	227	87.3
223	215	229	89.7
225	220	231	92.1
227	226	233	94.6
228	232	234	97.0



Test Results	
Pressuremeter modulus (E):	2,310 psi
Ultimate pressure (P _L):	253 psi
Ratio of E / P _L :	9.13
Yield pressure (P _F):	107 psi
Ratio of P _L / P _F :	2.36

Remarks

Test Results	
Borehole name:	PM9
Test date: (mm/dd/yyyy)	12/11/2009
Test number:	9A
Test depth:	21.00 ft
Material Description:	Brown Seams and Layers of Silty Fine Sand (SM) and Fine Sand With Silt (SP/SM), occasional to trace gravel
Gauge height above ground:	1.25 ft
Poisson's coefficient:	0.33
Fluid density:	1.078 g/cc
Probe size:	N
Slotted casing Used:	No

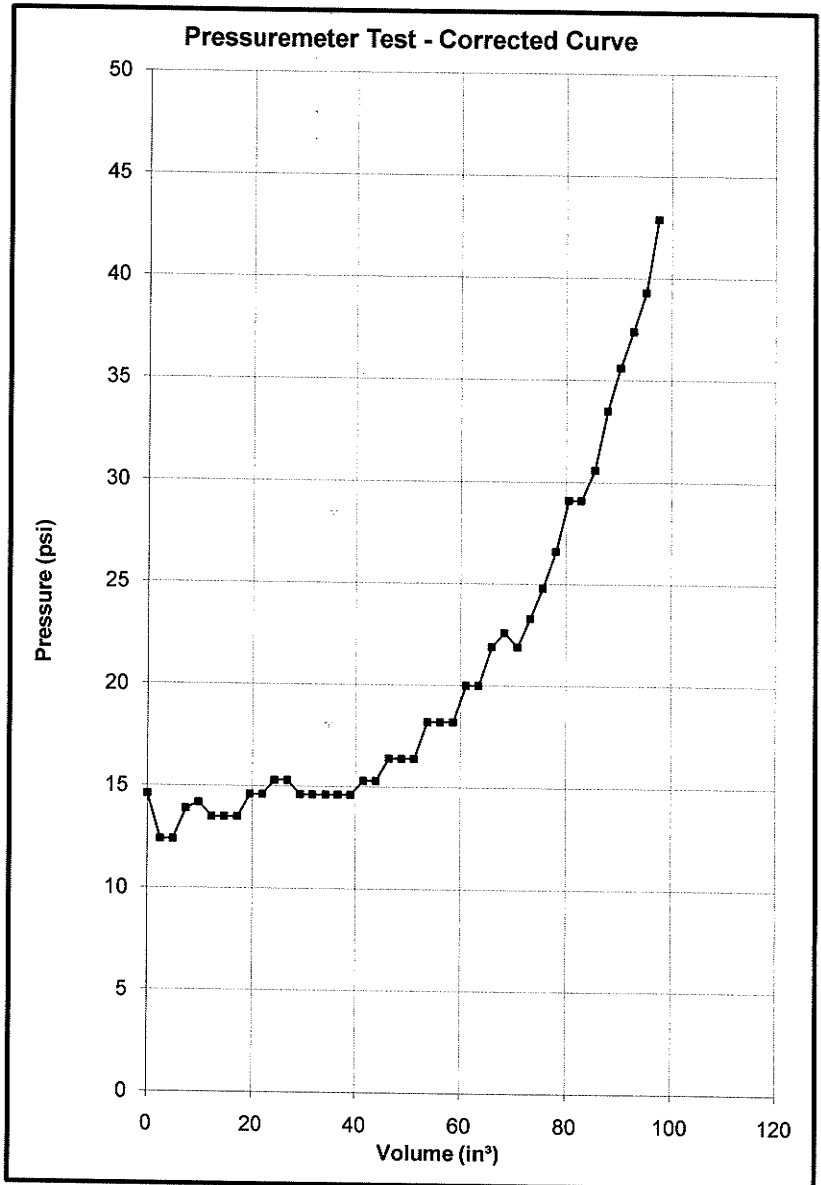
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FIGURE
12844-H

TEXAM Pressuremeter Test

Raw Readings		Corrected Readings	
Pressure psi	Volume in ³	Pressure psi	Volume in ³
0.00	0.00	14.6	0.00
0.00	5.80	12.4	2.44
0.00	11.6	12.4	4.88
1.45	17.4	13.9	7.32
1.81	23.2	14.2	9.76
1.81	29.0	13.5	12.2
1.81	34.8	13.5	14.6
1.81	40.6	13.5	17.1
2.90	46.4	14.6	19.5
2.90	52.2	14.6	22.0
3.63	58.0	15.3	24.4
3.63	63.8	15.3	26.8
3.63	69.6	14.6	29.3
3.63	75.4	14.6	31.7
3.63	81.2	14.6	34.2
3.63	87.0	14.6	36.6
3.63	92.8	14.6	39.0
4.35	98.6	15.3	41.5
4.35	104	15.3	43.9
5.44	110	16.4	46.4
5.44	116	16.4	48.8
5.44	122	16.4	51.2
7.25	128	18.2	53.7
7.25	133	18.2	56.1
7.25	139	18.2	58.6
9.06	145	20.0	61.0
9.06	151	20.0	63.4
10.9	157	21.9	65.9
11.6	162	22.6	68.3
11.6	168	21.9	70.8
13.1	174	23.3	73.2
14.5	180	24.8	75.6
16.3	186	26.6	78.1
18.9	191	29.1	80.5
18.9	197	29.1	82.9
20.3	203	30.6	85.4
23.2	209	33.5	87.8
25.4	215	35.6	90.2
27.2	220	37.4	92.7
29.0	226	39.3	95.1
32.6	232	42.9	97.5



Test Results	
Pressuremeter modulus (E):	n.a.
Ultimate pressure (P _L):	n.a. psi
Ratio of E / P _L :	n.a.
Yield pressure (P _F):	n.a. psi
Ratio of P _L / P _F :	n.a.

Remarks
Borehole too large to complete test.

Test Results	
Borehole name:	PM9
Test date: (mm/dd/yyyy)	12/11/2009
Test number:	9B
Test depth:	30.00 ft
Material Description:	Brown Silty Fine Sand, occasional to much gravel (SM)
Gauge height above ground:	1.25 ft
Poisson's coefficient:	0.33
Fluid density:	1.078 g/cc
Probe size:	N
Slotted casing Used:	No

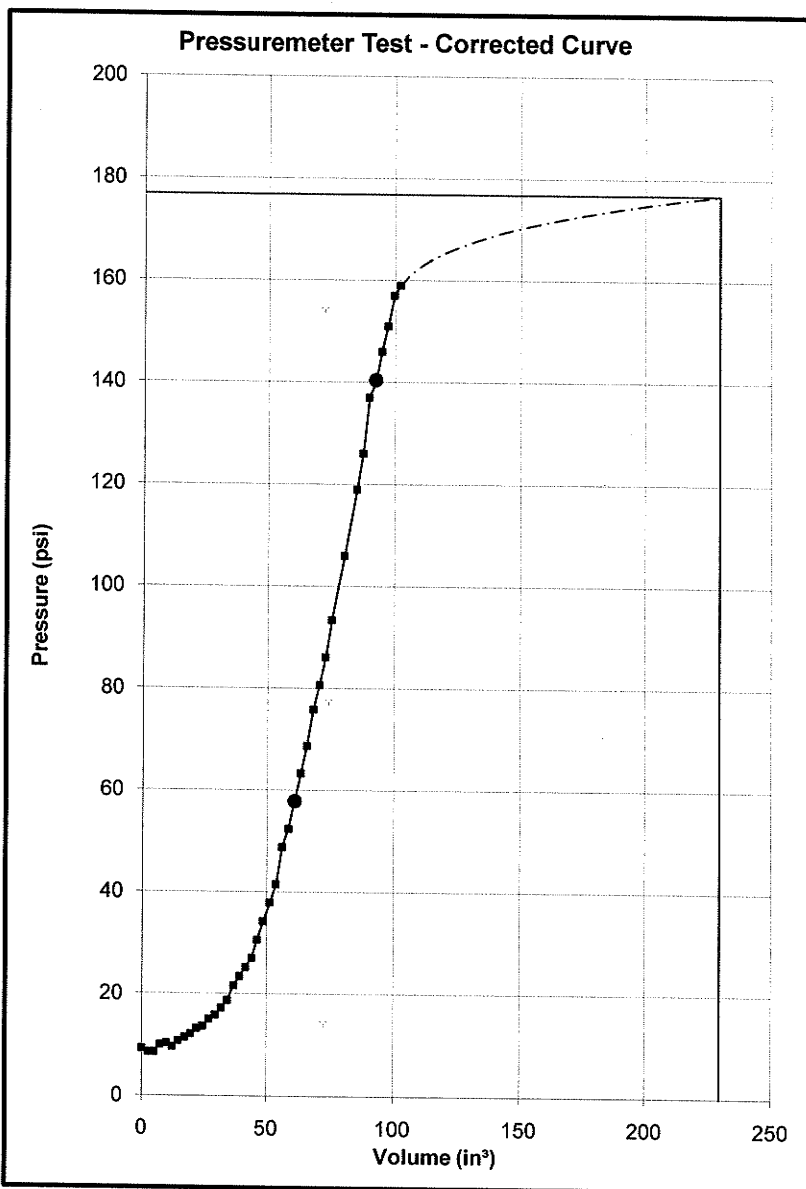
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FIGURE
12844-I

TEXAM Pressuremeter Test

Raw Readings		Corrected Readings	
Pressure psi	Volume in ³	Pressure psi	Volume in ³
0.00	0.00	9.23	0.00
1.45	5.80	8.50	2.44
1.45	11.6	8.50	4.88
2.90	17.4	9.95	7.31
3.26	23.2	10.3	9.75
3.26	29.0	9.59	12.2
4.35	34.8	10.7	14.6
5.08	40.6	11.4	17.1
5.80	46.4	12.1	19.5
6.89	52.2	13.2	21.9
7.25	58.0	13.6	24.4
8.70	63.8	15.0	26.8
10.2	69.6	15.8	29.3
11.6	75.4	17.2	31.7
13.1	81.2	18.7	34.1
16.0	87.0	21.6	36.6
17.8	92.8	23.4	39.0
19.6	98.6	25.2	41.4
21.4	104	27.0	43.9
25.0	110	30.6	46.3
28.6	116	34.2	48.7
32.3	122	37.9	51.2
35.9	128	41.5	53.6
43.1	133	48.8	56.0
46.8	139	52.4	58.5
52.2	145	57.8	60.9
57.7	151	63.3	63.3
63.1	157	68.7	65.7
70.3	162	75.9	68.2
75.8	168	80.7	70.6
81.2	174	86.1	73.0
88.5	180	93.4	75.4
101	191	106	80.3
114	203	119	85.1
121	209	126	87.5
132	215	137	89.9
136	220	140	92.4
141	226	146	94.8
146	232	151	97.2
152	238	157	99.7
154	244	159	102



Test Results	
Pressuremeter modulus (E):	1,290 psi
Ultimate pressure (P _L):	177 psi
Ratio of E / P _L :	7.29
Yield pressure (P _F):	140 psi
Ratio of P _L / P _F :	1.26

Remarks

Test Results	
Borehole name: PM10	
Test date: (mm/dd/yyyy) 12/15/2009	
Test number: 10A	
Test depth:	18.50 ft
Material Description: Brown Silty Fine Sand, occasional to much gravel (SM)	
Gauge height above ground:	1.25 ft
Poisson's coefficient:	0.33
Fluid density:	1.078 g/cc
Probe size:	N
Slotted casing Used:	No

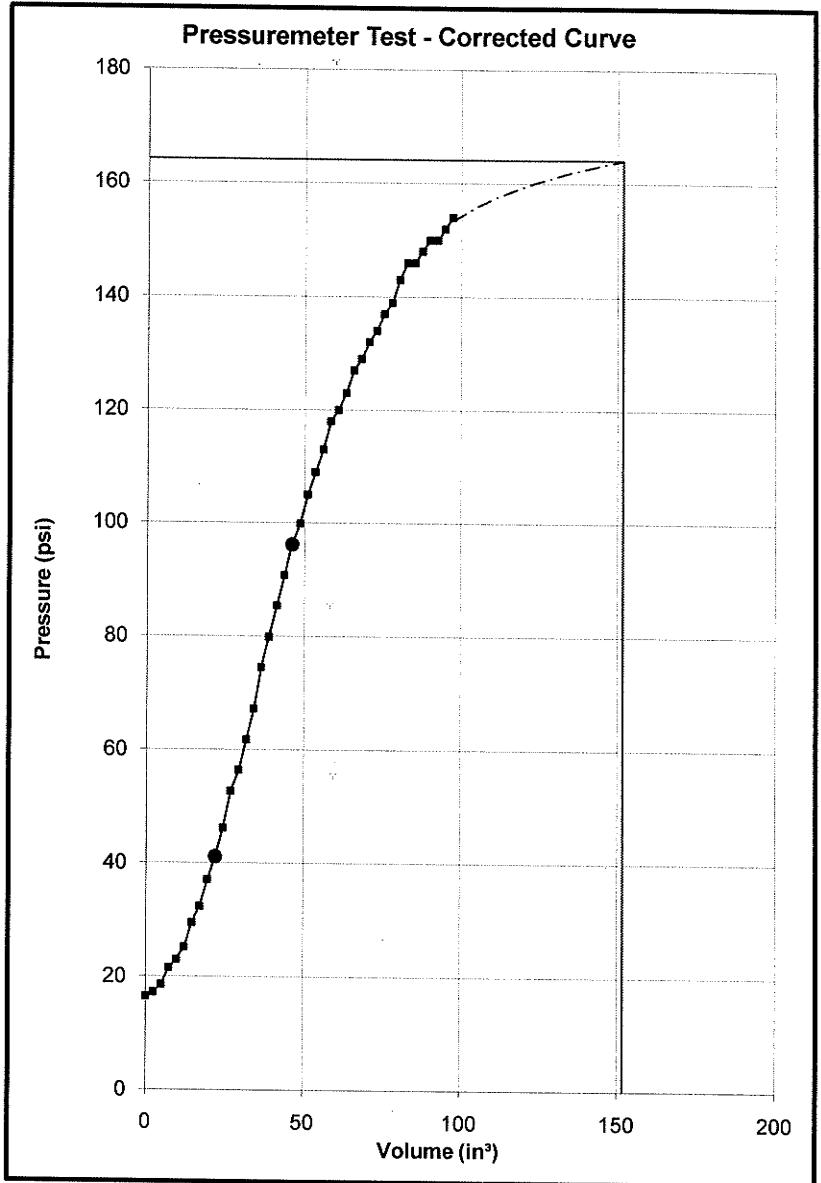
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FIGURE
12844-J

TEXAM Pressuremeter Test

Raw Readings		Corrected Readings	
Pressure psi	Volume in ³	Pressure psi	Volume in ³
0.00	0.00	16.5	0.00
2.90	5.80	17.2	2.43
4.35	11.6	18.6	4.87
7.25	17.4	21.5	7.30
8.70	23.2	23.0	9.74
11.6	29.0	25.2	12.2
16.0	34.8	29.5	14.6
18.9	40.6	32.4	17.0
23.6	46.4	37.1	19.5
27.6	52.2	41.1	21.9
32.6	58.0	46.2	24.3
39.2	63.8	52.7	26.7
43.5	69.6	56.4	29.2
49.0	75.4	61.8	31.6
54.4	81.2	67.2	34.0
61.6	87.0	74.5	36.4
67.1	92.8	79.9	38.9
72.5	98.6	85.4	41.3
78.0	104	90.8	43.7
83.4	110	96.2	46.1
87.0	116	99.9	48.6
92.5	122	105	51.0
96.1	128	109	53.4
99.7	133	113	55.9
105	139	118	58.3
107	145	120	60.7
111	151	123	63.2
114	157	127	65.6
116	162	129	68.0
120	168	132	70.5
121	174	134	72.9
125	180	137	75.3
127	186	139	77.8
131	191	143	80.2
134	197	146	82.6
134	203	146	85.1
136	209	148	87.5
138	215	150	89.9
138	220	150	92.4
140	226	152	94.8
141	232	154	97.2



Test Results	
Pressuremeter modulus (E):	859 psi
Ultimate pressure (P _L):	164 psi
Ratio of E / P _L :	5.24
Yield pressure (P _F):	96.2 psi
Ratio of P _L / P _F :	1.70

Remarks

Test Results	
Borehole name: PM10	
Test date: (mm/dd/yyyy) 12/15/2009	
Test number: 10B	
Test depth:	34.00 ft
Material Description: Brown Silty Fine Sand, occasional to much gravel (SM)	
Gauge height above ground:	1.25 ft
Poisson's coefficient:	0.33
Fluid density:	1.078 g/cc
Probe size:	N
Slotted casing Used:	No

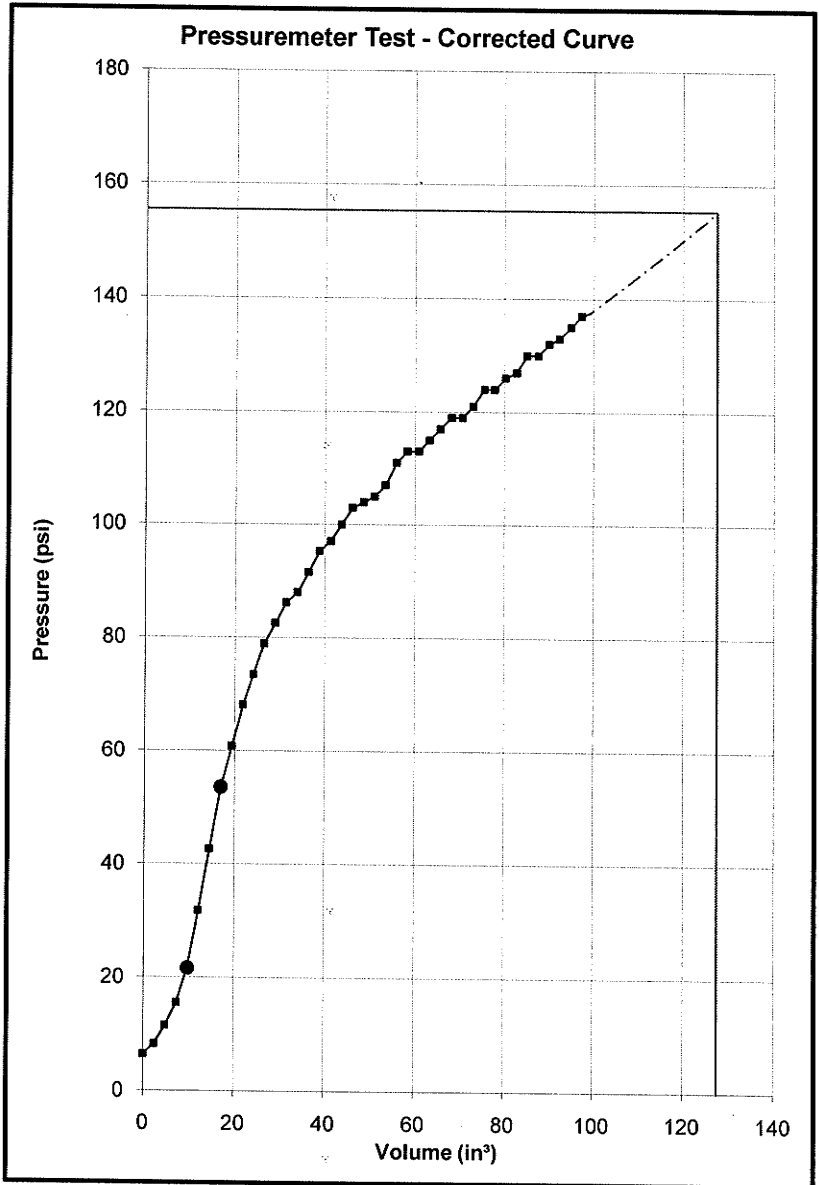
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FIGURE
12844-K

TEXAM Pressuremeter Test

Raw Readings		Corrected Readings	
Pressure psi	Volume in ³	Pressure psi	Volume in ³
0.00	0.00	6.43	0.00
3.63	5.80	8.24	2.43
6.89	11.6	11.5	4.87
10.9	17.4	15.5	7.30
18.1	23.2	21.7	9.72
29.0	29.0	31.8	12.1
39.9	34.8	42.7	14.5
50.8	40.6	53.6	17.0
58.0	46.4	60.8	19.4
65.3	52.2	68.1	21.8
70.7	58.0	73.5	24.2
76.1	63.8	78.9	26.7
79.8	69.6	82.6	29.1
83.4	75.4	86.2	31.5
85.2	81.2	88.0	34.0
88.8	87.0	91.6	36.4
92.5	92.8	95.3	38.8
94.3	98.6	97.1	41.3
97.2	104	100.0	43.7
99.7	110	103	46.1
102	116	104	48.6
103	122	105	51.0
105	128	107	53.4
109	133	111	55.9
111	139	113	58.3
112	145	113	60.8
114	151	115	63.2
116	157	117	65.6
118	162	119	68.1
118	168	119	70.5
120	174	121	72.9
123	180	124	75.4
123	186	124	77.8
125	191	126	80.2
126	197	127	82.7
129	203	130	85.1
129	209	130	87.6
131	215	132	90.0
132	220	133	92.4
134	226	135	94.9
136	232	137	97.3



Test Results	
Pressuremeter modulus (E):	1,420 psi
Ultimate pressure (P _L):	155 psi
Ratio of E / P _L :	9.16
Yield pressure (P _F):	53.6 psi
Ratio of P _L / P _F :	2.89

Test Results	
Borehole name: PM11	
Test date: (mm/dd/yyyy) 12/17/2009	
Test number: 11A	
Test depth:	12.50 ft
Material Description: Brown Silty Fine Sand, occasional to much gravel (SM)	
Gauge height above ground:	1.25 ft
Poisson's coefficient:	0.33
Fluid density:	1.078 g/cc
Probe size:	N
Slotted casing Used:	No

Remarks

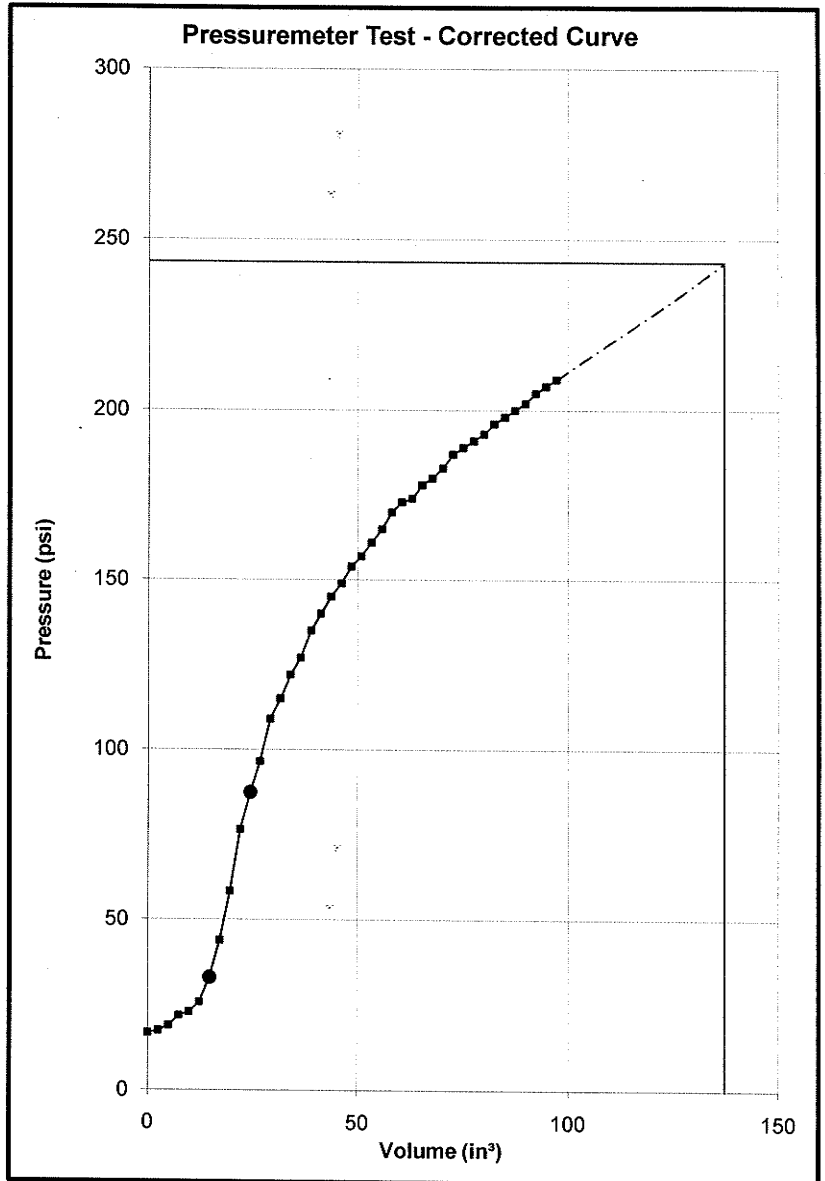
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FIGURE
12844-M

TEXAM Pressuremeter Test

Raw Readings		Corrected Readings	
Pressure psi	Volume in ³	Pressure psi	Volume in ³
0.00	0.00	16.7	0.00
2.54	5.80	17.4	2.43
3.99	11.6	18.9	4.87
6.89	17.4	21.8	7.31
9.06	23.2	22.9	9.74
12.7	29.0	25.8	12.2
19.9	34.8	33.0	14.6
30.8	40.6	43.9	17.0
45.3	46.4	58.4	19.4
63.5	52.2	76.5	21.8
74.3	58.0	87.4	24.2
83.4	63.8	96.5	26.6
96.1	69.6	109	29.1
102	75.4	115	31.5
109	81.2	122	33.9
114	87.0	127	36.3
121	92.8	135	38.8
127	98.6	140	41.2
132	104	145	43.6
136	110	149	46.1
141	116	154	48.5
145	122	157	50.9
149	128	161	53.3
152	133	165	55.8
158	139	170	58.2
161	145	173	60.6
163	151	174	63.1
167	157	178	65.5
169	162	180	67.9
172	168	183	70.4
176	174	187	72.8
178	180	189	75.2
179	186	191	77.7
181	191	193	80.1
185	197	196	82.5
187	203	198	85.0
189	209	200	87.4
190	215	202	89.9
194	220	205	92.3
196	226	207	94.7
198	232	209	97.2



Test Results	
Pressuremeter modulus (E):	1,910 psi
Ultimate pressure (P _L):	243 psi
Ratio of E / P _L :	7.86
Yield pressure (P _F):	87.4 psi
Ratio of P _L / P _F :	2.78

Remarks

Test Results	
Borehole name: PM11	
Test date: (mm/dd/yyyy) 12/17/2009	
Test number: 11B	
Test depth: 34.50 ft	
Material Description: Brown Seams and Layers of Silty Fine Sand (SM) and Fine Sand With Silt (SP/SM), occasional to trace gravel	
Gauge height above ground:	1.25 ft
Poisson's coefficient:	0.33
Fluid density:	1.078 g/cc
Probe size: N	
Slotted casing Used:	No

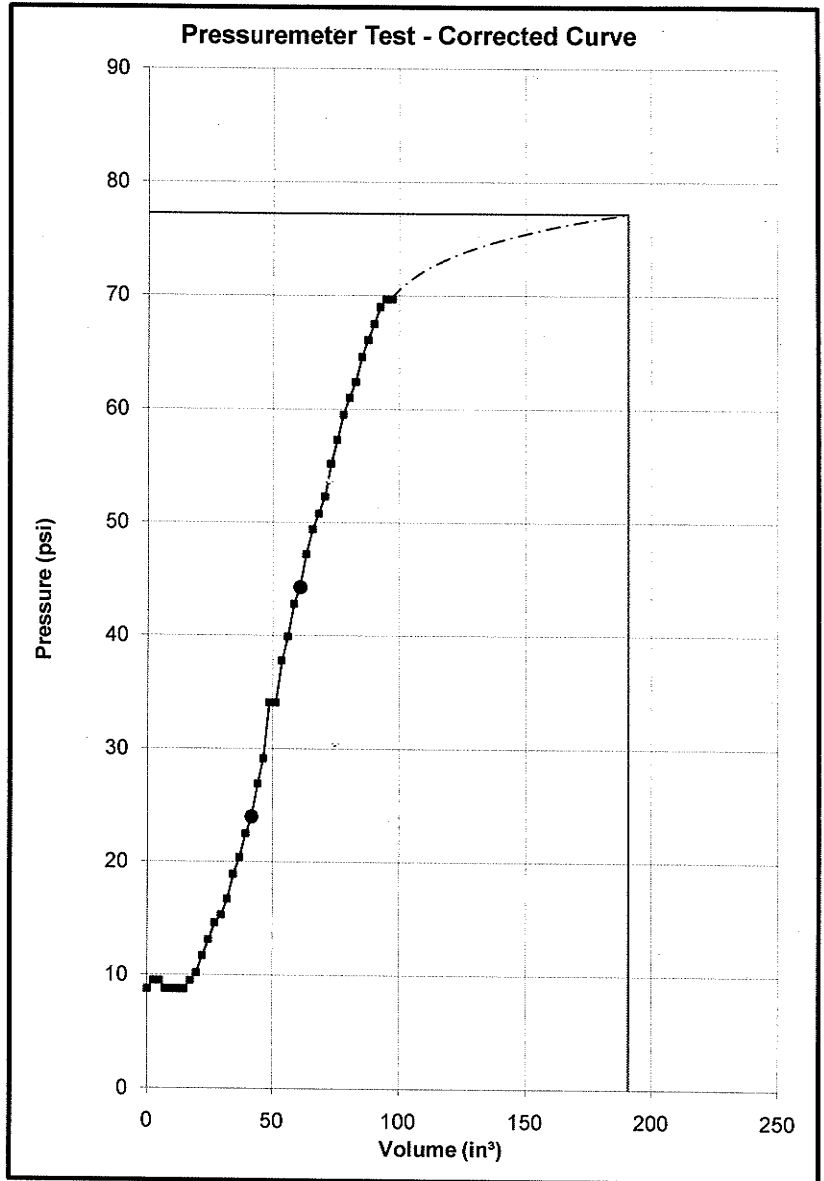
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FIGURE
12844-N

TEXAM Pressuremeter Test

Raw Readings		Corrected Readings	
Pressure psi	Volume in ³	Pressure psi	Volume in ³
0.00	0.00	8.76	0.00
3.63	5.80	9.49	2.43
3.63	11.6	9.49	4.87
3.63	17.4	8.76	7.31
4.35	23.2	8.76	9.75
4.35	29.0	8.76	12.2
4.35	34.8	8.76	14.6
5.08	40.6	9.49	17.1
5.80	46.4	10.2	19.5
7.25	52.2	11.7	21.9
8.70	58.0	13.1	24.4
10.2	63.8	14.6	26.8
10.9	69.6	15.3	29.3
12.3	75.4	16.7	31.7
14.5	81.2	18.9	34.1
16.0	87.0	20.4	36.6
18.1	92.8	22.5	39.0
20.3	98.6	24.0	41.4
23.2	104	26.9	43.9
25.4	110	29.1	46.3
30.5	116	34.1	48.7
30.5	122	34.1	51.2
34.1	128	37.8	53.6
36.3	133	39.9	56.0
39.2	139	42.8	58.5
40.6	145	44.3	60.9
43.5	151	47.2	63.3
45.7	157	49.4	65.8
47.1	162	50.8	68.2
49.3	168	52.3	70.7
52.2	174	55.2	73.1
54.4	180	57.3	75.5
56.6	186	59.5	78.0
58.0	191	61.0	80.4
59.5	197	62.4	82.8
61.6	203	64.6	85.3
63.1	209	66.1	87.7
65.3	215	67.5	90.1
66.7	220	69.0	92.6
68.2	226	69.7	95.0
68.2	232	69.7	97.5



Test Results	
Pressuremeter modulus (E):	442 psi
Ultimate pressure (P _L):	77.2 psi
Ratio of E / P _L :	5.73
Yield pressure (P _F):	44.3 psi
Ratio of P _L / P _F :	1.74

Remarks

Test Results	
Borehole name: PM12	
Test date: (mm/dd/yyyy) 12/08/2009	
Test number: 12A	
Test depth:	17.50 ft
Material Description: Brown Silty Fine Sand, occasional to much gravel (SM)	
Gauge height above ground:	1.25 ft
Poisson's coefficient:	0.33
Fluid density:	1.078 g/cc
Probe size:	N
Slotted casing Used:	No

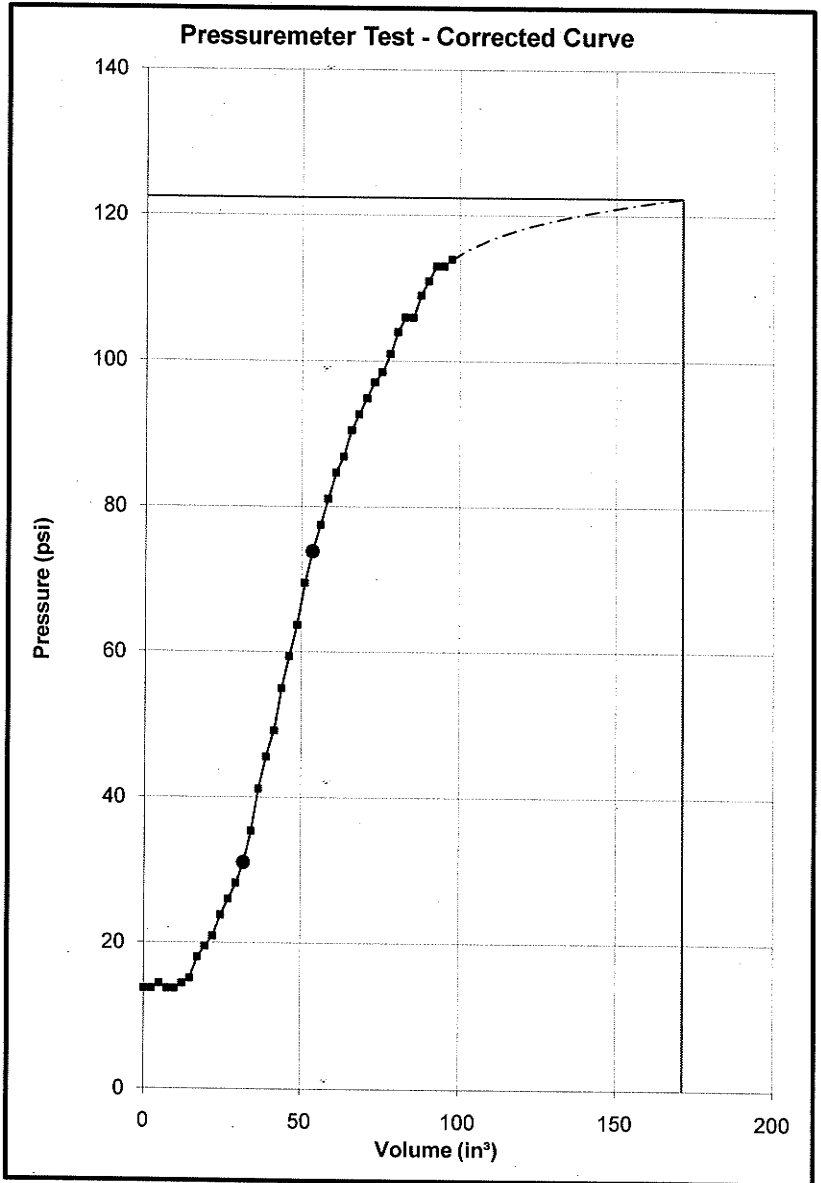
Soils & Engineering Services, Inc.
 1102 STEWART STREET • MADISON, WISCONSIN 53713
 Phone: 608-274-7600 • 888-866-SOIL (7645)
 Fax: 608-274-7511 • Email: soils@soils.ws
 CONSULTING CIVIL ENGINEERS SINCE 1966

FIELD TEST RESULT RECORD
 New Waste Transfer Station
 Rodefeld Landfill
 7102 US Highway 12
 Dane County, Wisconsin

FIGURE
12844-O

TEXAM Pressuremeter Test

Raw Readings		Corrected Readings	
Pressure psi	Volume in ³	Pressure psi	Volume in ³
0.00	0.00	13.7	0.00
2.90	5.80	13.7	2.43
3.63	11.6	14.4	4.87
3.63	17.4	13.7	7.31
4.35	23.2	13.7	9.75
5.08	29.0	14.4	12.2
5.80	34.8	15.1	14.6
8.70	40.6	18.0	17.1
10.2	46.4	19.5	19.5
11.6	52.2	20.9	21.9
14.5	58.0	23.8	24.4
16.7	63.8	26.0	26.8
18.9	69.6	28.2	29.2
21.8	75.4	31.1	31.7
26.1	81.2	35.4	34.1
31.9	87.0	41.2	36.5
36.3	92.8	45.6	39.0
40.6	98.6	49.2	41.4
46.4	104	55.0	43.8
50.8	110	59.4	46.2
55.1	116	63.7	48.7
60.9	122	69.5	51.1
65.3	128	73.9	53.5
68.9	133	77.5	56.0
72.5	139	81.1	58.4
76.1	145	84.7	60.8
78.3	151	86.9	63.3
81.9	157	90.5	65.7
84.1	162	92.7	68.1
87.0	168	94.9	70.6
89.2	174	97.1	73.0
90.6	180	98.5	75.4
92.8	186	101	77.9
95.7	191	104	80.3
97.9	197	106	82.7
98.6	203	106	85.2
102	209	109	87.6
104	215	111	90.0
106	220	113	92.5
107	226	113	94.9
107	232	114	97.3



Test Results	
Pressuremeter modulus (E):	784 psi
Ultimate pressure (P _L):	122 psi
Ratio of E / P _L :	6.43
Yield pressure (P _F):	73.9 psi
Ratio of P _L / P _F :	1.65

Remarks

Test Results	
Borehole name:	PM12
Test date: (mm/dd/yyyy)	12/08/2009
Test number:	12B
Test depth:	28.00 ft
Material Description:	Brown Silty Fine Sand, occasional to much gravel (SM)
Gauge height above ground:	1.25 ft
Poisson's coefficient:	0.33
Fluid density:	1.078 g/cc
Probe size:	N
Slotted casing Used:	No

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 CONSULTING CIVIL ENGINEERS SINCE 1966

FIELD TEST RESULT RECORD
 New Waste Transfer Station
 Rodefeld Landfill
 7102 US Highway 12
 Dane County, Wisconsin

FIGURE
12844-P

Revised on 1/13/2010



SOILS & ENGINEERING SERVICES, INC.

CONSULTING CIVIL ENGINEERS SINCE 1966

January 27, 2010

Project 12844 L01

Mr. John Welch
Dane County Dept. of Public Works, Highway & Transportation
Solid Waste Division
1919 Alliant Energy Center Way
Madison, Wisconsin 54713

Subject: Modulus of Subgrade Reaction
New Waste Transfer Station
Rodefild Landfill
7102 US Highway 12
Dane County, Wisconsin


Dear Mr. Welch:

We were contacted by Mr. Jonathan Hoeltke with GRAEF on January 26, 2010, requesting the modulus of subgrade reaction, "k," for usage in designing the slab-on-grade floor for the proposed Waste Transfer Station. We recommend a modulus of subgrade reaction of 125 pounds per square inch per inch (psi/in) be used for the recommended compacted cohesive/granular mixed fill material to be placed to raise the grade for the subject structure. The compacted cohesive/granular mixed fill material should be placed and compacted as specified in our January 19, 2010, *Geotechnical Exploration and Analyses Report*.

If you have any questions concerning this submittal, or if we can be of further assistance, please contact us.

Respectfully submitted,

SOILS & ENGINEERING SERVICES, INC.


Craig M. Bower, P.E.
CMB:OTG:cmb

xc: Mr. John H. Kannall, P.E., GRAEF (via email)
Mr. Daniel F. Windorski, P.E., GRAEF (via email)
Mr. Jonathon W. Hoeltke, P.E., GRAEF (via email)



SOILS & ENGINEERING SERVICES, INC.

CONSULTING CIVIL ENGINEERS SINCE 1966

April 19, 2010

Project 12844 R02

Mr. John Welch
Dane County Dept. of Public Works, Highway & Transportation
Solid Waste Division
1919 Alliant Energy Center Way
Madison, Wisconsin 54713

Subject: Supplementary Geotechnical Exploration Recommendations
 New Waste Transfer Station
 Rodefeld Landfill
 7102 US Highway 12
 Dane County, Wisconsin

Dear Mr. Welch:

We met with Messrs. Jonathan Hoeltke, Dan Windorski, and John Kannall with GRAEF on April 13, 2010, to discuss how to reduce the lateral earth pressures against the foundation wall below the push wall and to increase the sliding resistance forces of this same wall for the proposed Waste Transfer Station. They requested us to provide an equivalent soil surcharge load for use in the foundation wall design that represents the weight and forces for a compactor working behind the foundation wall during backfill operations. During the meeting, we also briefly discussed the pavement section on the east side of the station and they requested us to provide comments and recommendations regarding the proposed paved areas of the proposed development.

The comments and recommendations provided herein supplement the comments and recommendations provided in our January 19, 2010, *Geotechnical Exploration and Analyses Report* (hereafter referred to as *2010 Geotechnical Report*).

Pavement Recommendations

We recommend excavation of the existing fill material and/or topsoil followed by proof-rolling and/or thorough compaction of the exposed excavation surface under all proposed paved areas as

specified in our *2010 Geotechnical Report*. The excavation to remove these materials should extend outward 1-foot from the outside edge of the proposed paved areas for every 1-foot of depth below the proposed pavement elevation. Compacted granular fill material and/or compacted site fill material as defined in our *2010 Geotechnical Report* should then be placed to the proposed subgrade elevation.

On April 14, 2009, Mr. Hoeltke requested possible alternatives to removing the existing fill material and/or topsoil from below the proposed paved areas. Based on our review of the soil boring results and the proposed improvements, we recommend our recommendations as stated above should be accomplished under all proposed Portland cement concrete paved areas, the proposed ramp to the tipping slab area, and from below the existing small pond located immediately west of the proposed building. For all other areas, after removal of the existing pavement and surficial topsoil/vegetation, thorough compaction and/or proof-rolling of the exposed soil should be performed as specified in our *2010 Geotechnical Report*.

We recommend the increase in heavy vehicle traffic be considered in determining whether to remove the existing fill material and/or topsoil from below all proposed improvements or only some of the proposed improvements. If the recommended fill material and/or topsoil is not performed under all the proposed improvements, then the potential for differential settlement of the paved areas will be greater. The results from our soil borings indicate the existing fill material removed under any of the above scenarios consists predominantly of granular material. Any existing granular fill material removed from below the proposed improvements could be stockpiled for reuse as compacted granular fill material for the subject project.

Following completion of the excavation and backfilling operations in the proposed paved areas, we recommend placement of a minimum of 12 inches of dense graded crushed stone base course as specified in Section 305.2 of the WisDOT *Standard Specifications for Highway and Structure Construction*. Where the subgrade soils are predominantly cohesive, we recommend the placement of a woven, separation-type geotextile, such as Mirafi 600X, across the entire subgrade surface. We recommend the base course consist of 6 inches of 1¼-inch-size material followed by 6 inches of ¾-inch-size material. For the proposed ramp to the tipping slab area of the proposed building, we recommend 6 inches of 1-inch-size open graded crushed stone base course material as specified in Section 310.2 of the WisDOT *Standard Specifications for Highway and Structure Construction* be used in lieu of the 1¼-inch-size dense graded material. To prevent the migration of soil particles from the dense graded base course into the open graded base course, we recommend a woven, separation-type geotextile such as Mirafi 600X, be placed on top of the open graded base course. We recommend the dense graded and open graded crushed stone base courses be thoroughly compacted to a density of at least 95 percent of the maximum dry density determined for the base course material according to ASTM Designation D 1557.



At the bottom of the proposed ramp to the tipping slab area, we recommend the installation of 4-inch diameter drain tile pipe within the open graded base course layer to aid in draining any water that may accumulate in the open graded base course material. The drain tile pipes should be placed to drain into an existing or proposed storm sewer or a nearby ditch. Geotextile should cover the drain pipes to prevent the migration of soil particles.

Following placement of the crushed stone base course, we recommend a minimum thickness of 3 inches of hot-mix asphalt pavement meeting the requirements of Type E-0.3 material as specified in Section 460 of the WisDOT *Standard Specifications for Highway and Structure Construction* for proposed driveway and parking areas for cars in the vicinity of the household hazardous waste area. For the paved areas where garbage trucks, large container trucks, and/or large landfill/construction equipment will be traveling, we recommend a minimum thickness of 6 inches of hot-mix asphalt pavement meeting the requirements of Type E-1.0 material as specified in Section 460 of the WisDOT *Standard Specifications for Highway and Structure Construction* for asphaltic concrete pavement or a minimum thickness of 9 inches for Portland cement concrete pavement. We recommend the Portland cement concrete pavement be used where these heavy vehicles will be braking/stopping or where they will be turning without forward movement or at slow speeds. Stopping and turning of heavy vehicles can displace and/or tear hot-mix asphalt pavement.

Lateral Earth Pressure

The lateral earth pressures exerted on a wall are a function of the height, density, and friction angle of the material being retained by the wall. You can reduce the lateral earth pressures by increasing the friction angle and reducing the density of the material being retained. The material used can consist of soil or inert materials. Lean concrete or lightweight expanded polystyrene blocks are examples of inert materials that could be used. Inert materials are used to replace the existing or proposed retained material within the zone of influence behind the proposed wall. The zone of influence is the area defined by the ground surface of the retained material down, the back side of the wall, and the line created by the angle measured from the horizontal and equal to the friction angle of the material remaining in-place. The use of an inert material within the defined zone of influence eliminates the lateral earth pressure on a wall. Replacing a portion of the retained material with inert material to reduce the lateral earth pressure is also an option.

We updated the table presented on Page 14 of our *2010 Geotechnical Report* with additional estimated values of density, friction angle, cohesion, and lateral earth pressure coefficients for various materials that could be used for backfill behind the proposed walls for this project. We provide this revised table as follows:



Retained Material	Estimated Soil Parameters			Earth Pressure Coefficient		
	Moist Density (^{lb} / _{feet} ³)	Friction Angle, φ (degrees)	Cohesion (^{lb} / _{feet} ²)	Passive (K _p)	Active (K _a)	At-Rest (K ₀)
Compacted on-site excavated cohesive/granular fill material ¹	135	25	2000	2.46	0.41	0.58
Compacted granular fill material consisting of silty fine sand and gravel or similar ²	135	32	0	3.25	0.31	0.47
Compacted granular fill material consisting of fine sand with no gravel or similar ²	110	30	0	3.00	0.33	0.50
Compacted crushed stone base course ²	140	37	0	4.02	0.25	0.40
Compacted 3" clear crushed stone without fines ³	95	50	0	7.55	0.13	0.23
Compacted 1" clear crushed stone without fines ³	100	47	0	6.44	0.16	0.27
Compacted ¾" clear crushed stone without fines ³	105	41	0	4.82	0.21	0.34

We understand the current design uses the thickness of a 5-foot thick layer of lean concrete at the bottom of the wall to reduce the lateral earth pressure. This lean concrete layer could be increased or a lower density/high friction angle material could be used to further reduce the lateral earth pressure. If a lower density/high friction angle material is selected, we recommend the 3" clear crushed stone without fines be used to backfill the west foundation wall within the lateral earth pressure zone of influence to reduce the lateral earth pressure on the wall.

Equivalent Soil Pressure for Compactors

The pressure of a soil compactor similar to the type of compactors that are used at the Rodefild Landfill could exert a pressure in the range of 3,500 to 6,500 pounds per square foot. Due to this large pressure, we recommend that smaller compactors be used within the zone of influence horizontal distance behind any exposed foundation wall acting as a retaining wall. We understand a floor loading of 600 pounds per square foot is being used in the foundation wall design for the tipping slab area. The size of compactor a contractor could use in backfilling the wall should be limited to this pressure. Adequate temporary lateral bracing of exposed foundation walls could be

¹Compacted to a density at least 90 percent of the maximum dry density determined for the backfill material in accordance with ASTM Designation D 1557 at a moisture content of approximately 2 percent above optimum moisture. The material also needs to be well-knit together and have a minimum unconfined compressive strength of 2.0 tons per square foot as measured with a spring penetrometer. See Section 3.b. in our *2010 Geotechnical Report*.

²Compacted to a density at least 95 percent of the maximum dry density determined for the backfill material in accordance with ASTM Designation D 1557. See Section 3.a. in our *2010 Geotechnical Report*.

³Thoroughly compacted in maximum 1-foot loose lifts using a vibratory smooth-drum compactor.



accomplished to allow the usage of compactors exceeding the design limitations. The contractor should be aware of the design limitations.

Sliding Resistance Force

A wall will want to slide due to the lateral earth pressure of the retained soil behind the wall. The resistance to this sliding is provided by the weight of the wall, the thickness of material in front of the wall, the unit weight of the material in front of the wall, and the friction between the bottom of the concrete footing supporting the wall and the underlying support material. Any or all of the following items could increase the sliding resistance force:

- Increase the mass (size) of the wall to increase the weight of the structure.
- Lower the bottom footing elevation to increase the thickness of material in front of the wall.
- Add a keyway (short wall section extending below the footing) which increases the thickness of material in front of the wall and changes the friction in front of the keyway from between concrete on soil to between soil on soil. We recommend coefficients of sliding friction of 0.45 for concrete on soil and 0.70 for soil on soil sliding.
- Increase the weight of the material in front of the wall by changing to a higher density material. If selected, we recommend the usage of compacted dense-graded crushed stone base course in front of the wall. The compacted dense-graded crushed stone base course should extend vertically from the proposed finished grade in front of the wall to the bottom of the wall footing, or keyway if present, and should extend horizontally away from the wall a minimum of $\frac{1}{2}$ the height of the wall as measured from the top of the wall to the bottom of the wall footing or keyway. The dense-graded crushed stone base course should be placed and compacted as specified in Section 3.a. of our *2010 Geotechnical Report*.
- Decrease the lateral earth pressure of the material being retained by the wall using one of the materials discussed above to reduce the lateral earth pressure the wall needs to resist. A lower sliding resistance force is then needed if the lateral earth pressure is reduced.
- Change the type of material below the footing of the wall with a material with a higher friction angle. If used, we recommend a minimum of 5 feet of compacted 1" clear crushed stone without fines be placed below the footing for the wall. If a keyway is incorporated into the structure then a minimum of 4 feet of compacted 1" clear crushed stone without fines should be present below the bottom of the keyway with a minimum of 5 feet below the main footing of the wall. The compacted 1" clear crushed stone without fines should extend down and out from the edges of the wall footing at a slope of 1-foot horizontal for every 1-foot of depth. The excavation should extend lower, if necessary, to remove all native clay from



below the wall footing and the 1:1 excavation slope. The 1" clear crushed stone without fines should be placed and thoroughly compacted with a vibratory smooth-drum compactor in maximum 1-foot thick loose lifts.

- Slope the footing bearing surface that the footing for the wall is resting on. The sloping of the footing bearing surface changes many of the equations used to compute the driving and resisting forces impacting the proposed wall and thus affects not only the sliding but also the overturning factor of safety of the wall. To determine how much and to what extent this change would impact the proposed wall would require Soils & Engineering Services, Inc. to complete a stability analysis of the proposed wall configuration. Please let us know if you want to pursue this option.

The use of tie-backs and/or deadmen could be used to both resist the lateral earth pressure and to provide additional sliding resistance to the west foundation wall. The current design of the west foundation wall incorporates the use of a grade beam to tie the west and east foundation walls together near the top of the wall. This design is using the east foundation wall as a dead man to aid the west foundation wall in resisting the lateral earth pressure on the west foundation wall. Incorporating additional grade beams connecting to the east foundation wall and spaced throughout the height of the west foundation wall would further aid the west foundation wall in resisting the lateral earth pressure and providing additional sliding resistance force.

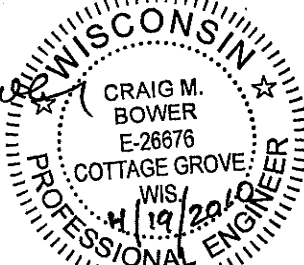
If you have any questions concerning this submittal, or if we can be of further assistance, please contact us.

Respectfully submitted,

SOILS & ENGINEERING SERVICES, INC.



Craig M. Bower, P.E.
CMB:OTG:cmb



xc: Mr. John H. Kannall, P.E., GRAEF (via email)
Mr. Daniel F. Windorski, P.E., GRAEF (via email)
Mr. Jonathon W. Hoeltke, P.E., GRAEF (via email)





SOILS & ENGINEERING SERVICES, INC.

CONSULTING CIVIL ENGINEERS SINCE 1966

April 19, 2010

Project 12844 L02

Mr. John Welch
Dane County Dept. of Public Works, Highway & Transportation
Solid Waste Division
1919 Alliant Energy Center Way
Madison, Wisconsin 54713

Subject: Sitework, Earthwork, and Excavation Specification Review
New Waste Transfer Station
Rodefeld Landfill
7102 US Highway 12
Dane County, Wisconsin

Dear Mr. Welch:

As requested by Mr. Jonathan Hoeltke and Mr. Dan Windorski with GRAEF on April 13, 2010, we have reviewed Sections 31 02 00 (General Requirements for Sitework), 31 05 13 (Soils for Earthwork), 31 05 16 (Aggregates for Earthwork), 31 23 15 (Excavation, Backfill, and Compaction for Buildings and Structures), and 31 23 16 (Utility Trench Excavation, Backfill and Compaction). Our review resulted in the following comments:

- The word “inspection” should be replaced with the word “observation” in Section 31 02 00 Part 1.2.F.; Section 31 23 15 Parts 3.5.A., 3.5.B., and 3.11.A.; and Section 31 23 16 Part 3.14.A.
- As recommended on page 9 of our January 19, 2010, *Geotechnical Exploration and Analyses Report*, hydraulic backhoes should be equipped with a cleaning bucket to minimize disturbance to the soils at the base of the excavations. This is not included in Section 31 23 15 Part 3.4 or Section 31 23 16 Part 3.7 of the specifications.
- The 10 pound sample size for submittal to the testing laboratory in Section 31 05 13 Part 1.3.B.; Section 31 05 16 Part 1.3.B.; and Section 31 23 16 Part 1.3.B. may be insufficient for

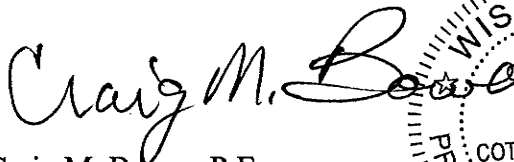
the type of material being tested and the type of test being performed.¹ The contractor should contact the testing laboratory to find out the sample size needed based on the type of material being submitted and which test or tests need to be performed.

- Section 31 23 15 Part 3.8.A. references compacting the subgrade prior to placing backfill material. As recommended on pages 9 and 10 of our January 19, 2010, *Geotechnical Exploration and Analyses Report*, exposed cohesive soils should be proof-rolled and exposed granular soils should be thoroughly compacted for a minimum of 18 inches. Please refer to pages 9 and 10 of January 19, 2010, *Geotechnical Exploration and Analyses Report* for specifics regarding the proof-rolling and thorough compaction.
- Section 31 23 15 Part 3.13 presents the required backfill material to be used for the various portions of the proposed improvement. This listing does not address the usage of the on-site cohesive/granular material stockpiled at the landfill. If this material, or a similar off-site material, will be allowed for use on this project, then our recommendations for the placement and compaction of this type of material as presented on pages 10 through 12 of our January 19, 2010, *Geotechnical Exploration and Analyses Report* should be incorporated into the specifications.

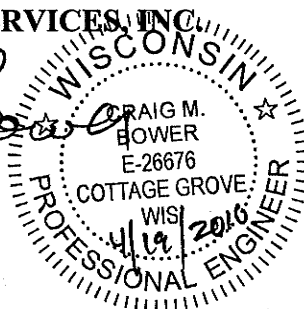
If you have any questions concerning this submittal, or if we can be of further assistance, please contact us.

Respectfully submitted,

SOILS & ENGINEERING SERVICES, INC.



Craig M. Bower, P.E.
CMB:OTG:cmb



xc: Mr. John H. Kannall, P.E., GRAEF (via email)
Mr. Daniel F. Windorski, P.E., GRAEF (via email)
Mr. Jonathon W. Hoeltke, P.E., GRAEF (via email)

¹Sample size examples for material submitted for gradation analysis only.

Aggregate Type A2 through A4 = 70 pounds

Aggregate Type A6 = 25 pounds

Aggregate Type A8 = 10 pounds

If a modified proctor is needed also, than an additional 30 to 50 pounds of material would be needed.



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BID FORM

BID NO. 310013

**PROJECT: CONSTRUCTION OF WASTE TRANSFER STATION BUILDING
& CLEAN SWEEP BUILDING
DANE COUNTY LANDFILL SITE #2**

**TO: DANE COUNTY DEPARTMENT OF PUBLIC WORKS, HIGHWAY &
TRANSPORTATION PROJECT ENGINEER
1919 ALLIANT ENERGY CENTER WAY
MADISON, WISCONSIN 53713**

BASE BID - LUMP SUM:

Construction of waste transfer station facility and adjacent household hazardous waste collection facility. The undersigned, having examined the site where the Work is to be executed and having become familiar with local conditions affecting the cost of the Work and having carefully examined the Drawings and Specifications, all other Construction Documents and Addenda thereto prepared by Dane County Department of Public Works, Highway & Transportation hereby agrees to provide all labor, materials, equipment and services necessary for the complete and satisfactory execution of the entire Work, as specified in the Construction Documents, for the Base Bid stipulated sum of:

_____ and _____/100 Dollars
Written Price

\$ _____
Numeric Price

The undersigned further agrees to add the alternate(s) portion of the Work as described, for the following addition(s) to or subtraction(s) from the Base Bid stipulated below. They further agree to honor the alternate(s) bid for 90 days from date of Award of Contract.

ALTERNATE BID 1 - LUMP SUM:

For this Alternate, Dane County will only purchase and install one compactor. Contractor's Work includes an additional plate infill in the tipping slab and door 9L to cover the compactor bay openings, and all associated work. Price for providing changes, as described in Specification Section 01 20 00, paragraph 1.6.

_____ and _____/100 Dollars
Written Price

\$ _____
Numeric Price (circle: Add or Deduct)

Receipt of the following addenda and inclusion of their provisions in this Bid is hereby acknowledged:

Addendum No(s). _____ through _____

Dated _____

Assuming a Notice to Proceed is issued by July 22, 2010, what dates can you commence and complete this job?

Commencement Date: _____ Completion Date: _____
(final, not substantial)

I hereby certify that all statements herein are made on behalf of:

(Name of Corporation, Partnership or Person submitting Bid)

Select one of the following:

1. A corporation organized and existing under the laws of the State of _____, or

2. A partnership consisting of _____, or

3. A person conducting business as _____;

Of the City, Village, or Town of _____ of the State of _____.

I have examined and carefully prepared this Bid from the associated Construction Documents and have checked the same in detail before submitting this Bid; that I have full authority to make such statements and submit this Bid in (its) (their) (my) behalf; and that the said statements are true and correct. In signing this Bid, we also certify that we have not, either directly or indirectly, entered into any agreement or participated in any collusion or otherwise taken any action in restraint of free competition; that no attempt has been made to induce any other person or firm to submit or not to submit a Bid; that this Bid has been independently arrived at without collusion with any other bidder, competitor, or potential competitor; that this Bid has not been knowingly disclosed prior to the opening of Bids to another bidder or competitor; that the above statement is accurate under penalty of perjury.

SIGNATURE: _____
(Bid is invalid without signature)

Print Name: _____ Date: _____

Title: _____

Address: _____

Telephone No.: _____ Fax No.: _____

Email Address: _____

Contact Person: _____

This page is for Bidders' reference and need not be submitted with Bid Form.

BID CHECK LIST:

These items **must** be included with Bid:

Bid Form

Bid Bond

Fair Labor Practices Certification

BIDDERS SHOULD BE AWARE OF THE FOLLOWING:

DANE COUNTY VENDOR REGISTRATION PROGRAM

Any person bidding on any County contract must be registered with the Dane County Purchasing Division & pay an annual registration fee. A contract will not be awarded to an unregistered vendor. Obtain a *Vendor Registration Form* by calling 608/266-4131 or complete a new form or renewal one online at:

www.danepurchasing.com/registration

DANE COUNTY BEST VALUE CONTRACTING PRE-QUALIFICATION

Contractors must be pre-qualified as a Best Value Contractor with the Dane County Public Works Engineering Division before the award of contract. Obtain a *Best Value Contracting Application* by calling 608/266-4018 or complete one online at:

www.co.dane.wi.us/pwht/BVC_Application.aspx

EQUAL BENEFITS REQUIREMENT

By submitting a Bid, the contractor acknowledges that a condition of this contract is to provide equal benefits as required by Dane County Code of Ordinances Chapter 25.016. Contractor shall provide equal benefits as required by that Ordinance to all required employees during the term of the contract. For more information:

www.danepurchasing.com/partner_benefit.aspx

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FAIR LABOR PRACTICES CERTIFICATION

The undersigned, for and on behalf of the BIDDER, APPLICANT or PROPOSER named herein, certifies as follows:

A. That he or she is an officer or duly authorized agent of the above-referenced BIDDER, APPLICANT or PROPOSER, which has submitted a proposal, bid or application for a contract with the county of Dane.

B. That BIDDER, APPLICANT or PROPOSER has (check one):

_____ not been found by the National Labor Relations Board (“NLRB”) or the Wisconsin Employment Relations Commission (“WERC”) to have violated any statute or regulation regarding labor standards or relations in the seven years prior to the signature date of this Certification.

_____ been found by the National Labor Relations Board (“NLRB”) or the Wisconsin Employment Relations Commission (“WERC”) to have violated any statute or regulation regarding labor standards or relations in the seven years prior to the signature date of this Certification.

Officer or Authorized Agent Signature

Date

Printed or Typed Name and Title

Printed or Typed Business Name

NOTE: You can find information regarding the violations described above at: www.nlr.gov and werc.wi.gov.

For reference, Dane County Ordinance 25.11(28)(a) is as follows:

(28) BIDDER RESPONSIBILITY. (a) Any bid, application or proposal for any contract with the county, including public works contracts regulated under chapter 40, shall include a certification indicating whether the bidder has been found by the National Labor Relations Board (NLRB) or the Wisconsin Employment Relations Committee (WERC) to have violated any statute or regulation regarding labor standards or relations within the last seven years. The purchasing manager shall investigate any such finding and make a recommendation to the committee, which shall determine whether the conduct resulting in the finding affects the bidder’s responsibility to perform the contract.

If you indicated that the NLRB or WERC have found you to have such a violation, you must include copies of any relevant information regarding such violation with your proposal, bid or application.

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DANE COUNTY DEPARTMENT of PUBLIC WORKS, HIGHWAY and TRANSPORTATION

County Executive
Kathleen M. Falk

1919 Alliant Energy Center Way • Madison, Wisconsin 53713
Phone: (608) 266-4018 • FAX: (608) 267-1533

Commissioner / Director
Gerald J. Mandli

BEST VALUE CONTRACTING APPLICATION

CONTRACTORS / LICENSURE APPLICANTS

The Dane County Department of Public Works requires all contractors to be pre-qualified as a best value contractor with the County prior to being awarded a contract. In addition, the County pre-qualifies potential contractors and sub-contractors who wish to work on County contracts. Subcontractors must become pre-qualified ten (10) days prior to commencing work under any Dane County Public Works Contract. Potential subcontractors are urged to become pre-qualified as early as possible. This document shall be completed, properly executed, along with the necessary attachments and additional information that the County requires for the protection and welfare of the public in the performance of a County contract.

Contractors or subcontractors of any tier who attain prequalification status will retain that status for a period of two (2) years from the date of qualification. Contractors shall notify the Dane County Department of Public Works, Highway & Transportation within 15 days of any changes to its business or operations that are relevant to the prequalification application. Failure to do so could result in suspension, revocation of the contractor's prequalification, debarment from County contracts for up to three years and / or other sanctions available under the law.

No contracts will be awarded for construction work performed on Dane County projects unless the contractor is currently approved as a Wisconsin Trade Trainer or has applied for approval as an Apprenticeship Trade Trainer to the Wisconsin Department of Workforce Development and agrees to an acceptable apprenticeship program. If you are not currently approved as a Wisconsin Trade Trainer, or have not applied for approval as an Apprenticeship Trade Trainer, please contact the Department of Workforce Development - Bureau of Apprenticeship Standards at 608/266-3133 or visit their web site at: dwd.wisconsin.gov/apprenticeship/.

EXEMPTIONS

- Contractors or subcontractors of any tier attain prequalification status with Dane County if the contractor has current Executive Order 108 precertification status with the State of Wisconsin.
- Contractors who employ less than five (5) apprenticeable trade workers are not required to prequalify.
- Contractors performing work that does not apply to an apprenticeable trade, as outlined in Appendix A.
- The contractor / subcontractor provides sufficient documentation to demonstrate one or more of the following:
 - apprentices are not available in a specific geographic area;
 - the applicable apprenticeship program is unsuitable or unavailable; or
 - there is a documented depression of the local construction market which prevents compliance.

SEC.	PROOF OF RESPONSIBILITY	CHECK IF APPLICABLE
1	Does your firm possess all technical qualifications and resources, including equipment, personnel and financial resources, necessary to perform the work required for any project or obtain the same through the use of responsible, prequalified subcontractors?	Yes: <input type="checkbox"/> No: <input type="checkbox"/>
2	Will your firm possess all valid, effective licenses, registrations or certificates required by federal, state, county, or local law, which are necessary for the type of work to be performed including, but not limited to, those for any type of trade work or specialty work?	Yes: <input type="checkbox"/> No: <input type="checkbox"/>
3	Will your firm meet all bonding requirements as required by applicable law or contract specifications?	Yes: <input type="checkbox"/> No: <input type="checkbox"/>
4	Will your firm meet all insurance requirements as required by applicable law or specifications, including general liability insurance, workers compensation insurance and unemployment insurance requirements?	Yes: <input type="checkbox"/> No: <input type="checkbox"/>
5	Will your firm maintain a substance abuse policy for employees hired for public works contracts that comply with Wis. Stats. Sec. 103.503?	Yes: <input type="checkbox"/> No: <input type="checkbox"/>
6	Does your firm acknowledge that it must pay all craft employees on public works projects the wage rates and benefits required under Section 66.0903 of the Wisconsin Statutes?	Yes: <input type="checkbox"/> No: <input type="checkbox"/>
7	Will your firm fully abide by the equal opportunity and affirmative action requirements of all applicable laws, including County ordinances?	Yes: <input type="checkbox"/> No: <input type="checkbox"/>
8	In the past three (3) years, has your firm had control or has another corporation, partnership or other business entity operating in the construction industry controlled it? If so, please attach a statement explaining the nature of the firm relationship?	Yes: <input type="checkbox"/> No: <input type="checkbox"/> If Yes, attach details.
9	In the past three (3) years, has your firm had any type of business, contracting or trade license, certification or registration revoked or suspended?	Yes: <input type="checkbox"/> No: <input type="checkbox"/> If Yes, attach details.
10	In the past three (3) years, has your firm been debarred by any federal, state or local government agency?	Yes: <input type="checkbox"/> No: <input type="checkbox"/> If Yes, attach details.
11	In the past three (3) years, has your firm defaulted or failed to complete any contract?	Yes: <input type="checkbox"/> No: <input type="checkbox"/> If Yes, attach details.
12	In the past three (3) years, has your firm committed a willful violation of federal, state or local government safety laws as determined by a final decision of a court or government agency authority.	Yes: <input type="checkbox"/> No: <input type="checkbox"/> If Yes, attach details.
13	In the past three (3) years, has your firm been in violation of any law relating to your contracting business where the penalty for such violation resulted in the imposition of a penalty greater than \$10,000?	Yes: <input type="checkbox"/> No: <input type="checkbox"/> If Yes, attach details.
14	Is your firm Executive Order 108 precertified with the State of Wisconsin?	Yes: <input type="checkbox"/> No: <input type="checkbox"/>
15	Is your firm an active Wisconsin Trade Trainer as determined by the Wisconsin Bureau of Apprenticeship Standards and listed at: dwd.wisconsin.gov/apprenticeship/executive_order108.htm ?	Yes: <input type="checkbox"/> No: <input type="checkbox"/>
16	Is your firm exempt from being prequalified with Dane County?	Yes: <input type="checkbox"/> No: <input type="checkbox"/> If Yes, attach reason for exemption.
17	Does your firm acknowledge that in doing work under any County Public Works Contract, it will be required to use as subcontractors only those contractors that are also prequalified with the County or become so ten days prior to commencing work?	Yes: <input type="checkbox"/> No: <input type="checkbox"/>

SIGNATURE SECTION

Your firm's Officer, or the individual who would sign a bid and / or contract documents must sign this document.

I do hereby certify that all statements herein contained are true and correct to the best of my knowledge:

Signature

Date

Printed or Typed Name and Title

NAME AND ADDRESS OF CONTRACTOR	
Name of Firm:	
Address:	
City, State, Zip:	
Telephone Number:	
Fax Number:	
E-mail Address:	

REMEMBER!

Return all to forms and attachments, or questions to:

JOHN SCHRAUFNAGEL
EMAIL: SCHRAUFNAGEL@CO.DANE.WI.US
OFFICE: (608)266-4798, CELL: (608)575-3374, FAX: (608)267-1533

**DANE COUNTY DEPARTMENT OF PUBLIC WORKS,
HIGHWAY & TRANSPORTATION
1919 ALLIANT ENERGY CENTER WAY
MADISON, WI 53713**

APPENDIX A

APPRENTICEABLE TRADES

Bricklayer
Carpenter
Cement Mason (Concrete Finisher)
Cement Mason (Heavy Highway)
Construction Craft Laborer
Data Communications Installer
Electrician
Elevator Mechanic / Technician
Environmental Systems Technician / HVAC Service Technician / HVAC Install & Service
Glazier
Heavy Equipment Operator / Operating Engineer
Insulation Worker (Heat & Frost)
Iron Worker (Assembler, Metal Buildings)
Painter / Decorator
Plasterer
Plumber
Roofer / Waterproofer
Sheet Metal Worker
Sprinkler Fitter
Steamfitter (Service & Refrigeration)
Taper & Finisher
Telecommunications (Voice, Data & Video) Installer / Technician
Tile Setter

COUNTY OF DANE

PUBLIC WORKS CONTRACT

Contract No. _____ Bid No. 310013

Authority: Res. _____, 2010-11

THIS CONTRACT, made and entered into as of the date by which authorized representatives of both parties have affixed their signatures, by and between the County of Dane (hereafter referred to as "COUNTY") and _____ (hereafter, "CONTRACTOR"), and

WITNESSETH:

WHEREAS, COUNTY, whose address is c/o Associate Public Works Director, 1919 Alliant Energy Center Way, Madison, WI 53713, desires to have CONTRACTOR provide Construction of Waste transfer Station building and Clean Sweep Building at Dane County Landfill Site #2 – Rodaefeld, 7102 U.S. Hwy 12& 18, Madison WI [including Alternate Bid 1 (if applicable)] ("the Project"); and

WHEREAS, CONTRACTOR, whose address is _____ is able and willing to construct the Project, in accordance with the Construction Documents;

NOW, THEREFORE, in consideration of the above premises and the mutual covenants of the parties hereinafter set forth, the receipt and sufficiency of which is acknowledged by each party for itself, COUNTY and CONTRACTOR do agree as follows:

1. CONTRACTOR agrees to construct, for the price of \$_____ the Project and at the CONTRACTOR'S own proper cost and expense to furnish all materials, supplies, machinery, equipment, tools, superintendence labor, insurance, and other accessories and services necessary to complete the Project in accordance with the conditions and prices stated in the Bid Form, General Conditions of Contract, the drawings which include all maps, plats, plans, and other drawings and printed or written explanatory matter thereof, and the specifications therefore as prepared by GRAEF-USA Inc. (hereinafter referred to as "the Architect / Engineer"), and as enumerated in the Project Manual Document Index, all of which are made a part hereof and collectively evidence and constitute the Contract.
2. COUNTY agrees to pay the CONTRACTOR in current funds for the performance of the Contract subject to additions and deductions, as provided in the General Conditions of Contract, and to make payments on account thereof as provided in Article entitled, "Payments to Contractor" of the General Conditions of Contract.
3. During the term of this Contract, CONTRACTOR agrees to take affirmative action to ensure equal employment opportunities. The CONTRACTOR agrees in accordance with Wisconsin Statute 111.321 and Chapter 19 of the Dane County Code of Ordinances not to discriminate on

the basis of age, race, ethnicity, religion, color, gender, disability, marital status, sexual orientation, national origin, cultural differences, ancestry, physical appearance, arrest record or conviction record, military participation or membership in the national guard, state defense force or any other reserve component of the military forces of the United States, or political beliefs. Such equal opportunity shall include, but not be limited to, the following: employment, upgrading, demotion, transfer, recruitment, advertising, layoff, termination, training, rates of pay, and any other form of compensation. CONTRACTOR agrees to post in conspicuous places, available to all employees and applicants for employment, notices setting forth the provisions of this paragraph.

4. CONTRACTOR shall file an Affirmative Action Plan with the Dane County Contract Compliance Officer in accord with Chapter 19 of the Dane County Code of Ordinances. CONTRACTOR must file such plan within fifteen (15) days of the effective date of this Contract. During the term of this Contract CONTRACTOR shall also provide copies of all announcements of employment opportunities to COUNTY'S Contract Compliance Office, and shall report annually the number of persons, by race, ethnicity, gender, and disability status, which apply for employment and, similarly classified, the number hired and number rejected.

5. During the term of this Contract, all solicitations for employment placed on CONTRACTOR'S behalf shall include a statement to the effect that CONTRACTOR is an "Equal Opportunity Employer."

6. CONTRACTOR agrees to comply with provisions of Chapter 25.016 of the Dane County Code of Ordinances, which pertains to domestic partnership benefits.

7. CONTRACTOR agrees to furnish all information and reports required by COUNTY'S Contract Compliance Officer as the same relate to affirmative action and nondiscrimination, which may include any books, records, or accounts deemed appropriate to determine compliance with Chapter 19, Dane County Code of Ordinances, and the provisions of this Contract.

8. CONTRACTOR agrees that all persons employed by CONTRACTOR or any subcontractor shall be paid no less than the minimum wage established under Chapter 40, Subchapter II, Dane County Code of Ordinances. CONTRACTOR agrees to abide by and comply with the provisions of Chapter 40, Subchapter II of the Dane County Code of Ordinances, and said Subchapter is fully incorporated herein by reference.

9. This Contract is intended to be a Contract solely between the parties hereto and for their benefit only. No part of this Contract shall be construed to add to, supplement, amend, abridge or repeal existing rights, benefits or privileges of any third party or parties including, but not limited to, employees of either of the parties.

10. The entire agreement of the parties is contained herein and this Contract supersedes any and all oral agreements and negotiations between the parties relating to the subject matter hereof. The parties expressly agree that the express terms of this Contract shall not be amended in any fashion except in writing, executed by both parties.

11. CONTRACTOR must be pre-qualified as a Best Value Contractor with Dane County Public Works Engineering Division before award of Contract. Subcontractors must be pre-qualified ten (10) days prior to commencing Work under this Contract.

IN WITNESS WHEREOF, COUNTY and CONTRACTOR, by their respective authorized agents, have caused this Contract and its Schedules to be executed, effective as of the date by which all parties hereto have affixed their respective signatures, as indicated below.

* * * * *

FOR CONTRACTOR:

Signature _____
Date

Printed or Typed Name and Title

Signature _____
Date

Printed or Typed Name and Title

NOTE: If CONTRACTOR is a corporation, Secretary should attest. In accordance with IRS Regulations, unincorporated entities are required to provide either their Social Security or Employer Number in order to receive payment for services rendered.

* * * * *

This Contract is not valid or effectual for any purpose until approved by the appropriate authority designated below, and no work is authorized until the CONTRACTOR has been given notice to proceed by COUNTY'S Associate Public Works Director.

FOR COUNTY:

Kathleen M. Falk, County Executive _____
Date

Robert Ohlsen, County Clerk _____
Date

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THE AMERICAN INSTITUTE OF ARCHITECTS



AIA Document A310

Bid Bond

Bond No.

KNOW ALL MEN BY THESE PRESENTS, that we (Here insert full name and address or legal title of Contractor)

as Principal, hereinafter called the Principal, and (Here insert full name and address or legal title of Surety)

a corporation duly organized under the laws of the State of WI as Surety, hereinafter called the Surety, are held and firmly bound unto (Here insert full name and address or legal title of Owner)

as Obligee, hereinafter called Obligee, in the sum of () Percent of total amount bid Dollars (\$) Percent of attached bid.

For the payment of which sum well and truly to be made, the said Principal and the said Surety, bind ourselves, our heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS, the Principal has submitted a bid for Project No.: (Here insert full name, address, and description of project)

NOW, THEREFORE, if the Obligee shall accept the bid of the Principal and the Principal shall enter into a Contract with the Obligee in accordance with the terms of such bid, and give such bond or bonds as may be specified in the bidding or Contract Documents with good and sufficient surety for the faithful performance of such Contract and for the prompt payment of labor and material furnished in the prosecution thereof, or in the event of the failure of the Principal to enter such Contract and give such bond or bonds, if the Principal shall pay to the Obligee the difference not to exceed the penalty hereof between the amount specified in said bid and such larger amount for which the Obligee may in good faith contract with another party to perform the Work covered by said bid, then this obligation shall be null and void, otherwise to remain in full force and effect.

Signed and sealed this day of , 20 .

(Principal) (Seal)
(Witness)
(Title)
(Surety) (Seal)
ATTORNEY-IN-FACT

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THE AMERICAN INSTITUTE OF ARCHITECTS



Bond No. _____

AIA Document A312

Performance Bond

Any singular reference to Contractor, Surety, Owner or other party shall be considered plural where applicable.

CONTRACTOR (Name and Address): _____

SURETY (Name and Principal Place of Business): _____

OWNER (Name and Address): _____

CONSTRUCTION CONTRACT
Date: _____
Amount: \$ _____
Description (Name and Location): _____

BOND

Date (Not earlier than Construction Contract Date): _____

Amount: \$ _____

Modifications to this Bond: _____

None

See Page 3

CONTRACTOR AS PRINCIPAL
COMPANY: _____
(Corporate Seal)

SURETY COMPANY: _____
(Corporate Seal)

Signature: _____
Name and Title:

Signature: _____
Name and Title: _____
Attorney-in-Fact

(Any additional signatures appear on page 3)

FOR INFORMATION ONLY-Name, Address and Telephone
AGENT OR BROKER: _____

OWNER'S REPRESENTATIVE (Architect,
Engineer or other party): _____

1. The Contractor and the Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors, and assigns to the Owner for the performance of the Construction Contract, which is incorporated herein by reference.

2. If the Contractor performs the Construction Contract, the Surety and the Contractor shall have no obligation under this Bond, except to participate in conferences as provided in Subparagraph 3.1.

3. If there is no Owner Default, the Surety's obligation under this Bond shall arise after:

3.1 The Owner has notified the Contractor and the Surety at its address described in Paragraph 10 below that the Owner is considering declaring a Contractor Default and has requested and attempted to arrange a conference with the Contractor and the Surety to be held not later than fifteen days after receipt of such notice to discuss methods of performing the Construction Contract. If the Owner, the Contractor and the Surety agree, the Contractor shall be allowed a reasonable time to perform the Construction Contract, but such an agreement shall not waive the Owner's right, if any, subsequently to declare a Contractor Default; and

3.2 The Owner has declared a Contractor Default and formally terminated the Contractor's right to complete the contract. Such Contractor Default shall not be declared earlier than twenty days after the Contractor and the Surety have received notice as provided in Subparagraph 3.1; and

3.3 The Owner has agreed to pay the Balance of the Contract Price to the Surety in accordance with the terms of the Construction Contract or to a contractor selected to perform the Construction Contract in accordance with the terms of the contract with the Owner.

4. When the Owner has satisfied the conditions of Paragraph 3, the Surety shall promptly and at the Surety's expense take one of the following actions:

4.1 Arrange for the Contractor, with consent of the Owner, to perform and complete the Construction Contract; or

4.2 Undertake to perform and complete the Construction Contract itself, through its agents or through independent contractors; or

4.3 Obtain bids or negotiated proposals from qualified contractors acceptable to the Owner for a contract for performance and completion of the Construction Contract, arrange for a contract to be prepared for execution by the Owner and the contractor selected with the Owner's concurrence, to be secured with performance and payment bonds executed by a qualified surety equivalent to the bonds issued on the Construction Contract, and pay to the Owner the amount of damages as described in Paragraph 6 in excess of the Balance of the Contract Price incurred by the Owner resulting from the Contractor's default; or

4.4 Waive its rights to perform and complete, arrange for completion, or obtain a new contractor and with reasonable promptness under the circumstances:

1. After investigation, determine the amount for

which it may be liable to the Owner and, as soon as practicable after the amount is determined, tender payment therefor to the Owner; or

2. Deny liability in whole or in part and notify the Owner citing reasons therefor.

5. If the Surety does not proceed as provided in Paragraph 4 with reasonable promptness, the Surety shall be deemed to be in default on this Bond fifteen days after receipt of an additional written notice from the Owner to the Surety demanding that the Surety perform its obligations under this Bond, and the Owner shall be entitled to enforce any remedy available to the Owner. If the Surety proceeds as provided in Subparagraph 4.4, and the Owner refuses the payment tendered or the Surety has denied liability, in whole or in part, without further notice the Owner shall be entitled to enforce any remedy available to the Owner.

6. After the Owner has terminated the Contractor's right to complete the Construction Contract, and if the Surety elects to act under Subparagraph 4.1, 4.2, or 4.3 above, then the responsibilities of the Surety to the Owner shall not be greater than those of the Contractor under the Construction Contract, and the responsibilities of the Owner to the Surety shall not be greater than those of the Owner under the Construction Contract. To the limit of the amount of this Bond, but subject to commitment by the Owner of the Balance of the Contract Price to mitigation of costs and damages on the Construction Contract, the Surety is obligated without duplication for:

6.1 The responsibilities of the Contractor for correction of defective work and completion of the Construction Contract;

6.2 Additional legal, design professional and delay costs resulting from the Contractor's Default, and resulting from the actions or failure to act of the Surety under Paragraph 4; and

6.3 Liquidated damages, or if no liquidated damages are specified in the Construction Contract, actual damages caused by delayed performance or non-performance of the Contractor.

7. The Surety shall not be liable to the Owner or others for obligations of the Contractor that are unrelated to the Construction Contract, and the Balance of the Contract Price shall not be reduced or set off on account of any such unrelated obligations. No right of action shall accrue on this Bond to any person or entity other than the Owner or its heirs, executors, administrators, or successors.

8. The Surety hereby waives notice of any change, including changes of time, to the Construction Contract or to related subcontracts, purchase orders and other obligations.

9. Any proceeding, legal or equitable, under this Bond may be instituted in any court of competent jurisdiction in the location in which the work or part of the work is located and shall be instituted within two years after Contractor Default or within two years after the Contractor ceased working or within two years after the Surety refuses or fails to perform its obligations under this Bond, whichever occurs first. If the provisions of this Paragraph are void or prohibited by law, the minimum period of limitation available to sureties as a defense in the jurisdiction of the suit shall be applicable.

10. Notice to the Surety, the Owner or the Contractor shall be mailed or delivered to the address shown on the signature page.

11. When this Bond has been furnished to comply with a statutory or other legal requirement in the location where the construction was to be performed, any provision in this Bond conflicting with said statutory or legal requirement shall be deemed deleted here from and provisions conforming to such statutory or other legal requirement shall be deemed incorporated herein. The intent is that this Bond shall be construed as a statutory bond and not as a common law bond.

12 DEFINITIONS

12.1 Balance of the Contract Price: The total amount payable by the Owner to the Contractor under the Construction Contract after all proper adjustments have been made, including allowance to the Contractor of any amounts received or to be received by the Owner in settlement of insurance or other

claims for damages to which the Contractor is entitled, reduced by all valid and proper payments made to or on behalf of the Contractor under the Construction Contract.

12.2 Construction Contract: The agreement between the Owner and the Contractor identified on the signature page, including all Contract Documents and changes thereto.

12.3 Contractor Default: Failure of the Contractor, which has neither been remedied nor waived, to perform or otherwise to comply with the terms of the Construction Contract.

12.4 Owner Default: Failure of the Owner, which has neither been remedied nor waived, to pay the Contractor as required by the Construction Contract or to perform and complete or comply with the other terms thereof.

MODIFICATIONS TO THIS BOND ARE AS FOLLOWS:

SAMPLE

(Space is provided below for additional signatures of added parties, other than those appearing on the cover page.)

CONTRACTOR AS PRINCIPAL
Company: (Corporate Seal)

SURETY
Company: (Corporate Seal)

Signature: _____
Name and Title:
Address:

Signature: _____
Name and Title:
Address:

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THE AMERICAN INSTITUTE OF ARCHITECTS



Bond No. _____

AIA Document A312

Payment Bond

Any singular reference to Contractor, Surety, Owner or other party shall be considered plural where applicable.

CONTRACTOR (Name and Address):

SURETY (Name and Principal Place of Business):

OWNER (Name and Address):

CONSTRUCTION CONTRACT
Date:
Amount: \$
Description (Name and Location):

BOND

Date (Not earlier than Construction Contract Date):

Amount: \$

Modifications to this Bond:

None

See Page 6

CONTRACTOR AS PRINCIPAL
COMPANY: (Corporate Seal)

SURETY COMPANY:
(Corporate Seal)

Signature: _____
Name and Title:

Signature: _____
Name and Title:
Attorney-in-Fact

(Any additional signatures appear on page 6)

FOR INFORMATION ONLY-Name, Address and Telephone
AGENT OR BROKER:

OWNER'S REPRESENTATIVE (Architect,
Engineer or other party):

1. The Contractor and the Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors, and assigns to the Owner to pay for labor, materials and equipment furnished for use in the performance of the Construction Contract, which is incorporated herein by reference.

2. With respect to the Owner, this obligation shall be null and void if the Contractor:

2.1 Promptly makes payment, directly, or indirectly, for all sums due Claimants, and

2.2 Defends, indemnifies and holds harmless the Owner from claims, demands, liens or suits by any person or entity whose claim, demand, lien or suit is for the payment for labor, materials, or equipment furnished for use in the performance of the Construction Contract, provided the Owner has promptly notified the Contractor and the Surety (at the address described in Paragraph 12) of any claims, demands, liens, or suits and tendered defense of such claims, demands, liens or suits to the Contractor and the Surety, and provided there is no Owner Default.

3. With respect to Claimants, this obligation shall be null and void if the Contractor promptly makes payment, directly or indirectly, for all sums due.

4. The Surety shall have no obligation to Claimants under this Bond until:

4.1 Claimants who are employed by or have a direct contract with the Contractor have given notice to the Surety (at the address described in Paragraph 12) and sent a copy, or notice thereof, to the Owner, stating that a claim is being made under this Bond and, with substantial accuracy, the amount of the claim.

4.2 Claimants who do not have a direct contract with the Contractor:

1. Have furnished written notice to the Contractor and sent a copy, or notice thereof, to the Owner, within 90 days after having last performed labor or last furnished materials or equipment included in the claim stating, with substantial accuracy, the amount of the claim and the name of the party to whom the materials were furnished or supplied or for whom the labor was done or performed; and
2. Have either received a rejection in whole or in part from the Contractor, or not received within 30 days of furnishing the above notice any communication from the Contractor by which the Contractor has indicated the claim will be paid directly or indirectly; and
3. Not having been paid within the above 30 days, have sent a written notice to the Surety (at the address described in Paragraph 12) and sent a copy, or notice thereof, to the Owner, stating that a claim is being made under this Bond and enclosing a copy of the previous written notice furnished to the Contractor.

5. If a notice required by Paragraph 4 is given by the Owner to the Contractor or to the Surety, that is sufficient compliance.

6. When the Claimant has satisfied the conditions of Paragraph 4, the Surety shall promptly and at the Surety's expense take the following actions:

6.1 Send an answer to the Claimant, with a copy to the Owner, within 45 days after receipt of the claim, stating the amounts that are undisputed and the basis for challenging any amounts that are disputed.

6.2 Pay or arrange for payment of any undisputed amounts.

7. The Surety's total obligation shall not exceed the amount of this Bond, and the amount of this Bond shall be credited for any payments made in good faith by the Surety.

8. Amounts owed by the Owner to the Contractor under the Construction Contract shall be used for the performance of the Construction Contract and to satisfy claims, if any, under any Construction Performance Bond. By the Contractor furnishing and the Owner accepting this Bond, they agree that all funds earned by the Contractor in the performance of the Construction Contract are dedicated to satisfy obligations of the Contractor and the Surety under this Bond, subject to the Owner's priority to use the funds for the completion of the work.

9. The Surety shall not be liable to the Owner, Claimants or others for obligations of the Contractor that are unrelated to the Construction Contract. The Owner shall not be liable for payment of any costs or expenses of any Claimant under this Bond, and shall have under this Bond no obligations to make payments to, give notices on behalf of, or otherwise have obligations to Claimants under this Bond.

10. The Surety hereby waives notice of any change, including changes of time, to the Construction Contract or to related subcontracts, purchase orders and other obligations.

11. No suit or action shall be commenced by a Claimant under this Bond other than in a court of competent jurisdiction in the location in which the work or part of the work is located or after the expiration of one year from the date (1) on which the Claimant gave the notice required by Subparagraph 4.1 or Clause 4.2.3, or (2) on which the last labor or service was performed by anyone or the last materials or equipment were furnished by anyone under the Construction Contract, whichever of (1) or (2) first occurs. If the provisions of this Paragraph are void or prohibited by law, the minimum period of limitation available to sureties as a defense in the jurisdiction of the suit shall be applicable.

12. Notice to the Surety, the Owner or the Contractor shall be mailed or delivered to the address shown on the signature page. Actual receipt of notice by Surety, the Owner or the Contractor, however accomplished, shall be sufficient compliance as of the date received at the address shown on the signature page.

13. When this Bond has been furnished to comply with a statutory or other legal requirement in the location where the construction was to be performed, any provision in this Bond conflicting with said statutory or legal requirement shall be deemed deleted herefrom and provisions conforming to such statutory or other legal requirement shall be deemed incorporated herein. The intent is that this Bond shall be construed as a statutory bond and not as a common law bond.

14. Upon request by any person or entity appearing to be a potential beneficiary of this Bond, the Contractor

shall promptly furnish a copy of this Bond or shall permit a copy to be made.

15. DEFINITIONS

15.1 Claimant: An individual or entity having a direct contract with the Contractor or with a subcontractor of the Contractor to furnish labor, materials or equipment for use in the performance of the Contract. The intent of this Bond shall be to include without limitation in the terms "labor, materials or equipment" that part of water, gas, power, light, heat, oil, gasoline, telephone service or rental equipment used in the Construction Contract, architectural and engineering services required for performance of the work of the Contractor and the Contractor's

subcontractors, and all other items for which a mechanic's lien may be asserted in the jurisdiction where the labor, materials or equipment were furnished.

15.2 Construction Contract: The agreement between the Owner and the Contractor identified on the signature page, including all Contract Documents and changes thereto.

15.3 Owner Default: Failure of the Owner, which has neither been remedied nor waived, to pay the Contractor as required by the Construction Contract or to perform and complete or comply with the other terms thereof.

MODIFICATIONS TO THIS BOND ARE AS FOLLOWS:

SAMPLE

(Space is provided below for additional signatures of added parties, other than those appearing on the cover page.)

CONTRACTOR AS PRINCIPAL
Company: (Corporate Seal)

SURETY
Company: (Corporate Seal)

Signature: _____
Name and Title:
Address:

Signature: _____
Name and Title:
Address:

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GENERAL CONDITIONS OF CONTRACT

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1. CONSTRUCTION DOCUMENTS

- A. Construction Documents, listed in Table of Contents of this Specification volume shall form part of this Contract and provisions of Construction Documents shall be as binding upon parties as if they were fully set forth in Contract itself.
- B. These shall also be considered as part of Construction Documents: Addenda, including additions and modifications incorporated in such addenda before execution of Contract; requests for information; construction bulletins; change orders; and written interpretations by Architect / Engineer or Public Works Project Engineer that are made after execution of Contract.
- C. Construction Documents are complementary, and what is required by one shall be as binding as if required by all. Intent of Construction Documents is to include all labor, materials and equipment necessary for proper execution of the Work.

2. DEFINITIONS

- A. These terms as used in this Contract are respectively defined as follows:
 - 1. All uses of term "County" in Construction Documents shall mean Dane County.
 - 2. All uses of term "Department" in Construction Documents shall mean Department of Public Works, Highway & Transportation, which is a unit of Dane County government. Department is County agency overseeing Contract with Contractor.
 - 3. Public Works Project Engineer is appointed by and responsible to Department. Public Works Project Engineer has authority to act on behalf of Department and will sign change orders, payment requests and other administrative matters related to projects.
 - 4. Public Works Project Engineer is responsible for supervision, administration and management of field operations involved in construction phase of this Work.
 - 5. Architect / Engineer is retained by, and is responsible to Department acting for County, to perform construction administration activities as described in Construction Documents.
 - 5. Term "Work" includes all labor, equipment and materials necessary to produce project required by Construction Documents.
 - 6. Term "Substantial Completion" is date when project or specified area of project is certified by Architect / Engineer that construction is sufficiently completed, in accordance with Construction Documents, and as modified by any subsequent changes agreed to by parties, so that County may occupy project or specified area of project for use for which it was intended subject to permit approval for occupancy.
 - 7. Contractor is person, firm, or corporation with whom County makes Contract. Though multiple contracts may be involved, Construction Documents treat them throughout as if each were of singular number.

3. ADDITIONAL INSTRUCTIONS AND DRAWINGS

- A. Contractor may be furnished additional instructions and detail drawings as necessary to carry out the Work included in Contract. Additional drawings and instructions thus supplied to Contractor will coordinate with Construction Documents and will be so prepared that they can be reasonably interpreted as part thereof. Contractor shall carry out the Work in accordance with additional detail drawings and instructions.

4. SHOP DRAWINGS, PRODUCT DATA AND SAMPLES

- A. For submittal of Shop Drawings, Product Data, and Samples, follow all procedures described in Specification Section 01 33 00 Submittal Procedures.
- B. Contractor shall not commence any work requiring Shop Drawing, Product Data or Sample submission until Architect / Engineer has approved submission. All such work shall be in accordance with approved Shop Drawings, Product Data and Samples.
- C. Contractor shall keep on site of the Work, approved or conformed copy of Shop Drawings and Product Data, and shall at all time give Department access thereto.
- D. Materials installed shall match approved Samples.

5. CUTTING AND PATCHING

- A. Follow all cutting and patching procedures described in Specification Section 01 30 00, subsection 3.1 Cutting and Patching. Contractor shall be responsible for all cutting, fitting or patching required to complete the Work or to make its parts fit together properly.
- B. Contractor shall not damage or endanger portion of the Work or fully or partially completed construction of County or separate contractors by cutting, patching or otherwise altering such construction, or by excavation. Contractor shall not cut or otherwise alter such construction by County or separate contractor except with written consent of County and of such separate contractor; such consent shall not be unreasonably withheld. Contractor shall not withhold unreasonably from County or separate contractor, Contractor's consent to cutting or otherwise altering the Work.

6. CLEANING UP

- A. Follow all cleaning procedures described in Specification Section 01 50 00, Specification Section 01 70 00, and all other Construction Documents. Contractor shall keep premises and surrounding area free from accumulation of waste materials or rubbish caused by operations under Contract. Contractor shall remove from and about the Work waste materials, rubbish, Contractor's tools, construction equipment, machinery, and surplus materials at completion of the Work. Contractor shall remove all spillage and prevent tracking of spillage arising from performance of the Work, into, out of, and within the Work site. Contractor shall establish regular maintenance program of sweeping, vacuuming and / or hosing to minimize accumulation of dirt and dust upon such areas.
- B. If Contractor fails to clean up as directed in Construction Documents, County may do so and shall charge Contractor cost thereof.
- C. Contractor shall be responsible for broken windows and glass, and at completion of the Work shall replace such damaged or broken windows and glass. After replacing damaged or broken windows and glass, Contractor shall remove all labels, wash and polish both sides of all windows and glass.
- D. In addition to general cleaning (sweeping, vacuuming and / or hosing, as is appropriate to work surface), Contractor shall perform following final cleaning for all trades at completion of the Work:
 - 1. Remove temporary protections;

2. Remove marks, stains, fingerprints and other soil or dirt from painted, decorated and finished woodwork and wall surfaces;
3. Remove spots, plaster, soil and paint from ceramic tile, marble and other finished materials, and wash or wipe clean;
4. Clean fixtures, cabinet work and equipment, removing stains, paint, dirt and dust, and leave same in undamaged, new condition;
5. Clean aluminum in accordance with recommendations of manufacturer; and
6. Clean resilient floors thoroughly with well-rinsed mop containing only enough moisture to clean off any surface dirt or dust and buff dry by machine to bring surfaces to sheen.

7. USE OF SITE

- A. Contractor shall provide County and Architect / Engineer access to the Work under all circumstances.
- B. Contractor shall confine operations at site to areas permitted by County, law, ordinance, permits and Construction Documents and shall not unreasonably encumber site with materials or equipment. Contractor shall assure free, convenient, unencumbered, direct and safe access to all properties adjacent to the Work for County, its employees, invitees and guests.

8. MATERIALS AND WORKMANSHIP

- A. Contractor shall perform all work and furnish all supplies and materials, machinery, equipment, facilities and means, necessary to complete the Work required by this Contract, within time specified, in accordance with provisions of Construction Documents.
- B. All equipment and materials incorporated in the Work covered by this Contract are to be new; use recycled and / or recovered materials to extent that such use is technically and economically feasible. Recovered materials are products recovered from solid waste in form identical to original form for use that is same as, or similar to original use. Recycled materials are products manufactured from solid waste.
- C. If requested, Contractor shall furnish satisfactory evidence as to kind and quality of construction materials proposed or used. Contractor shall furnish to Architect / Engineer, for approval, manufacturer name and model, performance capacities and other pertinent information of machinery, mechanical, electrical or other types of equipment, which Contractor plans to install.
- D. If not otherwise provided, materials and labor called for in this Contract shall be provided and performed in accordance with established practice and standards recognized by Architects, Engineers, Department, and construction industry.
- E. Reference to "Standard" specifications of any association or manufacturer, or codes of County authorities, intends most recent printed edition or catalog in effect on date that corresponds with date of Construction Documents.
- F. Whenever reference is made in Specifications that work shall be "performed", "applied", in accordance with "manufacturer's directions or instructions", Contractor to whom those instructions are directed shall furnish three (3) printed copies of such instructions to Architect / Engineer before execution of the Work.

9. CONTRACTOR'S TITLE TO MATERIALS

- A. Contractor or any subcontractor shall not purchase materials or supplies for the Work subject to any chattel mortgage or under conditional sale contract or other agreement by which seller retains interest. Contractor warrants that all materials and supplies used in the Work are free from all liens, claims or encumbrances and Contractor has good title to them.

10. "OR EQUAL" CLAUSE

- A. Whenever equipment or materials are identified on Drawings or in Specifications by reference to manufacturer's or vendor's name, trade name, catalog number, and other identifying information, it is intended to establish standards; and any equipment or material of other manufacturers and vendors which will perform adequately duties imposed by general design will be considered equally accepted provided equipment or material so proposed is, in opinion of Architect / Engineer, of equal substance and function. Architect / Engineer and Department shall provide written approval before Contractor may purchase or install it.
- B. Equipment or materials of manufacturers, other than those named, may be used only upon following conditions:
1. That, in opinion of Architect / Engineer and Department, proposed material or equipment item is fully equal or superior (in design, materials, construction, workmanship, performance, finish, etc.) to named item. No compromise in quality level, however small, is acceptable.
 2. That, in substituting materials or equipment, Contractor assumes responsibility for any changes in system or for modifications required in adjacent or related work to accommodate such substitution despite Architect / Engineer's and Department's approval, and all costs growing out of approval of "or equal" items shall be responsibility of Contractor. No extra costs resulting from such approval shall become responsibility of Department, Architect / Engineer or any other separate Contractor.
 3. It shall be understood that use of materials or equipment other than those specified, or approved equal by Architect / Engineer and Department, shall constitute violation of Contract, and that Architect / Engineer and Department shall have right to require removal of such materials or equipment and their replacement with specified materials or equipment at Contractor's expense.
 4. Product and manufacturer named first in Specifications or on information shown on Drawings is basis of selection of manufactured items and equipment, particularly mechanical equipment. In using other than first named products or manufacturers, including those specified as additionally approved or acceptable, Contractor assumes responsibility for any changes in system and for modifications in any work required to accommodate them. Architect / Engineer's approval of such additionally acceptable products or manufacturers, either in Specifications or in Addendum, does not relieve Contractor from obligation to coordinate such optional products with other Contractors, whose work may be affected by them, and to pay all additional costs resulting from their inclusion into the Work. Contractor's liability shall include payment of Architect / Engineer's fees for any additional services made necessary by or directly connected to such product changes. No extra costs resulting from such changes shall become responsibility of Department, Architect / Engineer or any other separate Contractor.
- C. No request for approval of "or equal" materials will be entertained except from Contractor. Identify any request for substitution as substitution on Contractor's letter of transmittal and give reasons for substitution. Department may in its sole discretion allow substitutions of materials. If requesting approval of "or equal" materials, follow procedures described in Specification Section 01 60 00, subsection 1.6 Product Substitution Procedures.

11. PATENTS AND ROYALTIES

- A. If Contractor uses any design, device or material covered by letters, patent or copyright, it is mutually agreed and understood, that, without exception, contract prices shall include all royalties or costs arising from use of such design, device or materials, in any way involved in the Work.
- B. Contractor shall indemnify and save harmless County from any and all claims for infringement by reason of use of such patent or copyright in connection with the Work agreed to be performed under this Contract, and shall indemnify County for any cost, expense or damage which it may be obliged to pay by reason of such infringement at any time during prosecution of the Work or after completion of the Work.

12. SURVEYS, PERMITS, REGULATIONS AND TAXES

- A. Department will furnish to Contractor all site, topography and property surveys necessary for execution of the Work.
- B. Contractor shall procure all permits, licenses and approvals necessary for execution of this Contract.
- C. Contractor shall give all notices and comply with all State of Wisconsin, Federal and local laws, codes, rules and regulations relating to performance of the Work, protection of adjacent property, and maintenance of passageways, guard fences or other protective facilities.
- D. Contractor shall pay all Sales, Consumer, Use and other similar taxes required by law.
- E. Contractor shall promptly notify Architect / Engineer of any variances of Drawings or Specifications with that of any State of Wisconsin, federal or local law, code, rule or regulation. Upon such notification, Architect / Engineer will require correction of variance to comply with applicable law, code, rule or regulation at no additional cost to Contractor.
- F. Work under this Contract shall comply with all applicable State of Wisconsin, Federal and local laws, codes and regulations.
- G. Contractor shall pay charges for water, sewer and other utility connections made by municipalities where required by Specifications.

13. CONTRACTOR'S OBLIGATIONS AND SUPERINTENDENCE

- A. Contractor shall provide and pay for all materials, labor, tools, equipment, transportation and superintendence necessary to execute, complete and deliver the Work within specified time. Contractor agrees to secure at their own expense all personnel necessary to carry out the Work. Such personnel shall not be deemed County employees nor shall they have or be deemed to have any direct contractual relationship with County.
- B. Performance of any work necessary after regular working hours, on Sundays or Legal Holidays shall be without additional expense to County. Performance of any work at site at other than normal working hours must be coordinated with Public Works Project Engineer.

- C. Contractor shall furnish, erect, maintain and remove such temporary works as may be required.
- D. Contractor shall observe, comply with, and be subject to all terms, conditions, requirements and limitations of Construction Documents.
- E. At the Work site, Contractor shall give personal superintendence to the Work or shall employ construction superintendent or foreman, experienced in character of work covered by Contract, who shall have full authority to act for Contractor. Understand that such superintendent or foreman shall be acceptable to Architect / Engineer and Department.
- F. Remove from project or take other corrective action upon notice from Architect / Engineer or Department for Contractor's employees whose work is considered by Architect / Engineer or Department to be unsatisfactory, careless, incompetent, unskilled or otherwise objectionable.
- G. Contractor and subcontractors shall be required to conform to Labor Laws of State of Wisconsin and various acts amendatory and supplementary thereto and to other laws, ordinances and legal requirements applicable to the Work.
- H. Presence and observation of the Work by Architect / Engineer or Public Works Project Engineer shall not relieve Contractor of any obligations.

14. WEATHER CONDITIONS

- A. In event of temporary suspension of work, or during inclement weather, or whenever Architect / Engineer shall direct, Contractor shall, and shall cause subcontractors to protect carefully all work and materials against damage or injury from weather. If, in opinion of Architect / Engineer or Department, any work or materials that have been damaged or injured due to failure on part of Contractor or any subcontractors so to protect the Work, such materials shall be removed and replaced at expense of Contractor.

15. PROTECTION OF WORK AND PROPERTY

- A. Contractor shall at all times safely guard County's property from injury or loss in connection with this Contract. Contractor shall at all times safely guard and protect the Work, and adjacent property, from damage. Contractor shall replace or make good any such damage, loss or injury unless such be caused directly by errors contained in Contract, or by County, or County's duly authorized representative.
- B. Contractor may act diligently, without previous instructions from Architect / Engineer and / or Department, in emergency that threatens loss or injury of property, or safety of life. Contractor shall notify Architect / Engineer and / or Department immediately thereafter. Promptly submit any claim for compensation by Contractor due to such extra work to Architect / Engineer and / or Department for approval as provided for in Article 18 herein.

16. INSPECTION AND TESTING OF MATERIALS

- A. Follow all inspection and testing procedures described in Specification Section 01 40 00, subsection 1.7 Inspection and testing Laboratory Services.
- B. Should it be considered necessary or advisable at any time before final acceptance of the Work to make examination of work already completed, by removing or tearing out same,

Contractor shall upon request, promptly furnish all necessary facilities, labor and materials. If such work is found to be defective in any aspect, due to fault of Contractor or subcontractors thereof, Contractor shall assume all expenses of such examination and of satisfactory reconstruction. Contractor will be reimbursed for such examination and replacement in accordance with Article 18 - A.3., of these General Conditions of Contract if such work is found to meet requirements of Contract.

- C. Cost of any testing performed by manufacturers or Contractor for substantiating acceptability of proposed substitution of materials and equipment, or necessary conformance testing in conjunction with manufacturing processes or factory assemblage, shall be borne by Contractor or manufacturer responsible.

17. REPORTS, RECORDS AND DATA

- A. Contractor shall submit to Architect / Engineer and Public Works Project Engineer such schedule of quantities and costs, progress schedules, payrolls, reports, estimates, invoices, records and other data as either may request concerning work performed or to be performed under this Contract.

18. CHANGES IN THE WORK

- A. Make no changes, except in cases of emergency, in the Work covered by approved Construction Documents without having prior written approval of Department. Charges or credits for the Work covered by approved change shall be determined as described in Specification Section 01 20 00, subsection 1.4 Change Procedures.
- B. If Contractor claims that by any instructions given by Architect / Engineer, Department, by drawings or otherwise, regarding performance of the Work or furnishing of material under Contract, involves extra cost, Contractor shall give Department written notice of cost thereof within two (2) weeks after receipt of such instructions and in any event before proceeding to execute work, unless delay in executing work would endanger life or property.
- C. No claim for extra work or cost shall be allowed unless it was done in pursuance of written Change Order from Architect / Engineer and approved by Department, as previously mentioned, and claim presented with payment request submitted after changed or extra work is completed.
- D. Negotiation of cost for change in the Work shall not be cause for Contractor to delay prosecution of the Work if Contractor has been authorized in writing by Public Works Project Engineer to proceed.

19. EXTRAS

- A. Without invalidating Contract, Department may order extra work or make changes by altering, adding to or deducting from the Work, contract sum being adjusted in accordance with Article 18 herein.

20. TIME FOR COMPLETION

- A. Contractor agrees that the Work shall be prosecuted regularly and diligently and complete the Work as stated in Construction Documents.

21. CORRECTION OF WORK

- A. All work, all materials whether incorporated in the Work or not, and all processes of manufacture shall at all times and places be subject to inspection of Architect / Engineer and Public Works Project Engineer who shall be judge of quality and suitability of the Work, materials, and processes of manufacture for purposes for which they are used. Should they fail to meet Architect / Engineer's and Public Works Project Engineer's approval they shall be reconstructed, made good, replaced or corrected, by Contractor at Contractor's expense.
- B. Follow procedures described in Specification Section 01 20 00, subsection 1.5 Defect Assessment.
- C. If Contractor defaults or neglects to carry out the Work in accordance with Construction Documents or fails to perform any provision of Contract, Department may, after ten (10) days' written notice to Contractor and without prejudice to any other remedy County may have, make good such deficiencies. In such case, appropriate Change Order shall be issued deducting from Contractor's payments then or thereafter, cost of correcting such deficiencies, including cost of Architect / Engineer's additional services made necessary by such default, neglect or failure.

22. SUBSURFACE CONDITIONS FOUND DIFFERENT

- A. If Contractor encounters subsurface or latent conditions at site materially differing from those shown on Drawings or indicated in Specifications, Contractor shall immediately give notice to Architect / Engineer and Public Works Project Engineer of such conditions before they are disturbed. Architect / Engineer will thereupon promptly investigate conditions, and if Architect / Engineer finds that they materially differ from those shown on Drawings or indicated in Specifications, Architect / Engineer will at once make such changes as necessary, any increase or decrease of cost resulting from such changes to be adjusted in manner provided in above Article 18 entitled "Changes in the Work".

23. RIGHT OF DEPARTMENT TO TERMINATE CONTRACT

- A. In event that any provisions of this Contract are violated by Contractor or by any subcontractors, County may serve written notice upon Contractor and Surety of its intention to terminate Contract, such notice to contain reasons for such intention to terminate Contract, and unless within ten (10) days after serving of such notice upon Contractor, such violation or delay shall cease and satisfactory arrangement or correction be made, Contract shall, upon expiration of said ten (10) days, cease and terminate.
- B. In event of any such termination, County shall immediately serve notice thereof upon Surety and Contractor, and Surety shall have right to take over and perform Contract subject to County's approval; provided, however, that if Surety does not commence performance thereof within ten (10) days from date of mailing to such Surety of notice of termination, County may take over the Work and prosecute same to completion by contract, or by force account, at expense of Contractor; Contractor and Surety shall be liable to County for any excess cost occasioned County thereby, and in such event County may take possession of and utilize in completing the Work, such materials and equipment as may be on the Work site and therefore necessary.

24. CONSTRUCTION SCHEDULE AND PERIODIC ESTIMATES

- A. Contractor shall be responsible for Construction Schedule and coordination. Follow procedures described in Specification Section 01 33 02, subsection 1.3 Construction progress Schedules.
- B. Contractor shall request delivery dates for all County-furnished equipment, materials or labor. This shall include any work handled by Department under separate contracts such as asbestos abatement, air and water balancing, etc. Indicate on Construction Schedule these associated delivery and installation dates.
- C. Failure of Contractor to keep Schedule in updated format shall result in County hiring firm specializing in construction schedule development and deducting those costs associated with updating process from payments due Contractor.
- D. Responsibility for timely completion requires:
 - 1. Contractor and subcontractors understand that performance of each is interdependent upon performance of others.
 - 2. Whenever it becomes apparent from current schedule, that phasing or progress completion dates will not be met, Contractor must take some or all following actions at no additional cost to County:
 - a) Increase construction manpower in such quantities and crafts as will eliminate backlog of work.
 - b) Increase number of working hours per shift, shifts per working day, working days per week, amount of construction equipment, or any combination of foregoing to eliminate backlog of work.
 - c) Reschedule work (yet remain in conformance with Drawings and Specifications).
 - 3. Prior to proceeding with any of above actions, Contractor shall notify Public Works Project Engineer.
- E. Maintain current Construction Schedule at all times. Revise Construction Schedule in same detail as original and accompany with explanation of reasons for revision. Schedule shall be subject to approval by Architect / Engineer and Public Works Project Engineer.

25. PAYMENTS TO CONTRACTOR

- A. Contractor shall provide pay requests as described in Specification Section 01 20 00, subsection 1.3 Applications for Payment.
- B. County will make partial payments to Contractor for value, proportionate to amount of Contract, of all labor and material incorporated in the Work during preceding calendar month upon receipt of Application and Certificate for Payment form from Architect / Engineer and approval of Department.
- C. Application and Certificate for Payment for preparatory work and materials delivered and suitably stored at site to be incorporated into the Work at some future period, will be given due consideration. Requesting payment for materials stored off site, may be rejected, however, if deemed essential for reasons of job progress, protection, or other sufficient cause, requests will be considered, conditional upon submission by Contractor of bills of sale, photographs and such other procedures as will adequately protect County's interest such as storage in bonded warehouse with adequate coverage. If there is any error in payment, Contractor is obligated to notify Department immediately, but no longer than ten (10) days from receipt of payment.

- D. Payments by County will be due within forty-five (45) days after receipt by Department of Application and Certificate for Payment.
- E. County will retain five percent (5%) of each Application and Certificate for Payment until final completion and acceptance of all the Work covered by Contract. However, anytime after fifty percent (50%) of the Work has been furnished and installed at site, County will make remaining payments in full if Architect / Engineer and Public Works Project Engineer find that progress of the Work corresponds with Construction Schedule. If Architect / Engineer and Public Works Project Engineer find that progress of the Work does not correspond with Construction Schedule, County may retain up to ten percent (10%) of each Application and Certificate for Payment for the Work completed.
- F. All material and work covered by partial payments made shall become sole property of County, but this provision shall not be construed as relieving Contractor from sole responsibility for care and protection of materials and work upon which payments have been made, or restoration of any damaged work, or as waiver of right of County to require fulfillment of all of terms of Contract.
- G. County will make final payment within sixty (60) days after final completion of the Work, and will constitute acceptance thereof.
- H. County may make payment in full, including retained percentages and less authorized deductions, upon completion and acceptance of each Division where price is stated separately in Contract.
- I. Every contractor engaged in performance of any contract for Department of Public Works, Highway & Transportation shall submit to this Department, as requested and with final application for payment for work under said contract, affidavit(s) as required to prove that all debts and claims against this Work are paid in full or otherwise satisfied, and give final evidence of release of all liens against the Work and County. If Wisconsin Prevailing Wage Rate Determination is required for this Work, use "Prime Contractor Affidavit of Compliance With Prevailing Wage Rate Determination" and "Agent or Subcontractor Affidavit of Compliance With Prevailing Wage Rate Determination" (if applicable). If Wisconsin Prevailing Wage Rate Determination is not required for this Work, use "Dane County, Wisconsin Contractor Wage Affidavit". Forms of such affidavits are included in Supplementary Conditions.

26. WITHHOLDING OF PAYMENTS

- A. County, after having served written notice on said Contractor, may either pay directly any unpaid bills of which Department has written notice, or withhold from Contractor's unpaid compensation sum of money deemed reasonably sufficient to pay any and all such lawful claims until satisfactory evidence is furnished that all liabilities have been fully discharged; whereupon, payment to Contractor shall be resumed in accordance with terms of this Contract, but in no event shall these provisions be construed to impose any obligations upon County to either Contractor or Contractor's Surety.
- B. In paying any unpaid bills of Contractor, County shall be deemed agent of Contractor, and any payment so made by County, shall be considered as payment made under Contract by County to Contractor and County shall not be liable to Contractor for any such payment made in good faith.

- C. Contractor shall indemnify, hold harmless and defend Dane County, its boards, commissions, agencies, officers, employees and representatives from all claims growing out of lawful demands of subcontractors, laborers, workmen, mechanics, material men, and furnishers of machinery and parts thereof, equipment, power tools, and all supplies, including commissary, incurred in performance of this Contract.
- D. At Department's request, Contractor shall furnish satisfactory evidence that all obligations of nature designated above have been paid, discharged or waived.

27. ACCEPTANCE OF FINAL PAYMENT AS RELEASE

- A. Making of final payment shall constitute waiver of all claims by County except those arising from:
 - 1. Unsettled lien;
 - 2. Faulty or defective work appearing after substantial completion;
 - 3. Failure of the Work to comply with requirements of Construction Documents; or
 - 4. Terms of any special guarantees required by Construction Documents.
- B. Acceptance of final payment shall constitute waiver of all claims by Contractor.

28. PAYMENTS BY CONTRACTOR

- A. Contractor shall pay following not later than fifth (5th) day following each payment received from County:
 - 1. All transportation and utility services rendered;
 - 2. All materials, tools, and other expendable equipment that have been delivered at site of the Work to extent of ninety percent (90%) of cost thereof, and balance of cost thereof when said balance is paid to Contractor; and
 - 3. Each subcontractor, respective amount allowed Contractor because of work performed by subcontractor to extent of subcontractor's interest therein.

29. CONTRACT SECURITY

- A. Contractor shall furnish Performance and Payment Bonds in amount at least equal to one hundred percent (100%) of Contract price as security for faithful performance of this Contract and payment of all persons performing labor on project under this Contract and furnishing materials in connection with this Contract.
- B. Sample Performance and Payment Bonds that Contractor will be required to execute is bound into these Construction Documents. Before construction Contract is consummated, completed Performance and Payment Bonds must be approved by Department.

30. ASSIGNMENTS

- A. Contractor shall not assign whole or any part of this Contract or any moneys due or to become due hereunder without written consent of Department. In case Contractor assigns all or any part of any moneys due or to become due under this Contract, instrument of assignment shall contain clause substantially to effect that it is agreed that right of assignee in and to any moneys due or to become due to Contractor shall be subject to prior claims of all persons, firms and corporations for services rendered or materials supplied for performance of the Work called for in this Contract.

31. MUTUAL RESPONSIBILITY OF CONTRACTORS

- A. If, through acts of neglect on part of Contractor or any subcontractor shall suffer loss or damage on the Work, Contractor agrees to settle with such subcontractor by agreement or arbitration if such other subcontractor will so settle. If such subcontractor shall assert any claim against County on account of any damage alleged to have been sustained, Department shall notify Contractor, who shall indemnify, hold harmless and defend Dane County, its boards, commissions, agencies, officers, employees and representatives against any such claim.

32. SEPARATE CONTRACTS

- A. Department may award other contracts for the Work and all Contractors shall fully cooperate with each other and carefully adjust their work to that provided under other contracts as may be directed by Department. No Contractor shall commit or permit any act that will interfere with performance of the Work by any other Contractor.
- B. Contractor shall coordinate the Work with those of other Contractors. Cooperation will be required in arrangement for storage of materials and in detailed execution of the Work. Contractor, including subcontractors, shall keep informed of progress and detail work of others and shall notify Architect / Engineer or Department immediately of lack of progress or defective workmanship on part of others. Failure of Contractor to keep informed of the Work progressing on site and failure to give notice of lack of progress or defective workmanship by others shall be construed as acceptance by Contractor of status of the Work as being satisfactory for proper coordination with Contractor's own work.

33. SUBCONTRACTS

- A. Contractor may use services of specialty subcontractors on those parts of the Work that, under normal contracting practices, are performed by specialty subcontractors.
- B. Contractor shall not award any work to any subcontractor without prior approval of Department. Qualifications of subcontractors shall be same as qualifications of Contractor. Request for subcontractor approval shall be submitted to Department fifteen (15) days before start of subcontractor's work. If subcontractors are changed or added, Contractor shall notify Department in writing.
- C. Contractor shall be as fully responsible to County for acts and omissions of subcontractors, and of persons either directly or indirectly employed by them, as Contractor is for acts and omissions of persons directly employed by Contractor.
- D. Contractor shall cause appropriate provisions to be inserted in all subcontracts relative to the Work to bind subcontractors to Contractor by terms of General Conditions of Contract and other Construction Documents insofar as applicable to work of subcontractors and to give Contractor same power as regards terminating any subcontract that Department may exercise over Contractor under any provision of Construction Documents.
- E. Nothing contained in this Contract shall create any contractual relation between any subcontractor and County.

- F. Contractor shall insert in all subcontracts, Articles 26, 33, 42 and 44, respectively entitled: “Withholding of Payments”, “Subcontracts”, “Affirmative Action Provision and Minority / Women / Disadvantaged Business Enterprises”, and “Minimum Wages”, and shall further require all subcontractors to incorporate physically these same Articles in all subcontracts.

34. PUBLIC WORKS PROJECT ENGINEER’S AUTHORITY

- A. Public Works Project Engineer shall:
1. Administer and ensure compliance with Construction Documents;
 2. Provide responsible on-site observations of construction and have authority to request work and to stop work whenever necessary to insure proper enforcement of Construction Documents;
 3. Convene and chair project meetings and foreman’s coordination meetings when necessary to coordinate resolution of conflicts between Contractors, Architects, Engineers, Consultants, and Department; and
 4. Check and inspect material, equipment and installation procedures of all trades for proper workmanship and for compliance with Drawings, Specifications and Shop Drawings, permit no material on project site that is not satisfactory and reject work not in compliance with Construction Documents.

35. ARCHITECT / ENGINEER’S AUTHORITY

- A. Architect / Engineer is retained by, and is responsible to Department acting for County.
- B. Architect / Engineer shall determine amount, quality, acceptability, and fitness of several kinds of work and materials that are provided under this Contract and shall decide all questions that may arise in relation to said work and construction thereof.
- C. Architect / Engineer shall decide meaning and intent of any portion of Specifications and of any Drawings where they may be found obscure or be in dispute.
- D. Architect / Engineer shall provide responsible observation of construction. Architect / Engineer has authority to stop the Work whenever such stoppage may be necessary to insure proper execution of Construction Documents.
- E. Architect / Engineer shall be interpreter of conditions of Construction Documents and judge of its performance.
- F. Within reasonable time, Architect / Engineer shall make decisions on all matters relating to progress of the Work or interpretation of Construction Documents.
- G. Architect / Engineer’s decisions are subject to review by Public Works Project Engineer.

36. ESTIMATES OF QUANTITIES

- A. Whenever estimated quantities of work to be done and materials to be furnished under this Contract are shown in any of Construction Documents, they are given for use in comparing bids and right is especially reserved to increase or diminish them as they may be deemed reasonably necessary or desirable by Department to complete the Work included in this Contract, and cost for such increase or diminution shall be adjusted in manner provided for in General Conditions of Contract Article 18 entitled “Changes in the Work”.

37. LANDS AND RIGHTS-OF-WAY

- A. Prior to start of construction, County shall furnish all land and rights-of-way necessary for carrying out and completion of the Work to be performed under this Contract.

38. GENERAL GUARANTEE

- A. Neither final certificate of payment nor any provision in Construction Documents nor partial or entire occupancy of premises by County shall constitute acceptance of work not done in accordance with Construction Documents or relieve Contractor of liability in respect to any expressed warranties or responsibility for faulty materials or workmanship.
 - 1. In no event shall making of any payment required by Contract constitute or be construed as waiver by County of any breach of covenants of Contract or waiver of any default of Contractor and making of any such payment by County while any such default or breach shall exist shall in no way impair or prejudice right of County with respect to recovery of damages or other remedy as result of such breach or default.
- B. Contractor shall remedy and make good all defective workmanship and materials and pay for any damage to other work resulting there from, which appear within period of one (1) year from date of substantial completion, providing such defects are not clearly due to abuse or misuse by County. Department will give notice of observed defects with reasonable promptness.
- C. Guarantee on work executed after certified date of substantial completion will begin on date when such work is inspected and approved by Architect / Engineer and Public Works Project Engineer.
- D. Where guarantees or warranties are required in sections of Specifications for periods in excess of one (1) year, such longer terms shall apply; however, Contractor's Performance and Payment Bonds shall not apply to any guarantee or warranty period in excess of one (1) year.

39. CONFLICTING CONDITIONS

- A. Any provision in any of Construction Documents which may be in conflict or inconsistent with any Articles in these General Conditions of Contract or Supplementary Conditions shall be void to extent of such conflict or inconsistency.
- B. In case of ambiguity or conflict between Drawings and Specifications, Specifications shall govern.
- C. Printed dimensions shall be followed in preference to measurements by scale. Large-scale drawings take precedence over small-scale drawings. Dimensions on Drawings and details are subject to field measurements of adjacent work.

40. NOTICE AND SERVICE THEREOF

- A. Any notice to Contractor from Department relative to any part of this Contract shall be in writing and considered delivered and service thereof completed, when said notice is posted, by certified or registered mail, to Contractor at Contractor's last given address, or delivered in person to said Contractor, or Contractor's authorized representative on the Work.

41. PROTECTION OF LIVES AND HEALTH

- A. In order to protect lives and health of Contractor's employees under Contract, Contractor shall comply with all pertinent provisions of Wisconsin Administrative Code, Rules of Department of Commerce, relating to Safety and Health.
- B. Contractor alone shall be responsible for safety, efficiency and adequacy of Contractor's tools, equipment and methods, and for any damage that may result from their failure or their improper construction, maintenance or operation.

42. AFFIRMATIVE ACTION PROVISION AND MINORITY / WOMEN / DISADVANTAGED BUSINESS ENTERPRISES

- A. Affirmative Action Provisions.
 - 1. During term of their Contract, Contractor agrees not to discriminate on basis of race, religion, color, sex, handicap, age, sexual preference, marital status, physical appearance, or national origin against any person, whether recipient of services (actual or potential), employee, or applicant for employment. Such equal opportunity shall include but not be limited to following: employment, upgrading, demotion, transfer, recruitment, advertising, layoff, termination, training, rates of pay, and any other form of compensation or level of service(s). Contractor agrees to post in conspicuous places, these affirmative action standards so as to be visible to all employees, service recipients and applicants for this paragraph. Listing of prohibited bases for discrimination shall not be construed to amend in any fashion state or federal law setting forth additional bases and exceptions shall be permitted only to extent allowable in state or federal law.
 - 2. Contractor is subject to this Article only if Contractor has ten (10) or more employees and receives \$10,000.00 or more in annual aggregate contracts with County. Contractor shall file and Affirmative Action Plan with Dane County Contract Compliance Officer in accord with Chapter 19 of Dane County Code of Ordinances. Such plan must be filed within fifteen (15) days of effective date of this Contract and failure to do so by said date shall constitute ground for immediate termination of Contract by County. Contractor shall also, during term of this Contract, provide copies of all announcements of employment opportunities to County's Contract Compliance Office, and shall report annually number of persons, by race, sex and handicap status, who apply for employment and, similarly classified, number hired and number rejected.
 - 3. Contact Dane County Contract Compliance Officer at Dane County Contract Compliance Office, 210 Martin Luther King, Jr. Blvd., Room 421, Madison, WI 53703, 608/266-4114.
 - 4. In all solicitations for employment placed on Contractor's behalf during term of this Contract, Contractor shall include statement to effect Contractor is "Equal Opportunity Employer". Contractor agrees to furnish all information and reports required by County's Contract Compliance Officer as same relate to affirmative action and nondiscrimination, which may include any books, records, or accounts deemed appropriate to determine compliance with Chapter 19, Dane County Code of Ordinances, and provision of this Contract.
- B. Minority / Women / Disadvantaged / Emerging Small Business Enterprises.
 - 1. Chapter 19.508 of Dane County Code of Ordinances is official policy of Dane County regarding utilization of, to fullest extent of, Minority Business Enterprises (MBEs), Women Business Enterprises (WBEs) Disadvantage Business Enterprises (DBEs) and Emerging Small Business Enterprises (ESBEs).
 - 2. Contractor may utilize MBEs / WBEs / DBEs / ESBEs as subcontractors or suppliers. List of subcontractors will be required of low bidder as stated in this Contract. List shall

indicate which are MBEs / WBEs / DBEs / ESBEs and percentage of subcontract awarded, shown as percentage of total dollar amount of bid.

43. COMPLIANCE WITH FAIR LABOR STANDARDS

- A. During term of this Contract, Contractor shall report to County Contract Compliance Officer, within ten (10) days, any allegations to, or findings by National Labor Relations Board (NLRB) or Wisconsin Employment Relations Commission (WERC) that Contractor has violated statute or regulation regarding labor standards or relations. If investigation by Contract Compliance Officer results in final determination that matter adversely affects Contractor's responsibilities under this Contract, and which recommends termination, suspension or cancellation of this Contract, County may take such action.
- B. Contractor may appeal any adverse finding by Contract Compliance Officer as set forth in Dane County Ordinance 25.015(11)(c) through (e).
- C. Contractor shall post this statement in prominent place visible to employees: "As condition of receiving and maintaining contract with Dane County, this employer shall comply with federal, state and all other applicable laws prohibiting retaliation or union organizing."

44. DOMESTIC PARTNERSHIP BENEFITS

- A. Contractor agrees to provide same economic benefits to all of its employees with domestic partners as it does to employees with spouses, or cash equivalent if such benefit cannot reasonably be provided. Contractor agrees to make available for County inspection Contractor's payroll records relating to employees providing services on or under this Contract or subcontract. If any payroll records of Contractor contain any false, misleading or fraudulent information, or if Contractor fails to comply with provisions of Chapter 25.016, Dane County Ordinances, contract compliance officer may withhold payments on Contract; terminate, cancel or suspend Contract in whole or in part; or, after due process hearing, deny Contractor right to participate in bidding on future County contracts for period of one year after first violation is found and for period of three years after second or subsequent violation is found.

45. USE AND OCCUPANCY PRIOR TO ACCEPTANCE

- A. Contractor agrees to use and occupancy of portion or unit of the Work before formal acceptance by Department, provided Department:
 - 1. Secures written consent of Contractor; except when in opinion of Public Works Project Engineer, Contractor is chargeable with unwarranted delay in final cleanup of punch list items or other Contract requirements.
 - 2. Secures endorsement from insurance carrier and consent of Surety permitting occupancy of building or use of the Work during remaining period of construction, or, secures consent of Surety.
 - 3. Assumes all costs and maintenance of heat, electricity and water.
 - 4. Accepts all work completed within that portion or unit of the Work to be occupied, at time of occupancy.

46. MINIMUM WAGES

- A. Contractor shall post, at appropriate conspicuous point on site of project, schedule showing all determined minimum wage rates for various classes of laborers and mechanics to be engaged in the Work under this Contract and all deductions, if any, required by law to be made from unpaid wages actually earned by laborers and mechanics so engaged.
- B. Supplementary Conditions section in Construction Documents lists wage determinations required by State Law.
- C. If, after award of Contract, it becomes necessary to employ any person in trade or occupation not classified in wage determinations, such person shall be paid at not less than such rate as shall be determined by Wisconsin Department of Workforce Development. Such approved minimum rate shall be retroactive to time of initial employment of such person in such trade or occupation. Contractor shall notify Department of Contractor's intention to employ persons in trades or occupations not so classified in sufficient time for Department to obtain approved rates for such trades or occupations.
- D. Specified wage rates are minimum rates only, and Department will not consider any claims for additional compensation made by Contractor because of payment by Contractor of any wage rate in excess of applicable rate contained in this Contract. Contractor shall adjust any disputes in regard to payment of wages in excess of those specified in this Contract.
- E. Submit required affidavit(s) to Department of Public Works, Highway & Transportation, as requested and with final application for payment for work under said contract. Affidavit(s) shall clearly indicate name, trade or occupation, and paid wages of every laborer, workman or mechanic employed by Contractor and all subcontractors during billing period including accurate record of number of hours worked by each employee and actual wages paid as stipulated in Wisconsin Statute 66.0903. If Wisconsin Prevailing Wage Rate Determination is required for this Work, use "Prime Contractor Affidavit of Compliance With Prevailing Wage Rate Determination" and "Agent or Subcontractor Affidavit of Compliance With Prevailing Wage Rate Determination" (if applicable). If Wisconsin Prevailing Wage Rate Determination is not required for this Work, use "Dane County, Wisconsin Contractor Wage Affidavit". Forms of such affidavits are included in Supplementary Conditions.

47. CLAIMS

- A. No claim may be made until Department's Associate Public Works Director has reviewed Architect / Engineer's decision as provided for in Article 35 of General Conditions of Contract. If any claim remains unresolved after such review by Department's Associate Public Works Director, claim may be filed under Wisconsin Statute 893.80. Work shall progress during period of any dispute or claim. Unless specifically agreed between parties, venue will be in Dane County, Wisconsin.

48. ANTITRUST AGREEMENT

- A. Contractor and County recognize that in actual economic practice, overcharges resulting from antitrust violations are in fact usually borne by County. Therefore, Contractor hereby assigns to County any and all claims for such overcharges as to goods and materials purchased in connection with this Contract, except as to overcharges which result from antitrust violations commencing after price is established under this Contract and any change order thereto.

49. INSURANCE

A. Contractor Carried Insurance:

1. Contractor shall not commence work under this Contract until Contractor has obtained all insurance required under this Article and has provided evidence of such insurance to Risk Manager, 425 City-County Building, 210 Martin Luther King Jr. Blvd., Madison, WI 53703. Contractor shall not allow any subcontractor to commence work until insurance required of subcontractor has been so obtained and approved. Company providing insurance must be licensed to do business in Wisconsin.
2. Worker's Compensation Insurance:
 - a) Contractor shall procure and shall maintain during life of this Contract, Worker's Compensation Insurance as required by statute for all of Contractor's employees engaged in work at site of project under this Contract and, in case of any such work sublet, Contractor shall require subcontractor similarly to provide Worker's Compensation Insurance for all of latter's employees to be engaged in such work unless such employees are covered by protection afforded by Contractor's Worker's Compensation Insurance.
 - b) If any claim of employees engaged in hazardous work on project under this Contract is not protected under Worker's Compensation Statute, Contractor shall provide and shall cause each subcontractor to provide adequate Employer's Liability Insurance for protection of such of Contractor's employees as are not otherwise protected.
3. Contractor's Public Liability and Property Damage Insurance:
 - a) Contractor shall procure and maintain during life of this Contract, Contractor's Public Liability Insurance and Contractor's Property Damage Insurance in amount not less than \$1,000,000 bodily injury, including accidental death, to any one person, and subject to same limit for each person, in amount not less than \$1,000,000 on account of one accident, and Contractor's Property Damage Insurance in amount not less than \$1,000,000 or combined single limit of at least \$1,000,000 with excess coverage over and above general liability in amount not less than \$5,000,000. Contractor shall add "Dane County" as additional insured for each project.
 - b) Contractor's Public Liability and Property Damage Insurance shall include Products, Completed Operation, and Contractual Liability under Insurance Contract. "Contractor shall in all instances save, defend, indemnify and hold harmless County and Architect / Engineer against all claims, demands, liabilities, damages or any other costs which may accrue in prosecution of the Work and that Contractor will save, defend, indemnify and hold harmless County and Architect / Engineer from all damages caused by or as result of Contractor's operations" and each shall be listed as additional insured on Contractor's and sub-contractors' insurance policies.
 - c) Obligations of Contractor under Article 48.A.2)b) shall not extend to liability of Architect / Engineer, agents or employees thereof, arising out of:
 - 1) Preparation or approval of maps, drawings, opinions, reports, surveys, change orders, designs or specifications; or
 - 2) giving of or failure to give directions or instructions by Architect / Engineer, agents or employees thereof provided such giving or failure to give is primary cause of injury or damage.
 - d) Contractor shall procure and shall maintain during life of this Contract, Comprehensive Automobile Liability Insurance covering owned, non-owned and hired automobiles for limits of not less than \$1,000,000 each accident single limit, bodily injury and property damage combined with excess coverage over and above general liability in amount not less than \$5,000,000.
 - e) Contractor shall either:
 - 1) Require each subcontractor to procure and to maintain during life of subcontract, subcontractor's Public Liability Property Damage Insurance, and Comprehensive

Automobile Liability Insurance of type and in same amount specified in preceding paragraphs; or

- 2) Insure activities of subcontractors in Contractor's own policy.
4. Scope of Insurance and Special Hazards: Insurance required under Article 48.A.2 hereof shall provide adequate protection for Contractor and subcontractors, respectively, against damage claims which may arise from operations under this Contract, whether such operation be by insured or by anyone directly or indirectly employed by insured and also against any of special hazards which may be encountered in performance of this Contract as enumerated in Supplementary Conditions.
5. Proof of Carriage of Insurance: Contractor shall furnish Risk Manager with certificates showing type, amount, class of operations covered, effective dates, dates of expiration of policies and "Dane County" listed as additional insured. Such certificates shall also contain (substantially) following statement: "Insurance covered by this certificate will not be canceled or materially altered, except after ten (10) days written notice has been received by Risk Manager."

B. Builder's Risk:

1. County shall provide Builder's Risk policy. Terms of this policy will be made available by County's Risk Manager, upon Contractor's request. By executing this Contract, Contractor warrants it is familiar with terms of said policy.

C. Indemnification / Hold Harmless:

1. Contractor shall indemnify, hold harmless and defend Dane County, its boards, commissions, agencies, officers, employees and representatives from and against all claims, damages, losses and expenses including attorneys' fees arising out of or resulting from performance of the Work, provided that any such claim, damage, loss or expense is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property (other than the Work itself) including loss of use resulting therefrom, and is caused in whole or in part by any act or omission of Contractor, any subcontractor, anyone directly or indirectly employed by any of them or anyone for whose acts any of them may be liable, regardless of whether or not it is caused in part by part indemnified hereunder.
2. In any and all claims against Dane County, its boards, commissions, agencies, officers, employees and representatives or by any employee of Contractor, any subcontractor, anyone directly or indirectly employed by any of them or anyone for whose acts any of them may be liable, indemnification obligation under this Contract shall not be limited in any way by any limitation on amount or type of damages, compensation or benefits payable by or for Contractor or any subcontractor under worker's compensation acts, disability benefits or other employee benefit acts.
3. Obligations of Contractor under this Contract shall not extend to liability of Architect / Engineer, its agents or employees arising out of:
 - a) Preparation or approval of maps, drawings, opinion, reports, surveys, change orders, designs or specifications; or
 - b) Giving of or failure to give directions or instruction by Architect / Engineer, its agents or employees provided such giving or failure to give is primary cause of injury or damage.
4. Dane County shall not be liable to Contractor for damages or delays resulting from work by third parties or by injunctions or other restraining orders obtained by third parties.


50. WISCONSIN LAW CONTROLLING

- A. It is expressly understood and agreed to by parties hereto that in event of any disagreement or controversy between parties, Wisconsin law shall be controlling.

SUPPLEMENTARY CONDITIONS

1. APPLICATION & CERTIFICATE FOR PAYMENT

- A. Follow payment procedures described in Specification Section 01 20 00. Every contractor engaged in performance of any contract for Department of Public Works, Highway & Transportation shall submit partial and final Application & Certificate for Payment for work under said contract. Form shall provide similar information as shown on AIA G702™ and G703™ forms (samples shown below). Forms shall be submitted to project Architect / Engineer.


AIA Document G702™ – 1992

Application and Certificate for Payment

TO OWNER:	PROJECT:	APPLICATION NO:	Distribution to:
		PERIOD TO:	OWNER <input type="checkbox"/>
		CONTRACT FOR:	ARCHITECT <input type="checkbox"/>
FROM CONTRACTOR:	VIA ARCHITECT:	CONTRACT DATE:	CONTRACTOR <input type="checkbox"/>
		PROJECT NOS:	FIELD <input type="checkbox"/>
			OTHER <input type="checkbox"/>

CONTRACTOR'S APPLICATION FOR PAYMENT
Application is made for payment, as shown below, in connection with the Contract. Continuation Sheet, AIA Document G703, is attached.

1. ORIGINAL CONTRACT SUM \$ _____

2. Net change by Change Orders \$ _____

3. CONTRACT SUM TO DATE (Line 1 + 2) \$ _____

4. TOTAL COMPLETED & STORED TO DATE (Column G on G703) \$ _____

5. RETAINAGE:

 a. % of Completed Work (Column D + E on G703) \$ _____

 b. % of Stored Material (Column F on G703) \$ _____

Total Retainage (Lines 5a or 5b or Total in Column I of G703) \$ _____

6. TOTAL EARNED LESS RETAINAGE \$ _____
(Line 4 less Line 5 Total)

7. LESS PREVIOUS CERTIFICATE FOR PAYMENT (Line 6 from prior Certificate) \$ _____

8. CURRENT PAYMENT DUE \$ _____

9. BALANCE TO FINISH, INCLUDING RETAINAGE (Line 6 less Line 8) \$ _____

The undersigned Contractor certifies that to the best of the Contractor's knowledge, information and belief the Work covered by this Application for Payment has been completed in accordance with the Contract Documents, that all amounts have been paid by the Contractor for Work for which previous Certificates for Payment were issued and payments received from the Owner, and that current payment shown herein is law due.

CONTRACTOR:
 By: _____ Date: _____
 State of _____
 County of _____
 Subscribed and sworn to before me this _____ day of _____
 Notary Public
 My Commission expires: _____

ARCHITECT'S CERTIFICATE FOR PAYMENT
In accordance with the Contract Documents, based on on-site observations and the data comprising this application, the Architect certifies to the Owner that to the best of the Architect's knowledge, information and belief the Work has progressed as indicated, the quality of the Work is in accordance with the Contract Documents, and the Contractor is entitled to payment of the

AMOUNT CERTIFIED \$ _____
(Attach explanation if amount certified differs from the amount applied. Attach all figures on this Application and on the Continuation Sheet that are changed to conform with the amount certified.)

ARCHITECT:
 By: _____ Date: _____

This Certificate is not negotiable. The AMOUNT CERTIFIED is payable only to the Contractor named herein. Issuance, payment and acceptance of payment are without prejudice to any rights of the Owner or Contractor under this Contract.

CHANGE ORDER SUMMARY	ADDITIONS	DEDUCTIONS
Total changes approved in previous months by Owner	\$	\$
Total approved this Month	\$	\$
TOTALS	\$	\$
NET CHANGES by Change Order	\$	\$

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Continuation Sheet

AIA Document G703. APPLICATION AND CERTIFICATION FOR PAYMENT, containing Contractor's signed certification is attached.
 In tabulations below, amounts are stated in the nearest dollar.
 Use Column E on Contracts where variable retainage for line items may apply.

APPLICATION NO:
 APPLICATION DATE:
 PERIOD TO:
 ARCHITECT'S PROJECT NO.:

A ITEM NO.	B DESCRIPTION OF WORK	C SCHEDULED VALUE	D WORK COMPLETED		F MATERIALS PRESENTLY STORED (NET-GROSS) (DOLLAR)	G TOTAL COMPLETED AND STORED TO DATE (DOLLAR)	H % (G ÷ C)	I BALANCE TO (PUSH) (C - G)	J RETAINAGE (IF VARIABLE RATE)
			FROM PREVIOUS APPLICATION (D + E)	THIS PERIOD					

CAUTION: You should sign an original AIA Contract Document, on which this text appears in RED. An original assures that changes will not be obscured.
 AIA Document G703™ – 1992. Copyright © 1963, 1965, 1966, 1967, 1970, 1976, 1982 and 1992 by The American Institute of Architects. All rights reserved. (WARNING) This AIA® Document is protected by U.S. Copyright Law and International Treaties. Unauthorized reproduction or distribution of this AIA® Document, or any portion of it, may result in severe civil and criminal penalties, and will be prosecuted to the maximum extent possible under the law. Purchasers are permitted to reproduce 175 copies of this document when completed. To report copyright violations of AIA Contract Documents, e-mail The American Institute of Architects legal counsel, copyright@aia.org.

2. PREVAILING WAGE RATE DETERMINATION

- A. These supplements shall modify, delete, and / or add to General Conditions of Contract. Where any article, paragraph, or subparagraph in General Conditions of Contract is supplemented by one of these paragraphs, provisions of such article, paragraph, or subparagraph shall remain in effect and supplementary provisions shall be considered as added thereto. Where any article, paragraph, or subparagraph in General Conditions of Contract is amended, voided, or superseded by any of these paragraphs, provisions of such article, paragraph, or subparagraph not so amended, voided, or superseded shall remain in effect.
 - 1. General Conditions of Contract Article 46, “Minimum Wages”, paragraph B. Prevailing Wage rates will be required on this Work. Dane County will issue an Addendum with the Prevailing Wage Rate Determination Number, which will be added to General Conditions of Contract.
- B. These State of Wisconsin forms, hereinafter set forth in this section, shall be filled out and submitted to Department of Public Works, Highway & Transportation:
 - 1. Prime Contractor Affidavit of Compliance With Prevailing Wage Rate Determination (ERD-5724)
 - 2. Agent or Subcontractor Affidavit of Compliance With Prevailing Wage Rate Determination (ERD-10584)
 - 3. Disclosure of Ownership (ERD-7777)
 - 4. Request To Employ Subjourneyperson (ERD-10880)

Prime Contractor Affidavit of Compliance With Prevailing Wage Rate Determination

Authorization for this form is provided under Sections, 66.0903(9) (b) and 103.49(4r) (9b) 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 [Privacy Law, s. 15.04(1)(m), Wisconsin Statutes]

This form must **ONLY** be filed with the **Awarding Agency** indicated below.

State Of _____))SS County Of _____)	Project Name	
	Project Number	Determination Number
	Date Determination Issued	Date of Contract
	Awarding Agency	
	Date Work Completed	

After being duly sworn, the person whose name and signature appears below hereby states under penalty of perjury that

- **I am** the duly authorized officer of the corporation, partnership, sole proprietorship or business indicated below and have recently completed all of the work required under the terms and conditions of a contract with the above-named awarding agency and make this affidavit in accordance with the requirements set forth in Section 66.0903(9)(c) or 103.49(4r)(c), Wisconsin Statutes and Chapter DWD 290 of the Wisconsin Administrative Code in order to obtain FINAL PAYMENT from such awarding agency.
- **I have** fully complied with the entire wage and hour requirements applicable to this project, including all of the requirements set forth in the prevailing wage rate determination indicated above which was issued for such project by the Department of Workforce Development on the date indicated above.
- **I have** received the required affidavit of compliance from each of my agents and subcontractors that performed work on this project and have listed each of their names and addresses on page 2 of this affidavit.
- **I have** full and accurate records that clearly indicate the name and trade or occupation of every worker(s) that I employed on this project, including an accurate record of the hours worked and actual wages paid to such worker(s).
- **I will** retain the records and affidavit(s) described above and make them available for inspection for a period of at least three (3) years from the completion date indicated above at the address indicated below and shall not remove such records or affidavit(s) without prior notification to the awarding agency indicated above.

Name of Corporation, Partnership, Sole Proprietorship or Business				
Street Address or P O Box	City	State	Zip Code	Telephone Number ()
Print Name of Authorized Officer			Date Signed	
Signature of Authorized Officer				

List of Agents and Subcontractors

Name			Name		
Street Address			Street Address		
City	State	Zip Code	City	State	Zip Code
Telephone Number ()			Telephone Number ()		
Name			Name		
Street Address			Street Address		
City	State	Zip Code	City	State	Zip Code
Telephone Number ()			Telephone Number ()		
Name			Name		
Street Address			Street Address		
City	State	Zip Code	City	State	Zip Code
Telephone Number ()			Telephone Number ()		
Name			Name		
Street Address			Street Address		
City	State	Zip Code	City	State	Zip Code
Telephone Number ()			Telephone Number ()		
Name			Name		
Street Address			Street Address		
City	State	Zip Code	City	State	Zip Code
Telephone Number ()			Telephone Number ()		
Name			Name		
Street Address			Street Address		
City	State	Zip Code	City	State	Zip Code
Telephone Number ()			Telephone Number ()		

If you have any questions call (608) 266-6861

Agent or Subcontractor Affidavit of Compliance With Prevailing Wage Rate Determination

Authorization for this form is provided under Sections, 66.0903(9) (b) and 103.49(4r)(9b) Wisconsin Statutes. The use of this form is mandatory. The penalty for failing to complete this form is prescribed in Section 103.0. Personal information you provide may be used for secondary purposes [Privacy Law, s. 15.04(1)(m), Wisconsin Statutes.

This form must **ONLY** be filed with the **Awarding Contractor** indicated below.

State Of _____))SS County Of _____)	Project Name		
	Project Number		Determination Number
	Date Determination Issued		Date of Subcontract
	Awarding Contractor		
	Date Work Completed		

After being duly sworn, the person whose name and signature appears below hereby states under penalty of perjury that

- **I am the duly authorized officer of the corporation, partnership, sole proprietorship or business indicated below.** We have recently completed all of the work required under the terms and conditions of a subcontract with the above-named awarding contractor. We make this affidavit in accordance with the requirements set forth in Section 66.0903(9)(b) or 103.49(4r)(b), Wisconsin Statutes and Chapter DWD 290 of the Wisconsin Administrative Code in order to obtain FINAL PAYMENT from such awarding contractor.
- **I have** fully complied with the entire wage and hour requirements applicable to this project, including all of the requirements set forth in the prevailing wage rate determination indicated above which was issued for such project by the Department of Workforce Development on the date indicated above.
- **I have** received the required affidavit of compliance from each of my agents and subcontractors that performed work on this project and have listed each of their names and addresses on page 2 of this affidavit.
- **I have** full and accurate records that clearly indicate the name and trade or occupation of every worker(s) that I employed on this project, including an accurate record of the hours worked and actual wages paid to such worker(s).
- **I will** retain the records and affidavit(s) described above and make them available for inspection for a period of at least three (3) years from the completion date indicated above at the address indicated below and shall not remove such records or affidavit(s) without prior notification to the awarding contractor.

Name of Corporation, Partnership, Sole Proprietorship or Business				
Street Address	City	State	Zip Code	Telephone Number ()
Print Name of Authorized Officer			Date Signed	
Signature of Authorized Officer				

List of Agents and Subcontractors

Name			Name		
Street Address			Street Address		
City	State	Zip Code	City	State	Zip Code
Telephone Number ()			Telephone Number ()		
Name			Name		
Street Address			Street Address		
City	State	Zip Code	City	State	Zip Code
Telephone Number ()			Telephone Number ()		
Name			Name		
Street Address			Street Address		
City	State	Zip Code	City	State	Zip Code
Telephone Number ()			Telephone Number ()		
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Street Address			Street Address		
City	State	Zip Code	City	State	Zip Code
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Name			Name		
Street Address			Street Address		
City	State	Zip Code	City	State	Zip Code
Telephone Number ()			Telephone Number ()		

If you have any questions call (608) 266-6861

Disclosure of Ownership

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 [Privacy Law, s. 15.04(1) (m), Wisconsin Statutes]

- (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.
- (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.
- (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.**
 - (A) The contractor, or a shareholder, officer or partner of the contractor:
 - (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.
 - (2) Or has owned at least a 25% interest in the "other construction business" at any time within the preceding three (3) years.
 - (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.

Other Construction Business

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
Name of Business			
Street Address or P O Box	City	State	Zip Code

I hereby state under penalty of perjury that the information, contained in this document, is true and accurate according to my knowledge and belief.

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) 266-6861

Request to Employ Subjourneyperson

The use of this form is mandatory. The authority for the use of this form is prescribed in Section DWD 290.025, Wisconsin Administrative Code. 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. [See Section 15.04(1) (m), Wisconsin Statutes for details.]

The employer indicated below requests that the Department of Workforce Development (DWD) determine the prevailing wage rate(s) and related qualifications to enable such employer to utilize a subjourneyperson(s) on the following public works project, in accordance with the provisions of Section DWD 290.025, Wisconsin Administrative Code.

1. Name of Public Works Project	
County	City, Village or Township
Determination Number	Project Number

2. Name of Employee (Last, First and Initial)	P.O. Box or Street Address	City	State	Zip Code	Date of Birth	Journey Classification

3. Name of Employer (Print)	Name of Person Making Request (Print)		
P O Box or Street Address	City	State	Zip Code
Telephone Number (.)	Title of Requestor		

READ CAREFULLY: I fully understand that this request is ONLY applicable to the project and employee(s) listed above and that such employee(s) will ONLY work under the direction of and directly assist a skilled trades employee by frequently using the tools of a skilled trades employee and will NOT regularly perform the duties of a general laborer, heavy equipment operator or truck driver. If the employee(s) indicated above regularly perform(s) the work of a different trade or occupation, he/she will be compensated for such work at the applicable journeypersons prevailing wage rate. I agree not to employ any employee as a subjourneyperson on this project until I receive written confirmation from the DWD. After such confirmation is received, I will compensate the employee(s) indicated above in strict accordance with the directions received from the DWD.

Signature of Requestor _____ Date Signed _____

MAIL COMPLETED REQUEST TO EQUAL RIGHTS DIVISION, LABOR STANDARDS BUREAU P. O. BOX 8928 MADISON WI 53708.
 You may call (608) 266-6860 if you need assistance in completing your request



December 15, 2009

TO: Public entities with ongoing prevailing wage projects
FROM: Labor Standards Bureau – Construction Wage Standards Section
RE: New prevailing wage law provisions regarding certified payroll records

On January 1, 2010, significant changes in Wisconsin's prevailing wage law will take effect. These changes will affect nearly every public entity in the state, including local governmental units under Section 66.0903, Wisconsin Statutes and state agencies under Section 103.49, Wisconsin Statutes. This memorandum addresses one of the significant changes to the state's prevailing wage laws, i.e., the requirement that all contractors submit certified payroll records to the Department of Workforce Development (DWD).

If a local governmental unit or state agency currently has a prevailing wage project underway and work on that project will continue in 2010 or commence in 2010, the public entity must do the following:

- Inform all project contractors that effective January 1, 2010, they must file certified payroll records with DWD on a monthly basis in a format that meets DWD reporting requirements. The first certified payroll reports must be filed with DWD by the end of the first week in February 2010.

If a local governmental unit or state agency has public works projects of \$25,000 or more that will commence after January 1, 2010, the public entity must:

- Inform all project contractors that effective January 1, 2010, they must file certified payroll records with DWD on a monthly basis in a format that meets DWD reporting requirements. Certified payroll reports must be filed with DWD by the end of the first week following the month in which the work was conducted. The January report will be due at DWD no later than February 7, 2010.
- Notify all project contractors that if DWD finds a contractor violating the prevailing wage law, DWD will assess liquidated damages of 100% of the wages owed to employees.

For more information, visit the prevailing wage website:
http://dwd.wisconsin.gov/er/prevailing_wage_rate/default.htm. For further assistance, please call the Equal Rights Division at 608-266-6860.

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SECTION 01 01 00

RECYCLING

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Waste Management Goals
 - 2. Waste Management Plan
 - 3. Reuse
 - 4. Recycling
 - 5. Materials Sorting and Storage On Site
 - 6. Lists of Recycling Facilities Processors and Haulers
 - 7. Waste Management Plan Form

1.2 WASTE MANAGEMENT GOALS

- A. Dane County requires that as many waste materials as possible produced as result of this project be salvaged, reused or recycled in order to minimize impact of construction waste on landfills and to minimize expenditure of energy and cost in fabricating new materials. Additional information may be found in The Dane County Green Building Policy, Resolution 299, 1999-2000.
- B. Contractor shall develop, with assistance of Public Works Project Engineer and Architect / Engineer, Waste Management Plan (WMP) for this project. Outlined in RECYCLING section of this specification are examples of materials that can be recycled or reused as well as recommendations for waste sorting methods.

1.3 WASTE MANAGEMENT PLAN

- A. Contractor shall complete WMP and include cost of recycling / reuse in Bid. WMP will be submitted to Public Works Project Engineer within fifteen (15) days of Notice to Proceed date. Copy of blank WMP form is in this Section. Submittal shall include cover letter and WMP form with:
 - 1. Information on:
 - a. Types of waste materials produced as result of work performed on site;
 - b. Estimated quantities of waste produced;
 - c. Identification of materials with potential to be recycled or reused;
 - d. How materials will be recycled or reused;
 - e. On-site storage and separation requirements (on site containers);
 - f. Transportation methods; and
 - g. Destinations.

1.4 REUSE

- A. Contractors and subcontractors are encouraged to reuse as many waste materials as possible. Salvage should be investigated for materials not reusable on site.

1.5 RECYCLING

- A. These materials can be recycled in Dane County area:
 1. Wood.
 2. Wood Pallets.
 3. Fluorescent Lamps.
 4. Foam Insulation & Packaging (extruded and expanded).
 5. PVC Plastic (pipe, siding, etc.).
 6. Asphalt & Concrete.
 7. Bricks & Masonry
 8. Corrugated Cardboard.
 9. Metal.
 10. Carpet Padding.
 11. Gypsum Drywall.
 12. Shingles.
 13. Barrels & Drums.
 14. Solvents.

1.6 MATERIALS SORTING AND STORAGE ON SITE

- A. Contractor shall provide separate containers for recyclable materials. Number of containers will be dependent upon project and site conditions.
- B. Contractor shall provide on-site locations for subcontractors supplied recycling containers to help facilitate recycling.

1.7 LISTS OF RECYCLING FACILITIES PROCESSORS AND HAULERS

- A. Web site www.countyofdane.com has recycling symbol (link) near top of page that lists current information for Dane County Recycling Markets. Contractors can also contact Dane County's Recycling Manager at 608/267-8815, or local city, village, town recycling staff listed in above referenced web site. Statewide listings of recycling / reuse markets at available from Wisconsin Department of Natural Resources, www.dnr.state.wi.us/org/aw/wm/markets.

1.8 WASTE MANAGEMENT PLAN FORM

A. Contractor Information:

Name: _____

Address: _____

Phone No.: _____ Recycling Coordinator: _____

MATERIAL	ESTIMATED QUANTITY	DISPOSAL METHOD (CHECK ONE)		RECYCLING / REUSE COMPANY OR DISPOSAL SITE
Salvaged & reused building materials	_____ cu. yds. _____ tons	_____ Recycled	_____ Reused	Name: _____
		_____ Landfilled	_____ Other	
Glass	_____ cu. yds. _____ tons	_____ Recycled	_____ Reused	Name: _____
		_____ Landfilled	_____ Other	
Wood	_____ cu. yds. _____ tons	_____ Recycled	_____ Reused	Name: _____
		_____ Landfilled	_____ Other	
Wood Pallets	_____ units	_____ Recycled	_____ Reused	Name: _____
		_____ Landfilled	_____ Other	
Fluorescent Lamps	_____ cu. ft. _____ lbs.	_____ Recycled	_____ Reused	Name: _____
		_____ Landfilled	_____ Other	
Foam Insulation	_____ cu. ft. _____ lbs.	_____ Recycled	_____ Reused	Name: _____
		_____ Landfilled	_____ Other	
Asphalt & Concrete	_____ cu. ft. _____ lbs.	_____ Recycled	_____ Reused	Name: _____
		_____ Landfilled	_____ Other	
Bricks & Masonry	_____ cu. ft. _____ lbs.	_____ Recycled	_____ Reused	Name: _____
		_____ Landfilled	_____ Other	
PVC Plastic	_____ cu. ft. _____ lbs.	_____ Recycled	_____ Reused	Name: _____
		_____ Landfilled	_____ Other	
Corrugated Cardboard	_____ cu. ft. _____ lbs.	_____ Recycled	_____ Reused	Name: _____
		_____ Landfilled	_____ Other	
Metals	_____ cu. yds. _____ tons	_____ Recycled	_____ Reused	Name: _____
		_____ Landfilled	_____ Other	
Carpet Padding	_____ cu. ft. _____ lbs.	_____ Recycled	_____ Reused	Name: _____
		_____ Landfilled	_____ Other	
Gypsum / Drywall	_____ cu. yds. _____ tons	_____ Recycled	_____ Reused	Name: _____
		_____ Landfilled	_____ Other	

Shingles	_____ cu. yds. _____ tons	_____ Recycled _____ Landfilled	_____ Reused _____ Other	Name: _____
Barrels & Drums	_____ units	_____ Recycled _____ Landfilled	_____ Reused _____ Other	Name: _____
Solvents	_____ gallons	_____ Recycled _____ Landfilled	_____ Reused _____ Other	Name: _____
Other	_____	_____ Recycled _____ Landfilled	_____ Reused _____ Other	Name: _____
Other	_____	_____ Recycled _____ Landfilled	_____ Reused _____ Other	Name: _____
Other	_____	_____ Recycled _____ Landfilled	_____ Reused _____ Other	Name: _____
Other	_____	_____ Recycled _____ Landfilled	_____ Reused _____ Other	Name: _____
Other	_____	_____ Recycled _____ Landfilled	_____ Reused _____ Other	Name: _____

SECTION 01 10 00

SUMMARY OF WORK

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Project Description.
 - 2. Contract Method.
 - 3. Work by Owner.
 - 4. Owner supplied products.
 - 5. Contractor's use of site and premises.
 - 6. Staging areas.
 - 7. Owner occupancy.

1.2 PROJECT DESCRIPTION

- A. Work of the Project includes construction of:
 - 1. Waste Transfer Facility
 - 2. Household Hazardous Waste Collection Facility.
- B. Work of the Project includes construction of:
 - 1. Related site work including landscaping and access drive.

1.3 CONTRACT METHOD

- A. Perform Work of Contract under stipulated lump sum contract with Owner in accordance with Conditions of Contract.
- B. Work of Contract is identified in the Contract Drawings and this Project Manual.

1.4 WORK BY OWNER

- A. Reference Division 00 – Instructions to Bidders.

1.5 OWNER SUPPLIED PRODUCTS

- A. Owner's Responsibilities:
 - 1. Arrange for and deliver Owner-reviewed Shop Drawings, product data, and samples, to Contractor.
 - 2. Arrange and pay for delivery to site.
 - 3. On delivery, inspect products jointly with Contractor.
 - 4. Submit claims for transportation damage and replace damaged, defective, or deficient items.

5. Arrange for manufacturers' warranties, inspections, and service.
- B. Contractor's Responsibilities:
1. Review Owner-reviewed Shop Drawings, product data, and samples.
 2. Receive and unload products at site; inspect for completeness or damage jointly with Owner.
 3. Handle, store, install and finish products.
 4. Repair or replace items damaged after receipt.
- C. Items furnished by Owner for installation by Contractor:
1. Compactors.

1.6 CONTRACTOR'S USE OF SITE AND PREMISES

- A. Limit use of site and premises to allow:
1. Owner occupancy.
 2. Work by Others and Work by Owner.
 3. Use of site and premises by the public.
- B. Construction Operations: Limited to Monday through Friday, 7:00 a.m. to 3:00 p.m., and Saturday, 8:00 a.m. to 11:00 a.m. Contractor can arrange additional hours with Owner, but front gate must remain locked outside of these hours.
- C. Utility Outages and Shutdown: In accordance with Owner's policies and recommendations. If Contractor requires utility shutdown for construction operations, shutdown must be coordinated with Owner fifteen (15) days prior to shutdown.
- D. Permits: Prior to commencement of the Work, Contractor shall secure any and all necessary permits for completion of the Work and facility occupancy

1.7 STAGING AREAS

- A. Coordinate staging areas with Public Works Project Engineer prior to starting the Work.
- B. On-site space for use as staging areas and storage of materials is limited and will be apportioned among the various Contractors as their needs dictate with due regard for storage requirements of each Contractor. Each Contractor shall be responsible for safety of equipment and materials that are stored on site.

1.8 OWNER OCCUPANCY

- A. Owner will occupy premises during entire period of construction.
- B. Cooperate with Owner to minimize conflict, and to facilitate Owner's operations.
- C. Schedule the Work to accommodate Owner occupancy.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

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SECTION 01 20 00

PRICE AND PAYMENT PROCEDURES

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Schedule of values.
 - 2. Applications for payment.
 - 3. Change procedures.
 - 4. Defect assessment.
 - 5. Alternates.

- B. Related Sections
 - 1. Section 01 33 00 – Submittal Procedures.
 - 2. Section 01 40 00 – Quality Requirements.
 - 3. Section 0 16 00 – Product Requirement.
 - 4. Section 01 70 00 – Execution Requirements.

1.2 SCHEDULE OF VALUES

- A. Submit printed schedule on AIA Form G703 Continuation Sheet for G702.
- B. Submit Schedule of Values in duplicate within 15 days after date of Notice to Proceed.
- C. Format: Utilize Table of Contents of this Project Manual. Identify each line item with number and title of major specification Division. Identify site mobilization, bonds and insurance.
- D. Include within each line item, direct proportional amount of Contractor's overhead and profit.
- E. Revise schedule to list approved Change Orders, with each Application For Payment.

1.3 APPLICATIONS FOR PAYMENT

- A. Submit three copies of each application on AIA Form G702 - Application and Certificate for Payment and AIA G703 - Continuation Sheet for G702.
- B. Content and Format: Utilize Schedule of Values for listing items in Application for Payment.
- C. Submit updated construction schedule with each Application for Payment.
- D. Payment Period: Submit at intervals stipulated in the Agreement.

- E. Submit with transmittal letter as specified for Submittals in Section 01 33 00 – Submittal Procedures.
- F. Beginning with second Application for Payment, submit Contractor’s waiver of lien for Work included in previous Application for Payment. Beginning with third Application for Payment, submit Subcontractors’ and Suppliers’ waivers of lien for Work included in Application of Payment two periods previous.
- G. Substantiating Data: When Engineer/Architect requires substantiating information, submit data justifying dollar amounts in question. Include the following with Application for Payment:
 - 1. Partial release of liens from subcontractors and vendors.
 - 2. Record documents as specified in Section 01 70 00 – Execution Requirements, for review by Owner and return to Contractor.
 - 3. Affidavits attesting to off-site stored products and insurance of those stored products.
 - 4. Construction progress schedules, revised and current as specified in Section 01 33 00 – Submittal Procedures.
- H. Submit Equal Partner Benefit Compliance form with Final Payment Application.

1.4 CHANGE PROCEDURES

- A. Submittals: Submit name of individual authorized to receive change documents, and responsible for informing others in Contractor's employ or Subcontractors of changes to the Work.
- B. Engineer/Architect will advise of minor changes in the Work not involving adjustment to Contract Sum/Price or Contract Time by issuing supplemental instructions on AIA Form G710 – Engineer/Architect’s Supplemental Instructions.
- C. Engineer/Architect may issue a Proposal Request including detailed description of proposed change with supplementary or revised Drawings and specifications, change in Contract Time for executing change period of time during which requested price will be considered valid. Contractor will prepare and submit estimate within ten (10) days.
- D. Contractor may propose changes by submitting a request for change to Engineer/Architect, describing proposed change and its full effect on the Work. Submit digital photographs of changes, if applicable. Include a statement describing reason for change and effect on Contract Sum/Price and Contract Time with full documentation and a statement describing effect on Work by separate or other Contractors. Document requested substitutions in accordance with Section 0 16 00 – Product Requirements.
- E. Stipulated Sum/Price Change Order: Based on Proposal Request and Contractor's request for Change Order as approved by Engineer. Submit digital photographs of changes, if applicable.

- F. Construction Change Directive: Engineer/Architect may issue directive, on AIA Form G714 Construction Change Directive signed by Owner, instructing Contractor to proceed with change in the Work, for subsequent inclusion in a Change Order. Document will describe changes in the Work, and designate method of determining any change in Contract Sum/Price or Contract Time. Promptly execute change.
- G. Time and Material Change Order: Submit itemized account and supporting data including digital photographs of Change Order after completion of change, within time limits indicated in Conditions of the Contract. Engineer/Architect will determine change allowable in Contract Sum/Price and Contract Time as provided in Contract Documents.
- H. Maintain detailed records of work done on Time and Material basis. Provide full information required for evaluation of proposed changes, and to substantiate costs for changes in the Work.
- I. Document each quotation for change in cost or time with sufficient data to allow evaluation of quotation.
- J. Change Order Forms: AIA G701 - Change Order.
- K. Execution of Change Orders: Engineer/Architect will issue Change Orders for signatures of parties as provided in Conditions of the Contract.
- L. Correlation of Contractor Submittals:
 1. Promptly revise Schedule of Values and Application for Payment forms to record each authorized Change Order as separate line item and adjust Contract Sum/Price.
 2. Promptly revise progress schedules to reflect change in Contract Time, revise sub-schedules to adjust times for other items of work affected by change, and resubmit.
 3. Promptly enter changes in Project Record Documents.

1.5 DEFECT ASSESSMENT

- A. Replace the Work, or portions of the Work, not conforming to specified requirements.
- B. If, in opinion of Engineer/Architect, it is not practical to remove and replace the Work, Engineer will direct appropriate remedy or adjust payment.
- C. Defective Work may remain, but unit sum/price will be adjusted to new sum/price at discretion of Engineer/Architect.
- D. Individual specification sections may modify these options or may identify specific formula or percentage sum/price reduction.
- E. Authority of Engineer/Architect to assess defects and identify payment adjustments is final.

- F. Non-Payment For Rejected Products: Payment will not be made for rejected products for any of the following causes:
1. Products wasted or disposed of in a manner that is not acceptable.
 2. Products determined as unacceptable before or after placement.
 3. Products not completely unloaded from transporting vehicle.
 4. Products placed beyond lines and levels of required Work.
 5. Products remaining on hand after completion of the Work.
 6. Loading, hauling, and disposing of rejected products.

1.6 ALTERNATES

- A. Alternates quoted on Bid Form will be reviewed and accepted or rejected at Owner's option. Accepted Alternates will be identified in Owner-Contractor Agreement.
- B. Coordinate related work and modify surrounding work.
- C. Schedule of Alternates:
1. Alternate No. 1: Title: Steel Cover for Tipping Slab Opening and Overhead Door at Compactor Wall Opening
 - a. Base Bid Item: Drawing number A101 including opening in south wall for new compactor between column lines E.2 and E.8, and 8 foot square opening in tipping slab above compactor based on Section 18/S500.
 - b. Alternate Item: Drawing numbers A101 and A600 including Door 9L, Drawing number S101 including plate infill per Section 2/S500, and Section 08 33 23.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

SECTION 01 30 00
ADMINISTRATIVE REQUIREMENTS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Coordination and project conditions.
 - 2. Field engineering.
 - 3. Preconstruction meeting.
 - 4. Progress meetings.
 - 5. Equipment electrical characteristics and components.
 - 6. Cutting and patching.
 - 7. Special procedures.

- B. Related Sections:
 - 1. Applicable provisions of Division 01 shall govern all work under this Section.

1.2 COORDINATION AND PROJECT CONDITIONS

- A. Coordinate scheduling, submittals, and Work of various sections of Project Manual to ensure efficient and orderly sequence of installation of interdependent construction elements, with provisions for accommodating items installed later.

- B. Verify utility requirements and characteristics of operating equipment are compatible with building utilities. Coordinate work of various sections having interdependent responsibilities for operating equipment installation, connection, and start-up.

- C. Coordinate space requirements, supports, and installation of mechanical and electrical Work indicated diagrammatically on Drawings. Follow routing shown for pipes, ducts, and conduit, as closely as practicable; place runs parallel with lines of building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.

- D. In finished areas except as otherwise indicated, conceal pipes, ducts, and wiring within construction. Coordinate locations of fixtures and outlets with finish elements.

- E. Coordinate completion and clean-up of Work of separate sections in preparation for Substantial Completion.

- F. After Owner occupancy of premises, coordinate access to site for correction of defective Work and Work not in accordance with Contract Documents, to minimize disruption of Owner's activities.

1.3 FIELD ENGINEERING

- A. Employ Land Surveyor registered in State of Wisconsin acceptable to Engineer/Architect.
- B. Locate and protect survey control and reference points. Promptly notify Engineer/Architect of discrepancies discovered.
- C. Control datum for survey is that established by Owner provided survey.
- D. Verify setbacks and easements; confirm drawing dimensions and elevations.
- E. Provide field engineering services. Establish elevations, lines, and levels, utilizing recognized engineering survey practices.
- F. Maintain complete and accurate log of control and survey work as Work progresses.
- G. Protect survey control points prior to starting site work; preserve permanent reference points during construction.
- H. Promptly report to Engineer/Architect loss or destruction of reference point or relocation required because of changes in grades or other reasons.
- I. Replace dislocated survey control points based on original survey control. Make no changes without prior written notice to Engineer/Architect.

1.4 PRECONSTRUCTION MEETING

- A. Engineer/Architect will administer pre-construction conference for execution of Owner-Contractor Agreement and exchange of preliminary submittals, clarification of Owner and Contractor responsibilities in use of site and for review of administrative procedures.
- B. Required attendance shall include representatives of the Contractor including the superintendent(s) designated for the project, representative of major subcontractors, resident project representative, and representatives of the Owner.

1.5 PROGRESS MEETINGS

- A. Schedule and administer Project meetings throughout progress of the Work twice each month, called meetings, and pre-installation conferences.
- B. Make physical arrangements for meetings and preside at meetings. Engineer/Architect will record minutes, and distribute copies within two (2) days to participants, and those affected by decisions made at meetings.
- C. Attendance: Job superintendent, major Subcontractors and suppliers, resident project representative, Owner and Engineer/Architect as appropriate to agenda topics for each

meeting.

- D. Suggested Agenda: Review of Work progress, work during next period, status of progress schedule and adjustments thereto, delivery schedules, submittals, maintenance of quality standards, pending changes and substitutions, and other items affecting progress of Work.

PART 2 PRODUCTS

2.1 EQUIPMENT ELECTRICAL CHARACTERISTICS AND COMPONENTS

- A. Motors: Specific motor type is specified in individual specification sections.
- B. Wiring Terminations: Furnish terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Include lugs for terminal box.
- C. Cord and Plug: Furnish minimum six (6) foot cord and plug including grounding connector for connection to electric wiring system. Cord of longer length is specified in individual specification sections.

PART 3 EXECUTION

3.1 CUTTING AND PATCHING

- A. Employ skilled and experienced installer to perform cutting and patching.
- B. Submit written request in advance of cutting or altering elements affecting:
 - 1. Structural integrity of element.
 - 2. Integrity of weather-exposed or moisture-resistant elements.
 - 3. Efficiency, maintenance, or safety of element.
 - 4. Visual qualities of sight exposed elements.
 - 5. Work of Owner or separate contractor.
- C. Execute cutting, fitting, and patching including excavation and fill, to complete Work, and to:
 - 1. Fit the several parts together, to integrate with other Work.
 - 2. Uncover Work to install or correct ill-timed Work.
 - 3. Remove and replace defective and non-conforming Work.
 - 4. Remove samples of installed Work for testing.
 - 5. Provide openings in elements of Work for penetrations of mechanical and electrical Work.
- D. Execute Work by methods to avoid damage to other Work, and to provide proper surfaces to receive patching and finishing.
- E. Cut masonry and concrete materials using masonry saw or core drill.
- F. Restore Work with new products in accordance with requirements of Contract Documents.

- G. Fit Work tight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.
- H. Maintain integrity of wall, ceiling, or floor construction; completely seal voids.
- I. At penetrations of fire rated walls, partitions, ceiling, or floor construction, completely seal voids with fire rated material in accordance with Section 07 84 00, to full thickness of penetrated element.
- J. Refinish surfaces to match adjacent finishes. For continuous surfaces, refinish to nearest intersection; for assembly, refinish entire unit.
- K. Identify hazardous substances or conditions exposed during the Work to Engineer/Architect for decision or remedy.

3.2 SPECIAL PROCEDURES

- A. Materials: As specified in product sections; match existing with new products and salvaged products for patching and extending work.
- B. Employ skilled and experienced installer to perform alteration work.
- C. Cut, move, or remove items as necessary for access to alterations and renovation Work. Replace and restore at completion.
- D. Remove unsuitable material not marked for salvage, including rotted wood, corroded metals, and deteriorated masonry and concrete. Replace materials as specified for finished Work.
- E. Remove debris and abandoned items from area and from concealed spaces.
- F. Prepare surface and remove surface finishes to permit installation of new work and finishes.
- G. Close openings in exterior surfaces to protect existing work from weather and extremes of temperature and humidity.
- H. Remove, cut, and patch Work in manner to minimize damage and to permit restoring products and finishes to specified condition.
- I. Refinish existing visible surfaces to remain in renovated rooms and spaces, to specified condition for each material, with neat transition to adjacent finishes.
- J. Where new Work abuts or aligns with existing, provide smooth and even transition. Patch Work to match existing adjacent Work in texture and appearance.
- K. When finished surfaces are cut so that smooth transition with new Work is not possible, terminate existing surface along straight line at natural line of division and submit recommendation to Engineer/Architect for review.

- L. Patch or replace portions of existing surfaces that are damaged, lifted, discolored, or showing other imperfections.
- M. Finish surfaces as specified in individual product sections.

END OF SECTION

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SECTION 01 33 00
SUBMITTAL PROCEDURES
(FACILITY CONSTRUCTION)

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Submittal procedures.
 - 2. Construction progress schedules.
 - 3. Proposed products list.
 - 4. Product data.
 - 5. Shop Drawings.
 - 6. Samples.
 - 7. Design data.
 - 8. Test reports.
 - 9. Manufacturer's Certificates.
 - 10. Manufacturer's Instructions.
 - 11. Manufacturer's Field Reports.
 - 12. Erection drawings.

- B. Related Sections:
 - 1. Applicable provisions of Division 01 shall govern all work under this Section.

1.2 SUBMITTAL PROCEDURES

- A. Transmit each submittal with Engineer/Architect accepted form.

- B. Sequentially number transmittal forms. Mark revised submittals with original number and sequential alphabetic suffix.

- C. Identify Project, Contractor, Subcontractor and supplier; pertinent drawing and detail number, and specification section number, appropriate to submittal.

- D. Apply Contractor's stamp, signed or initialed certifying that review, approval, verification of products required, field dimensions, adjacent construction Work, and coordination of information is in accordance with requirements of the Work and Contract Documents. Submittals not signed by Contractor will not be recognized or processed.

- E. Schedule submittals to expedite Project, and deliver to Engineer/Architect as follows:
 - 1. Send Structural submittals to Engineer/Architect at:

GRAEF
5126 West Terrace Drive, Suite 111
Madison, WI 53718-8346

2. Send all other submittals to Engineer/Architect at

GRAEF
One Honey Creek Corporate Center
125 South 84th Street, Suite 401
Milwaukee, WI 53214-1470

3. Coordinate submission of related items.
- F. For each submittal for review, allow 10 days excluding delivery time to and from Contractor.
- G. Identify variations from Contract Documents and product or system limitations that may be detrimental to successful performance of completed Work.
- H. Allow space on submittals for Contractor and Engineer/Architect review stamps.
- I. When revised for resubmission, identify changes made since previous submission.
- J. Distribute copies of reviewed submittals as appropriate. Instruct parties to promptly report inability to comply with requirements.
- K. Submittals not requested will not be recognized or processed.

1.3 CONSTRUCTION PROGRESS SCHEDULES

- A. Submit initial schedules within 15 days after date established in Notice to Proceed. After review, resubmit required revised data within 10 days.
- B. Submit revised Progress Schedules with each Application for Payment.
- C. Distribute copies of reviewed schedules to Project site file, subcontractors, suppliers, and other concerned parties.
- D. Instruct recipients to promptly report, in writing, problems anticipated by projections indicated in schedules.
- E. Submit computer generated horizontal bar chart with separate line for each major portion of Work or operation, identifying first work day of each week.
- F. Show complete sequence of construction by activity, identifying Work of separate stages and other logically grouped activities. Indicate early and late start, early and late finish, float dates, and duration.

- G. Indicate estimated percentage of completion for each item of Work at each submission.
- H. Submit separate schedule of submittal dates for Shop Drawings, product data, and samples, including Owner furnished products, and dates reviewed submittals will be required from Engineer/Architect. Indicate decision dates for selection of finishes.
- I. Indicate delivery dates for Owner furnished products.
- J. Revisions to Schedules:
 - 1. Indicate progress of each activity to date of submittal, and projected completion date of each activity.
 - 2. Identify activities modified since previous submittal, major changes in scope, and other identifiable changes.
 - 3. Prepare narrative report to define problem areas, anticipated delays, and impact on Schedule. Report corrective action taken, or proposed, and its effect including effect of changes on schedules of separate contractors.

1.4 PROPOSED PRODUCTS LIST

- A. Within 15 days after date of Notice to Proceed, submit list of major products proposed for use, with name of manufacturer, trade name, and model number of each product.
- B. For products specified only by reference standards, give manufacturer, trade name, model or catalog designation, and reference standards.

1.5 PRODUCT DATA

- A. Product Data: Submit to Engineer/Architect for review for limited purpose of checking for conformance with information given and design concept expressed in Contract Documents. Provide copies and distribute in accordance with Submittal Procedures article and for record documents purposes described in Section 01 70 00 – Execution Requirements.
- B. Submit number of copies Contractor requires, plus three copies Engineer/Architect will retain.
- C. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturers' standard data to provide information specific to this Project.
- D. Indicate product utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.
- E. After review distribute in accordance with Submittal Procedures article above and provide copies for record documents described in Section 01 70 00 – Execution Requirements.

1.6 SHOP DRAWINGS

- A. Shop Drawings: Submit to Engineer/Architect FTP site for review for limited purpose of checking for conformance with information given and design concept expressed in Contract Documents. Produce copies and distribute in accordance with Submittal Procedures article and for record documents purposes described in Section 01 70 00 – Execution Requirements.
- B. Indicate special utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.
- C. Submit one pdf copy on FTP site and one hard copy to Engineer/Architect and Owner. All submittals must be stamped by Contractor, unless noted otherwise.
- D. After review, Contractor shall maintain copies required for Record Documents described in Section 01 70 00, and sufficient copies in accordance with Article on Procedures above.

1.7 SAMPLES

- A. Samples: Submit to Engineer/Architect for review for limited purpose of checking for conformance with information given and design concept expressed in Contract Documents. Produce duplicates and distribute in accordance with Submittal Procedures article and for record documents purposes described in Section 01 70 00 – Execution Requirements.
- B. Samples for selection as specified in product sections:
 - 1. Submit to Engineer/Architect for aesthetic, color, or finish selection.
 - 2. Submit samples of finishes in custom colors selected, textures, and patterns for Engineer/Architect selection.
- C. After review, produce duplicates and distribute in accordance with Submittal Procedures article and for record documents purposes described in Section 01 70 00 – Execution Requirements.
- D. Submit samples to illustrate functional and aesthetic characteristics of Products, with integral parts and attachment devices. Coordinate sample submittals for interfacing work.
- E. Include identification on each sample, with full Project information.
- F. Submit number of samples specified in individual specification sections; Engineer/Architect will retain one sample.
- G. Reviewed samples which may be used in the Work are indicated in individual specification sections.
- H. Samples will not be used for testing purposes unless specifically stated in specification section.

1.8 DESIGN DATA

- A. Submit for Engineer/Architect's knowledge as contract administrator for Owner.
- B. Submit for information for limited purpose of assessing conformance with information given and design concept expressed in Contract Documents.

1.9 TEST REPORTS

- A. Submit for Engineer/Architect's knowledge as contract administrator for Owner.
- B. Submit test reports for information for limited purpose of assessing conformance with information given and design concept expressed in Contract Documents.

1.10 MANUFACTURER'S CERTIFICATES

- A. When specified in individual specification sections, submit certification by manufacturer, installation/ application subcontractor, or Contractor to Engineer/Architect, in quantities specified for Product Data.
- B. Indicate material or product conforms to or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.
- C. Certificates may be recent or previous test results on material or Product, but must be acceptable to Engineer/Architect.

1.11 MANUFACTURER'S INSTRUCTIONS

- A. When specified in individual specification sections, submit printed instructions for delivery, storage, assembly, installation, start-up, adjusting, and finishing, to Engineer/Architect for delivery to Owner in quantities specified for Product Data.
- B. Indicate special procedures, perimeter conditions requiring special attention, and special environmental criteria required for application or installation.

1.12 MANUFACTURER'S FIELD REPORTS

- A. Submit reports for Engineer/Architect's benefit as contract administrator for Owner.
- B. Submit report in duplicate within 15 days of observation to Engineer/Architect for information.
- C. Submit for information for limited purpose of assessing conformance with information given and design concept expressed in Contract Documents.

1.13 ERECTION DRAWINGS

- A. Submit drawings for Engineer/Architect's benefit as contract administrator for Owner.
- B. Submit for information for limited purpose of assessing conformance with information given and design concept expressed in Contract Documents.
- C. Data indicating inappropriate or unacceptable Work may be subject to action by Engineer/Architect.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

SECTION 01 40 00
QUALITY REQUIREMENTS
(FACILITY CONSTRUCTION)

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Quality Assurance and Control of Installation.
 - 2. Tolerances.
 - 3. References.
 - 4. Field samples.
 - 5. Mock-up Requirements.
 - 6. Inspection and Testing Laboratory Services.
 - 7. Manufacturers' Instructions.
 - 8. Manufacturers' Certificates.
 - 9. Manufacturers' Field Services and Reports.
 - 10. Examination.
 - 11. Preparation.

- B. Related Sections:
 - 1. Applicable provisions of Division 01 shall govern all work under this Section.

1.2 QUALITY ASSURANCE AND CONTROL OF INSTALLATION

- A. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship to produce Work of specified quality.

- B. Comply fully with manufacturer's instructions, including each step in sequence.

- C. Should manufacturer's instructions conflict with Contract Documents, request clarification from Engineer/Architect before proceeding.

- D. Comply with specified standards as a minimum quality for the Work except when more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.

- E. Perform Work by persons qualified to produce workmanship of specified quality.

- F. Verify field measurements are as indicated on Shop Drawings or as instructed by manufacturer.

- G. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, or disfigurement.

1.3 TOLERANCES

- A. Monitor fabrication and installation tolerance control of products to produce acceptable Work. Do not permit tolerances to accumulate.
- B. Comply with manufacturer's tolerances. When manufacturer's tolerances conflict with Contract Documents, request clarification from Engineer/Architect before proceeding.
- C. Adjust products to appropriate dimensions; position before securing products in place.
- D. Reference individual technical specifications for tolerance requirements for specified products and materials.

1.4 REFERENCES

- A. Conform to reference standard by date of issue current on date of Contract Documents.
- B. Obtain copies of standards when required by Contract Documents.
- C. Should specified reference standards conflict with Contract Documents, request clarification from Engineer/Architect before proceeding.
- D. Contractual relationships, duties, and responsibilities of parties in Contract and those of Engineer/Architect shall not be altered from the Contract Documents by mention or inference otherwise in any reference document.

1.5 FIELD SAMPLES

- A. Install field samples at the site as required by individual specifications Sections for review.
- B. Acceptable samples represent a quality level for the Work.
- C. Where field sample is specified in individual Sections to be removed, clear area after field sample has been accepted by Engineer/Architect.

1.6 MOCK-UP REQUIREMENTS

- A. Tests will be performed under provisions identified in this section and identified in respective product specification sections.
- B. Assemble and erect specified items, with specified attachment and anchorage devices, flashings, seals, and finishes.
- C. Accepted mock-ups shall be comparison standard for remaining work.

1.7 INSPECTION AND TESTING LABORATORY SERVICES

- A. Owner will appoint, employ, and pay for services of an independent firm to perform inspection and testing.
- B. The independent firm will perform tests, inspections and other services specified in individual specification sections and as required by Engineer/Architect.
 - 1. Agency: Authorized to operate in State of Wisconsin.
 - 2. Agency Staff: Maintain full time registered Engineer on staff to review services.
 - 3. Testing Equipment: Calibrated at reasonable intervals with devices of accuracy traceable to National Institute of Standards and Technology or accepted values of natural physical constants.
- C. Testing, inspections and source quality control may occur on or off project site. Perform off-site testing as required by Engineer/Architect.
- D. Reports will be submitted by independent firm to Engineer/Architect, in duplicate, indicating observations and results of tests and compliance or non-compliance with Contract Documents.
- E. Cooperate with independent firm; furnish samples of materials, design mix, equipment, tools, storage, safe access, and assistance by incidental labor as requested.
 - 1. Notify Engineer/Architect and independent firm 24 hours prior to expected time for operations requiring testing services.
 - 2. Make arrangements with independent firm and pay for additional samples and tests required for Contractor's use.
- F. Testing and employment of testing agency or laboratory shall not relieve Contractor of obligation to perform Work in accordance with requirements of Contract Documents. Any work that is defective shall be removed and replaced at Contractor's Expense.
- G. Re-testing or re-inspection required because of non-conformance to specified requirements shall be performed by same independent firm on instructions by Engineer/Architect. Payment for re-testing or re-inspection will be charged to Contractor by deducting testing charges from Contract Sum/Price.
- H. Agency Responsibilities:
 - 1. Test samples of mixes submitted by Contractor.
 - 2. Provide qualified personnel at site. Cooperate with Engineer/Architect and Contractor in performance of services.
 - 3. Perform specified sampling and testing of products in accordance with specified standards.
 - 4. Ascertain compliance of materials and mixes with requirements of Contract Documents.

5. Promptly notify Engineer/Architect and Contractor of observed irregularities or non-conformance of Work or products.
 6. Perform additional tests required by Engineer/Architect.
 7. Attend preconstruction meetings and progress meetings.
- I. Agency Reports: After each test, promptly submit two copies of report to Engineer/Architect and to Contractor. When requested by Engineer/Architect, provide interpretation of test results. Include the following:
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 Project.
 7. Type of inspection or test.
 8. Date of test.
 9. Results of tests.
 10. Conformance with Contract Documents.
- J. Limits On Testing Authority:
1. Agency or laboratory may not release, revoke, alter, or enlarge on requirements of Contract Documents.
 2. Agency or laboratory may not approve or accept any portion of the Work.
 3. Agency or laboratory may not assume duties of Contractor.
 4. Agency or laboratory has no authority to stop the Work.

1.8 MANUFACTURER'S INSTRUCTIONS

- A. Comply with instructions in full detail, including each step in sequence. Should instructions conflict with Contract Documents, request clarification from Engineer/Architect before proceeding.
- B. Contractor shall apply, install, connect, erect, use, clean, and condition manufactured articles, materials, and equipment as directed by the manufacturer, unless specified to the contrary.
- C. Whenever specifications call for work to be performed or material to be installed "In Accordance with Manufacturer's Printed Instructions or Directions," Contractor shall furnish three (3) copies of those instructions or directions to Engineer/Architect before installing materials or performing work.

1.9 MANUFACTURERS' CERTIFICATES

- A. When required by individual Specifications Section, submit manufacturer's certificate, in duplicate, stating that products meet or exceed specified requirements.

1.10 MANUFACTURERS' FIELD SERVICES AND REPORTS

- A. When specified in individual specification Sections, require material or product suppliers or manufacturers to provide qualified staff personnel to observe site conditions, conditions of surfaces and installation, quality of workmanship, start-up of equipment, testing, adjusting, and balancing of equipment as applicable, and to initiate instructions when necessary.
- B. Submit qualifications of observer to Engineer/Architect 30 days in advance of required observations. Observer is subject to approval of Engineer/Architect.
- C. Individuals are to report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions.
- D. Submit report in duplicate within (30) thirty days of observation to Engineer/Architect for review.
- E. Refer to Section 01 33 00 - Submittal Procedures, Manufacturers' Field Reports Article.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify existing site conditions and substrate surfaces are acceptable for subsequent Work. Beginning new Work means acceptance of existing conditions.
- B. Verify existing substrate is capable of structural support or attachment of new Work being applied or attached.
- C. Examine and verify specific conditions described in individual specification sections.
- D. Verify utility services are available, of correct characteristics, and in correct locations.

3.2 PREPARATION

- A. Clean substrate surfaces prior to applying next material or substance.
- B. Seal cracks or openings of substrate prior to applying next material or substance.
- C. Apply manufacturer required or recommended substrate primer, sealer, or conditioner prior to applying new material or substance in contact or bond.

END OF SECTION

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SECTION 01 50 00
TEMPORARY FACILITIES AND CONTROLS
(FACILITY CONSTRUCTION)

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Temporary Utilities:
 - a. Temporary electricity.
 - b. Temporary lighting for construction purposes.
 - c. Temporary heating.
 - d. Temporary cooling.
 - e. Temporary ventilation.
 - f. Temporary water service.
 - g. Temporary sanitary facilities.
 2. Construction Facilities:
 - a. Field offices and sheds.
 - b. Vehicular access.
 - c. Parking.
 - d. Progress cleaning and waste removal.
 - e. Project identification.
 - f. Traffic regulation.
 3. Temporary Controls:
 - a. Barriers.
 - b. Enclosures and fencing.
 - c. Security.
 - d. Water control.
 - e. Dust control.
 - f. Erosion and sediment control.
 - g. Pollution control.
 4. Removal of utilities, facilities, and controls.
- B. Related Sections:
1. Applicable provisions of Division 01 shall govern all work under this Section.

1.2 REFERENCES

- A. ASTM International (American Society for Testing and Materials)
1. ASTM E84 - Test Method for Surface Burning Characteristics of Building Materials.
 2. ASTM E90 - Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.

- B. U.S. Department of Transportation, Federal Highway Administration
 - 1. Standard Highway Signs.

1.3 TEMPORARY ELECTRICITY

- A. Owner will pay cost of energy used. Exercise measures to conserve energy. Utilize Owner's existing power service.
- B. Provide temporary electric feeder from electrical service as directed by Owner. Do not disrupt Owner's use of service.
- C. Complement existing power service capacity and characteristics as required for construction operations.
- D. Provide power outlets, with branch wiring and distribution boxes located as required for construction operations. Provide flexible power cords as required for portable construction tools and equipment.
- E. Provide main service disconnect and over-current protection at convenient location.
- F. Existing building convenience receptacles may not be utilized during construction.

1.4 TEMPORARY LIGHTING FOR CONSTRUCTION PURPOSES

- A. Provide and maintain incandescent lighting for construction operations to achieve minimum lighting level of 2 watt/square foot.
- B. Provide and maintain 1 watt/square foot lighting in exterior staging and storage areas after dark for security purposes.
- C. Provide and maintain 0.25 watt/square foot HID lighting in interior work areas after dark for security purposes.
- D. Provide branch wiring from power source to distribution boxes with lighting conductors, pigtails, and lamps for specified lighting levels.
- E. Maintain lighting and provide routine repairs.
- F. Existing building lighting may not be utilized during construction.

1.5 TEMPORARY HEATING

- A. Provide and pay for heating devices and heat as needed to maintain specified conditions for construction operations.

1.6 TEMPORARY COOLING

- A. Provide and pay for cooling devices and cooling as needed to maintain specified conditions for construction operations.

1.7 TEMPORARY VENTILATION

- A. Ventilate enclosed areas to achieve curing of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, or gases.

1.8 TEMPORARY WATER SERVICE

- A. Owner will pay cost of temporary water. Exercise measures to conserve water. Utilize Owner's existing water system, extend and supplement with temporary devices as needed to maintain specified conditions for construction operations. Owner will provide and install meter, prior to construction operations.
- B. Extend branch piping with outlets located so water is available by hoses with threaded connections. Provide temporary pipe insulation to prevent freezing.

1.9 TEMPORARY SANITARY FACILITIES

- A. Provide and maintain required facilities and enclosures. Existing facility use is not permitted. Provide facilities at time of project mobilization.

1.10 FIELD OFFICES AND SHEDS

- A. Do not use existing facilities for field offices or for storage.
- B. Office: Weather tight, with lighting, electrical outlets, heating, cooling and ventilating equipment, and equipped with sturdy desk, chair, drawing rack, and drawing display table.
- C. Provide space for Project meetings, with table and chairs to accommodate 8 persons.
- D. Locate offices and sheds minimum distance of 30 feet from existing and new structures.
- E. Storage Areas And Sheds: Size to storage requirements for products of individual Sections, allowing for access and orderly provision for maintenance and for inspection of products to requirements of Section 01 60 00.
- F. Preparation: Fill and grade sites for temporary structures sloped for drainage away from buildings.
- G. Maintenance and Cleaning:
 - 1. Periodic cleaning and maintenance for office and storage areas.
 - 2. Maintain approach walks free of mud, water, and snow.

- H. Removal: At completion of Work remove buildings, foundations, utility services, and debris. Restore areas.

1.11 VEHICULAR ACCESS

- A. Construct temporary access roads from public thoroughfares to serve construction area, of width and load bearing capacity to accommodate unimpeded traffic for construction purposes. Construct tracking pad where access roads meet public thoroughfares, as shown on Drawings. Clean tracking pad periodically to keep mud off thoroughfares.
- B. Construct temporary bridges and culverts to span low areas and allow unimpeded drainage.
- C. Extend and relocate vehicular access as Work progress requires, provide detours as necessary for unimpeded traffic flow.
- D. Location approved by Engineer/Architect.
- E. Provide unimpeded access for emergency vehicles. Maintain 20-foot wide driveways with turning space between and around combustible materials.
- F. Provide and maintain access to fire hydrants free of obstructions.
- G. Provide means of removing mud from vehicle wheels before entering streets.
- H. Use existing on-site roads for construction traffic. Tracked vehicles not allowed on paved areas.

1.12 PARKING

- A. Provide temporary gravel surface parking areas as required to accommodate construction personnel.
- B. Locate as approved by Engineer/Architect.
- C. When site space is not adequate, provide additional off-site parking.
- D. Use of existing on-site streets and driveways used for construction traffic is not permitted. Tracked vehicles not allowed on paved areas.
- E. Do not allow heavy vehicles or construction equipment in parking areas.
- F. Do not allow vehicle parking on existing pavement.
- G. Permanent Pavements:
 - 1. Avoid traffic loading beyond paving design capacity. Tracked vehicles not allowed.

- H. Maintenance:
 - 1. Maintain traffic and parking areas in sound condition free of excavated material, construction equipment, and products.
 - 2. Maintain existing and permanent paved areas used for construction; promptly repair breaks, potholes, low areas, standing water, and other deficiencies, to maintain paving and drainage in original, or specified, condition.
- I. Removal, Repair:
 - 1. Remove temporary materials and construction when permanent paving is usable at Substantial Completion.
 - 2. Remove underground work and compacted materials to depth of 2 feet; fill and grade site as specified.
 - 3. Repair existing facilities damaged by use, to original condition.

1.13 PROGRESS CLEANING AND WASTE REMOVAL

- A. Maintain areas free of waste materials, debris, and rubbish. Maintain site in clean and orderly condition.
- B. Remove debris and rubbish from pipe chases, plenums, attics, crawl spaces, and other closed or remote spaces, prior to enclosing spaces.
- C. Broom and vacuum clean interior areas prior to start of surface finishing, and continue cleaning to eliminate dust.
- D. Collect and remove waste materials, debris, and rubbish from site periodically and dispose of off-site.
- E. Open free-fall chutes are not permitted. Terminate closed chutes into appropriate containers with lids.

1.14 PROJECT IDENTIFICATION

- A. Project Identification Sign:
 - 1. One painted sign, 32 sq ft area, bottom 6 feet above ground.
 - 2. Content:
 - a. Project title and name of Owner as indicated on Contract Documents.
 - b. Names and titles of Engineer/Architect.
 - c. Name of Prime Contractor.
- B. Project Informational Signs:
 - 1. Painted informational signs of same colors and lettering as Project Identification sign, or standard products; size lettering for legibility at 100 feet distance.
 - 2. Provide sign at each field office, storage shed, and directional signs to direct traffic into and within site. Relocate as Work progress requires.

3. Provide municipal traffic agency directional traffic signs to and within site.
 4. No other signs are allowed without Owner permission except those required by law.
- C. Design sign and structure to withstand 60 miles/hour wind velocity.
- D. Finishes, Painting: Adequate to withstand weathering, fading, and chipping for duration of construction.
- E. Show content, layout, lettering, and color.
- F. Sign Materials:
1. Structure and Framing: New, structurally adequate.
 2. Sign Surfaces: Exterior grade plywood with medium density overlay, minimum 3/4 inches thick, standard large sizes to minimize joints.
 3. Paint and Primers: Exterior quality, two coats; sign background of color as selected.
- G. Installation:
1. Install project identification sign within 15 days after date of Owner-Contractor Agreement.
 2. Erect at designated location.
 3. Erect supports and framing on secure foundation, rigidly braced and framed to resist wind loadings.
 4. Install sign surface plumb and level, with butt joints. Anchor securely.
 5. Paint exposed surfaces of sign, supports, and framing.
- H. Maintenance: Maintain signs and supports clean, repair deterioration and damage.
- I. Removal: Remove signs, framing, supports, and foundations at completion of Project and restore area.

1.15 TRAFFIC REGULATION

- A. Signs, Signals, And Devices:
1. Post Mounted and Wall Mounted Traffic Control and Informational Signs: As approved by authority having jurisdiction.
 2. Traffic Control Signals: As approved by local jurisdictions.
 3. Traffic Cones and Drums, Flares and Lights: As approved by authority having jurisdiction.
 4. Flagperson Equipment: As required by authority having jurisdiction.
- B. Haul Routes:
1. Consult with authority having jurisdiction, establish public thoroughfares to be used for haul routes and site access.
 2. Confine construction traffic to designated haul routes.
 3. Provide traffic control at critical areas of haul routes to regulate traffic and minimize

interference with public traffic.

- C. Traffic Signs And Signals:
 - 1. Provide signs at approaches to site and on site, at crossroads, detours, parking areas, and elsewhere as needed to direct construction and affected public traffic.
 - 2. Relocate as Work progresses, to maintain effective traffic control.
- D. Removal:
 - 1. Remove equipment and devices when no longer required.
 - 2. Repair damage caused by installation.
 - 3. Remove post settings to depth of 2 feet.

1.16 BARRIERS

- A. Provide barriers to prevent unauthorized entry to construction areas to allow for Owner's use of site, and to protect existing facilities and adjacent properties from damage from construction operations, demolition, and theft.
- B. Provide barricades required by authorities having jurisdiction for public rights-of-way and for public access to existing building.
- C. Provide protection for plants designated to remain. Replace damaged plants.
- D. Protect non-owned vehicular traffic, stored materials, site, and structures from damage.

1.17 ENCLOSURES AND FENCING

- A. Construction: Plastic construction netting.
- B. Exterior Enclosures:
 - 1. Provide temporary weather tight closure of exterior openings to accommodate acceptable working conditions and protection for products, to allow for temporary heating and maintenance of required ambient temperatures identified in individual specification sections, and to prevent entry of unauthorized persons. Provide access doors with self-closing hardware and locks.
- C. Security Program:
 - 1. Protect Work, existing premises, and Owner's operations from theft, vandalism, and unauthorized entry.
 - 2. Initiate program in coordination with Owner's existing security system at project mobilization.
 - 3. Maintain program throughout construction period until Owner acceptance precludes need for Contractor security.
- D. Entry Control:
 - 1. Restrict entrance of persons and vehicles into Project site and existing facilities.

2. Allow entrance only to authorized persons with proper identification.
3. Maintain log of workers and visitors, make available to Owner on request.
4. Coordinate access of Owner's personnel to site in conjunction with Owner's security forces.

E. Restrictions:

1. Do no work on days indicated in Owner-Contractor Agreement.

1.18 WATER CONTROL

- A. Grade site to drain. Maintain excavations free of water. Provide, operate, and maintain pumping equipment.
- B. Protect site from puddling or running water. Provide water barriers as required to protect site from soil erosion.

1.19 DUST CONTROL

- A. Execute Work by methods to minimize raising dust from construction operations.
- B. Provide positive means to prevent air-borne dust from dispersing into atmosphere.

1.20 EROSION AND SEDIMENT CONTROL

- A. Conform to requirements of Section 31 25 13 - Erosion Controls.
- B. Minimize bare soil surface area exposed at one time.
- C. Provide temporary measures including berms, dikes, and drains, and other devices to prevent water flow.
- D. Construct fill and waste areas by selective placement to avoid erosive surface silts or clays.
- E. Periodically inspect earthwork to detect evidence of erosion and sedimentation; promptly apply corrective measures.

1.21 POLLUTION CONTROL

- A. Provide methods, means, and facilities to prevent contamination of soil, water, and atmosphere from discharge of noxious or toxic substances, and pollutants produced by construction operations.
- B. Comply with pollution and environmental control requirements of authorities having jurisdiction.

1.22 REMOVAL OF UTILITIES, FACILITIES, AND CONTROLS

- A. Remove temporary utilities, equipment, facilities, and materials, prior to Substantial Completion inspection.
- B. Remove underground installations to minimum depth of 2 feet. Grade site as indicated on Drawings.
- C. Clean and repair damage caused by installation or use of temporary work.
- D. Restore existing and permanent facilities used during construction to original condition. Restore permanent facilities used during construction to specified condition.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

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SECTION 01 60 00
PRODUCT REQUIREMENTS
(FACILITY CONSTRUCTION)

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Products.
 - 2. Product delivery requirements.
 - 3. Product storage and handling requirements.
 - 4. Product options.
 - 5. Product substitution procedures.

- B. Related Sections:
 - 1. Applicable provisions of Division 01 shall govern all work under this Section.
 - 2. Section 01 10 00 – Summary of Work.
 - 3. Section 01 40 00 - Quality Requirements.
 - 4. Section 01 70 00 - Execution Requirements.

1.2 PRODUCTS

- A. Furnish products of qualified manufacturers suitable for intended use. Furnish products of each type by single manufacturer unless specified otherwise.

- B. Do not use materials and equipment removed from existing premises, except as specifically permitted by Contract Documents.

- C. Furnish interchangeable components from same manufacturer for components being replaced.

1.3 PRODUCT DELIVERY REQUIREMENTS

- A. Transport and handle products in accordance with manufacturer's instructions.

- B. Promptly inspect shipments to ensure products comply with requirements, quantities are correct, and products are undamaged.

- C. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage.

1.4 PRODUCT STORAGE AND HANDLING REQUIREMENTS

- A. Store and protect products in accordance with manufacturer's instructions.

- B. Store with seals and labels intact and legible.
- C. Store sensitive products in weather tight, climate controlled, enclosures in an environment favorable to product.
- D. For exterior storage of fabricated products, place on sloped supports above ground.
- E. Provide proof of bonded and insured off-site storage and protection when site does not permit on-site storage or protection.
- F. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.
- G. Store loose granular materials on solid flat surfaces in well-drained area. Prevent mixing with foreign matter.
- H. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, damage, or theft.
- I. Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.

1.5 PRODUCT OPTIONS

- A. Products Specified by Reference Standards or by Description Only: Any product meeting those standards or description.
- B. Products Specified by Naming One or More Manufacturers: Products of one named manufacturer meeting specifications; no options or substitutions allowed.
- C. Products Specified by Naming One or More Manufacturers with Provision for Substitutions: Submit request for substitution for any manufacturer not named in accordance with following article.

1.6 PRODUCT SUBSTITUTION PROCEDURES

- A. Where definite material is specified, it is not the intention to discriminate against “equal” product made by another manufacturer. Intention is to set definite standard of material quality. Should bidder choose to bid materials other than those specified, bidder shall submit said materials specifications to Public Works Project Manager for approval at least nine (9) days prior to Bid Opening.
- B. Products and materials that are not specified, but have been approved for use by Public Works Project Engineer shall be identified in addenda to all bidding contractors.
- C. Requests for material or product substitutions submitted after Bid Opening may be considered

up to seven (7) days after acceptance of lowest responsible bidder. Public Works Engineer reserves right to approve or reject substitutions based on Specification requirements and intended use.

- D. Document each request with complete data substantiating compliance of proposed Substitution with Contract Documents.
- E. A request constitutes a representation that Contractor:
 - 1. Has investigated proposed product and determined that it meets or exceeds quality level of specified product.
 - 2. Will provide same warranty for Substitution as for specified product.
 - 3. Will coordinate installation and make changes to other Work that may be required for the Work to be complete with no additional cost to Owner.
 - 4. Waives claims for additional costs or time extension that may subsequently become apparent.
 - 5. Will reimburse Owner and Engineer/Architect for review or redesign services associated with re-approval by authorities having jurisdiction.
- F. Substitutions will not be considered when they are indicated or implied on Shop Drawing or Product Data submittals, without separate written request, or when acceptance will require revision to Contract Documents.
- G. Substitution Submittal Procedure:
 - 1. Submit three copies of request for Substitution for consideration. Limit each request to one proposed Substitution.
 - 2. Submit Shop Drawings, Product Data, and certified test results attesting to proposed product equivalence. Burden of proof is on proposer.
 - 3. Engineer/Architect will notify Contractor in writing of decision to accept or reject request.
- H. Only one request for substitution will be considered for each product. When substitution is not accepted, provide specified product.
- I. Substitutions shall not change contract price established at Bid Opening.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

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SECTION 01 70 00
EXECUTION REQUIREMENTS
(FACILITY CONSTRUCTION)

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Closeout procedures.
 2. Final cleaning.
 3. Starting of systems.
 4. Demonstration and instructions.
 5. Testing, adjusting and balancing.
 6. Protecting installed construction.
 7. Project record documents.
 8. Operation and maintenance data.
 9. Manual for materials and finishes.
 10. Manual for equipment and systems.
 11. Spare parts and maintenance products.
 12. Product warranties and product bonds.
 13. Maintenance service.
- B. Related Sections:
1. Applicable provisions of Division 01 shall govern all work under this Section.
 2. Section 01 10 00 – Summary of Work: Provisions for Owner occupancy.
 3. Section 01 20 00 - Price and Payment Procedures: Final application for payment.
 4. Section 01 50 00 – Temporary Facilities and Controls: Cleaning during construction.

1.2 CLOSEOUT PROCEDURES

- A. Submit written certification that Contract Documents have been reviewed, Work has been inspected, and that Work is complete in accordance with Contract Documents and ready for Engineer/Architect review.
- B. Provide submittals to Engineer/Architect required by authorities having jurisdiction.
- C. Submit final Application for Payment identifying total adjusted Contract Sum, previous payments, and sum remaining due.
- D. Owner will occupy portions of project as specified in Section 01 10 00 – Summary of Work.

1.3 FINAL CLEANING

- A. Execute final cleaning prior to final project assessment.

- B. Clean interior and exterior glass, surfaces exposed to view; remove temporary labels, stains and foreign substances, polish transparent and glossy surfaces.
- C. Clean equipment and fixtures to sanitary condition with cleaning materials appropriate to surface and material being cleaned.
- D. Clean filters of operating equipment.
- E. Clean debris from roofs, gutters, downspouts, and drainage systems.
- F. Clean site; sweep paved areas, rake clean landscaped surfaces.
- G. Remove waste and surplus materials, rubbish, and construction facilities from site.

1.4 STARTING OF SYSTEMS

- A. Coordinate schedule for start-up of various equipment and systems.
- B. Notify Engineer/Architect seven (7) days prior to start-up of each item.
- C. Verify each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, and for conditions that may cause damage.
- D. Verify tests, meter readings, and specified electrical characteristics agree with those required by equipment or system manufacturer.
- E. Verify wiring and support components for equipment are complete and tested.
- F. Execute start-up under supervision of appropriate Contractor's personnel in accordance with manufacturer's instructions.
- G. 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.
- H. Submit a written report in accordance with Section 01 33 00 – Submittal Procedures, that equipment or system has been properly installed and is functioning correctly.

1.5 DEMONSTRATION AND INSTRUCTIONS

- A. Demonstrate operation and maintenance of products to Owner's personnel two weeks prior to date of Substantial Completion.
- B. Demonstrate Project equipment, instructed by qualified personnel who are knowledgeable about the Project.

1. For equipment or systems requiring seasonal operation, perform demonstration for other season within six months.
2. Utilize operation and maintenance manuals as basis for instruction. Review contents of manual with Owner's personnel in detail to explain all aspects of operation and maintenance.
3. Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shutdown of each item of equipment at scheduled time, at equipment location.
4. Prepare and insert additional data in operations and maintenance manuals when need for additional data becomes apparent during instruction.
5. Required instruction time for each item of equipment and system is specified in individual sections.

1.6 TESTING, ADJUSTING AND BALANCING

- A. Owner will appoint, employ, and pay for services of independent firm to perform testing, adjusting, and balancing.
- B. Independent firm will perform services specified in Divisions 21 through 23.
- C. Reports will be submitted by independent firm to Engineer/Architect indicating observations and results of tests and indicating compliance or non-compliance with requirements of Contract Documents.

1.7 PROTECTING INSTALLED CONSTRUCTION

- A. Protect installed Work and provide special protection where specified in individual specification sections.
- B. Provide temporary and removable protection for installed products. Control activity in immediate work area to prevent damage.
- C. Provide protective coverings at walls, projections, jambs, sills, and soffits of openings.
- D. Protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.
- E. Prohibit traffic or storage upon waterproofed or roofed surfaces. When traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.
- F. Prohibit traffic from landscaped areas.

1.8 PROJECT RECORD DOCUMENTS

- A. Maintain on site one set of following record documents; record actual revisions to the Work:

1. Drawings.
 2. Specifications.
 3. Addenda.
 4. Change Orders and other modifications to the Contract.
 5. Reviewed Shop Drawings, Product Data, and Samples.
 6. Manufacturer's instruction for assembly, installation, and adjusting.
- B. Ensure entries are complete and accurate, enabling future reference by Owner.
- C. Store record documents separate from documents used for construction.
- D. Record information concurrent with construction progress, not less than weekly.
- E. Specifications: Legibly mark and record at each product section description of actual products installed, including following:
1. Manufacturer's name, product model, and serial number.
 2. Product substitutions or alternates utilized.
 3. Changes made by Addenda and modifications.
- F. Record Drawings and Shop Drawings: Legibly mark each item to record actual construction including:
1. Measured depths of foundations in relation to finish floor datum.
 2. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
 3. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work.
 4. Field changes of dimension and detail.
 5. Details not on original Contract drawings.
- G. Submit documents to Engineer/Architect with final Application for Payment.

1.9 OPERATION AND MAINTENANCE DATA

- A. Submit data bound in 8-1/2 x 11 inch (A4) text pages, three D side ring binders with durable plastic covers.
- B. Prepare binder cover with printed title "OPERATION AND MAINTENANCE INSTRUCTIONS", title of project, and subject matter of binder when multiple binders are required.
- C. Internally subdivide binder contents with permanent page dividers, logically organized as described below; with tab titling clearly printed under reinforced laminated plastic tabs.
- D. Drawings: Provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.

- E. Contents: Prepare Table of Contents for each volume, with each product or system description identified, typed on white paper, in three parts as follows:
 - 1. Part 1: Directory, listing names, addresses, and telephone numbers of Engineer/Architect, Subconsultants, Contractor, Subcontractors, and major equipment suppliers and their local representatives.
 - 2. Part 2: Operation and maintenance instructions, arranged by system and subdivided by specification section. For each category, identify names, addresses, and telephone numbers of Subcontractors and suppliers. Identify following:
 - a. Significant design criteria.
 - b. List of equipment.
 - c. Parts list for each component.
 - d. Operating instructions.
 - e. Maintenance instructions for equipment and systems.
 - f. Maintenance instructions for special finishes, including recommended cleaning methods and materials, and special precautions identifying detrimental agents.
 - 3. Part 3: Project documents and certificates, including following:
 - a. Shop Drawings and product data.
 - b. Air and water balance reports.
 - c. Certificates.
 - d. Originals of warranties and bonds.

1.10 MANUAL FOR MATERIALS AND FINISHES

- A. Submit two copies of preliminary draft or proposed formats and outlines of contents before start of Work. Engineer/Architect will review draft and return one copy with comments.
- B. For equipment, or component parts of equipment put into service during construction and operated by Owner, submit documents within ten days after acceptance.
- C. Submit one copy of completed volumes 15 days prior to final inspection. Copy will be reviewed and returned after final inspection, with Engineer/Architect comments. Revise content of document sets as required prior to final submission.
- D. Submit three sets of revised final volumes in final form within 10 days after final inspection.
- E. Building Products, Applied Materials, and Finishes: Include product data, with catalog number, size, composition, and color and texture designations. Include information for re-ordering custom manufactured products.
- F. Instructions for Care and Maintenance: Include manufacturer's recommendations for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.

- G. Moisture Protection and Weather Exposed Products: Include product data listing applicable reference standards, chemical composition, and details of installation. Include recommendations for inspections, maintenance, and repair.
- H. Additional Requirements: As specified in individual product specification sections.
- I. Include listing in Table of Contents for design data, with tabbed flysheet and space for insertion of data.

1.11 MANUAL FOR EQUIPMENT AND SYSTEMS

- A. Submit two copies of preliminary draft or proposed formats and outlines of contents before start of Work. Engineer/Architect will review draft and return one copy with comments.
- B. For equipment, or component parts of equipment put into service during construction and operated by Owner, submit documents within ten days after acceptance.
- C. Submit one copy of completed volumes 15 days prior to final inspection. Draft copy will be reviewed and returned after final inspection, with Engineer/Architect comments. Revise content of document sets as required prior to final submission.
- D. Submit three sets of revised final volumes in final form within 10 days after final inspection.
- E. Each Item of Equipment and Each System: Include description of unit or system, and component parts. Identify function, normal operating characteristics, and limiting conditions. Include performance curves, with engineering data and tests, and complete nomenclature and model number of replaceable parts.
- F. Panelboard Circuit Directories: Provide electrical service characteristics, controls, and communications; typed.
- G. Include color-coded wiring diagrams as installed.
- H. Operating Procedures: Include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and special operating instructions.
- I. Maintenance Requirements: Include routine procedures and guide for preventative maintenance and trouble-shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.
- J. Include servicing and lubrication schedule, and list of lubricants required.
- K. Include manufacturer's printed operation and maintenance instructions.
- L. Include sequence of operation by controls manufacturer.

- M. Include original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
- N. Include control diagrams by controls manufacturer as installed.
- O. Include Contractor's coordination drawings, with color-coded piping diagrams as installed.
- P. Include charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.
- Q. Include list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.
- R. Include test and balancing reports as specified.
- S. Additional Requirements: As specified in individual product specification sections.
- T. Include listing in Table of Contents for design data, with tabbed dividers and space for insertion of data.

1.12 SPARE PARTS AND MAINTENANCE PRODUCTS

- A. Furnish spare parts, maintenance, and extra products in quantities specified in individual specification sections.
- B. Deliver to Project site and place in location as directed by Owner; obtain receipt prior to final payment.

1.13 PRODUCT WARRANTIES AND PRODUCT BONDS

- A. Obtain warranties and bonds executed in duplicate by responsible subcontractors, suppliers, and manufacturers, within ten (10) days after completion of applicable item of work.
- B. Execute and assemble transferable warranty documents and bonds from subcontractors, suppliers, and manufacturers.
- C. Verify documents are in proper form, contain full information, and are notarized.
- D. Co-execute submittals when required.
- E. Include Table of Contents and assemble in three D side ring binder with durable plastic cover.
- F. Submit prior to final Application for Payment.

- G. Time of Submittals:
1. For equipment or component parts of equipment put into service during construction with Owner's permission, submit documents within ten (10) days after acceptance.
 2. Make other submittals within ten (10) days after Date of Substantial Completion, prior to final Application for Payment.
 3. For items of Work for which acceptance is delayed beyond Date of Substantial Completion, submit within ten (10) days after acceptance, listing date of acceptance as beginning of warranty or bond period.

1.14 MAINTENANCE SERVICE

- A. Furnish service and maintenance of components indicated in specification sections during warranty period.
- B. Examine system components at frequency consistent with reliable operation. Clean, adjust, and lubricate as required.
- C. Include systematic examination, adjustment, and lubrication of components. Repair or replace parts whenever required. Use parts produced by manufacturer of original component.
- D. Do not assign or transfer maintenance service to agent or Subcontractor without prior written consent of Owner's Representative.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

SECTION 03 31 00
STRUCTURAL CONCRETE

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Structural Concrete.
 - 2. Admixtures.
 - 3. Curing and Treatment Requirements.
 - 4. Formwork, shoring, bracing, and anchorage.
 - 5. Concrete reinforcement and accessories.

- B. Related Sections:
 - 1. Applicable provisions of Division 01 shall govern all work under this Section.
 - 2. Section 03 41 13 – Precast Concrete Hollow Core Planks.
 - 3. Section 07 21 13 – Board Insulation.
 - 4. Section 07 90 00 – Joint Protection: Backer rod and sealant for construction joints.

1.2 REFERENCES

- A. Incorporated Guides and References
 - 1. American Concrete Institute (ACI):
 - a. ACI 302.1R – Guide for Concrete Floor and Slab Construction.
 - b. ACI 304R – Guide for Measuring, Mixing, Transporting and Placing Concrete.
 - c. ACI 304.2R - Placing Concrete by Pumping Methods.
 - d. ACI 305R - Hot Weather Concreting.
 - e. ACI 309R – Guide for the Consolidation of Concrete.
 - f. ACI 347 – Guide to Formwork for Concrete.
 - g. ACI SP-66 – ACI Detailing Manual.

- B. Specifications
 - 1. American Concrete Institute (ACI):
 - a. ACI 117 - Specifications for Tolerances for Concrete Construction and Materials.
 - b. ACI 301 - Specifications for Structural Concrete.
 - c. ACI 303.1 – Specification for Cast-In-Place Architectural Concrete.
 - d. ACI 306.1 – Specification for Cold Weather Concreting.
 - e. ACI 308.1 – Specification for Curing Concrete.
 - f. ACI 315 - Details and Detailing of Concrete Reinforcement.

- g. ACI 318 - Building Code Requirements for Structural Concrete and Commentary.
- 2. ASTM International (ASTM):
 - a. ASTM A82 - Specification for Steel Wire, Plain, for Concrete Reinforcement.
 - b. ASTM A184 - Specification for Fabricated Deformed Steel Bar Mats for Concrete Reinforcement.
 - c. ASTM A185 – Specification for Steel Welded Wire Reinforcement, Plain, for Concrete.
 - d. ASTM A497 – Specification for Steel Welded Wire Reinforcement, Deformed, for Concrete.
 - e. ASTM A615 – Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
 - f. ASTM A704 - Specification for Welded Steel Plain Bar or Rod Mats for Concrete Reinforcement.
 - g. ASTM A706 - Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement.
 - h. ASTM A820 - Specification for Steel Fibers for Fiber-Reinforced Concrete.
 - i. ASTM A884 - Specification for Epoxy-Coated Steel Wire and Welded Wire Reinforcement.
 - j. ASTM A934 - Specification for Epoxy-Coated Prefabricated Steel Reinforcing Bars.
 - k. ASTM A1044 - Specification for Steel Stud Assemblies for Shear Reinforcement of Concrete.
 - l. ASTM C33 – Specification for Concrete Aggregates.
 - m. ASTM C94 – Specification for Ready-Mixed Concrete.
 - n. ASTM C150 – Specification for Portland Cement.
 - o. ASTM C171 – Specification for Sheet Materials for Curing Concrete.
 - p. ASTM C260 – Specification for Air-Entraining Admixtures for Concrete.
 - q. ASTM C309 – Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
 - r. ASTM C494 – Specification for Chemical Admixtures for Concrete.
 - s. ASTM C618 – Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for use in Concrete.
 - t. ASTM C1116 – Specification for Fiber-Reinforced Concrete and Shotcrete.
 - u. ASTM D3963 - Specification for Fabrication and Jobsite Handling of Epoxy-Coated Steel Reinforcing Bars.

1.3 SUBMITTALS

- A. Submit proposed mix design of each class of concrete to Engineer not later than 10 days after Notice to Proceed or 15 days prior to the first concrete placement, whichever comes first.

- B. Submit shop drawings of reinforcing steel under provisions of Division 01 – Submittal Procedures.
 - 1. Initial submittal of reinforcement shop drawings shall be complete. No partial submittals will be accepted.
 - 2. Indicate reinforcement sizes, spacings, locations and quantities of reinforcing steel, and wire reinforcement, bending and cutting schedules, splicing, supporting and spacing devices.
 - 3. Reinforcement placement shop drawings for foundations and walls shall conform to ACI SP-66 providing full wall elevations.

1.4 QUALITY ASSURANCE

- A. Perform work in accordance with ACI 301, 305R, and 306.1.
- B. Maintain copy of ACI 301 on site.
- C. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from one source, and obtain admixtures through one source from a single manufacturer.

1.5 QUALIFICATIONS

- A. Supplier: Company specializing in supplying material for this section with minimum ten (10) years documented experience.
- B. Installer: Company specializing in performing work of this section with minimum ten (10) years documented experience.

1.6 REGULATORY REQUIREMENTS

- A. Conform to requirements of local, state and federal rules and regulations applicable to Work and Project location.

1.7 ENVIRONMENTAL REQUIREMENTS

- A. Cold Weather Concreting
 - 1. Placement and curing of concrete where (1) average daily temperature for three consecutive days is less than 40 degrees F, and (2) air temperature is not greater than 50 degrees F for more than one-half of a 24-hour period from midnight to midnight shall be in accordance with ACI 306.1.
- B. Hot Weather Concreting
 - 1. Placement and curing of concrete subject to a combination of (1) rising air temperature (generally greater than 75 degrees F) and (2) wind and low relative humidity shall be in accordance with ACI 305R.

2. Contractor shall provide plan for minimizing exposure of concrete to adverse conditions due to combinations of high air temperature, direct sunlight, drying winds, and high concrete temperature.
3. Protect concrete from rapid temperature drop.
4. Pre-wet subgrade and forms.

1.8 SLAB PRE-CONSTRUCTION MEETING

- A. At least 20 days prior to placing first concrete floor slab, Contractor shall hold a meeting to review detailed requirements for preparing final concrete design mixes and to establish procedures for placing, finishing, curing, and protecting concrete to meet required quality under anticipated conditions.
- B. Contractor shall request responsible representatives of each party concerned with concrete work to attend meeting, including but not limited to following:
 1. Contractor's Superintendent.
 2. Testing Laboratory responsible for field quality control.
 3. Concrete Subcontractor's Project Manager.
 4. Ready-mix Concrete Supplier.
 5. Concrete Pumping Equipment Supplier.
 6. Resident Project Representative.
 7. Structural Engineer.
- C. Minutes of the meeting shall be recorded, typed, reproduced and distributed by Contractor to all parties concerned within five working days of meeting.
- D. Minutes shall include a statement by admixture manufacturer(s) indicating that proposed mix design and placing can produce concrete quality required by this Section.
- E. Contractor shall notify Structural Engineer at least 10 days prior to scheduled date of meeting.
- F. During construction, additional meetings may be held to review and modify procedures and materials established to assure attainment of required quality level.

PART 2 PRODUCTS

2.1 FORM MATERIALS

- A. Plywood Forms: Douglas Fir or Spruce-Pine-Fir species: Sound, undamaged sheets with clean true edges, exterior glue, facing material to provide finish specified.
- B. Lumber: Douglas Fir or Spruce species; construction grade or better; with grade stamp clearly visible.

- C. Preformed Steel Wall Forms: Minimum 16 gage thick, matched, tight fitting, stiffened to support weight of concrete without deflection detrimental to tolerances and surface appearance.

- D. Form Ties For Exposed Surfaces: Plastic cone snap ties with 1-inch outside diameter by 1-inch (nominal) long cones, with no metal within 1-inch of concrete face after removal;
 - 1. Manufacturers:
 - a. Dayton-Richmond.
 - b. Symons Corporation.
 - c. Universal Building Products, Inc.
 - d. Substitutions: As approved by Engineer.

- E. Form Ties For Hidden Surfaces: Metal spreader type, removable to a depth of 1-inch from concrete face;
 - 1. Manufacturers:
 - a. Dayton-Richmond.
 - b. Symons Corporation.
 - c. Universal Building Products, Inc.
 - d. Substitutions: As approved by Engineer.

2.2 REINFORCING STEEL

- A. Reinforcing Steel: ASTM A615, 60 ksi yield grade carbon steel deformed bars; uncoated and epoxy coated in accordance with ASTM A775, finish. Reinforcing bars to be welded shall conform to ASTM A706.

- B. Welded Steel Wire Reinforcement: Plain type, ASTM A185; in flat sheets; uncoated, finish.

- C. Reinforcement Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars, welded wire fabric, and dowels in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete of greater compressive strength than concrete.

2.3 SLAB DOWELS IN TIPPING SLAB

- A. Dowels: 3/4 inch x 4-1/2 inch x 4-1/2 inch diamond plate dowels.

- B. Diamond plate dowel pocket former.

- C. Manufacturer:
 - 1. PNA Construction Technologies.
 - 2. Substitutions: As approved by Engineer.

2.4 FIBER REINFORCEMENT

- A. Steel Fiber: Steel fibers engineered and designed for use in concrete, complying with ASTM C1116, Type I, 1-inch to 2-1/2 inches long.
 - 1. Manufacturers - Steel Fibers
 - a. Bekaert Corporation - Dramix RC 80/60 BN.
 - b. Substitutions: As approved by Engineer.

2.5 CONCRETE MATERIALS

- A. Cementitious Materials
 - 1. Portland Cement: ASTM C150, gray color, Type I except as specified below.
 - 2. Fly Ash: ASTM C618, Class C.
 - 3. Ground Granulated Blast Furnace Slag: ASTM C989, Grade 100 or 120.
 - 4. Silica Fume: ASTM C1240.
- B. Fine and Coarse Aggregates: ASTM C33. Reference Structural Drawings for aggregates within tipping slab of waste transfer station.
- C. Water: ASTM C1602, clean and not detrimental to concrete.

2.6 ADMIXTURES

- A. Admixtures to be used in the concrete mixture shall be submitted to the Engineer for approval as part of the mixture design.
- B. Chemical admixtures shall be in accordance with ASTM C494.
- C. Admixtures shall be used in accordance with manufacturer's written recommendations.
- D. Admixtures containing chlorides, sulfides, or nitrides are not permitted.
- E. Admixtures permitted shall be supplied by a single manufacturer for project.
- F. Air Entrainment Admixture: ASTM C260;
 - 1. Manufacturers:
 - a. Axim Italcementi Group.
 - b. The Euclid Chemical Company.
 - c. BASF Admixtures, Inc.
 - d. Grace Construction Products.
 - e. Substitutions: As approved by Engineer.
- G. Crystalline Waterproofing:
 - 1. Product: Xypex Admix C-500.
 - 2. Crystalline waterproofing powder shall be added to concrete mix at time of batching

- at a rate of 2 percent to 3 percent by weight of Portland cement content.
- 3. Random tests will be performed to assure compliance with batching rate.
- 4. Joint waterproofing slurry shall be manufactured by the same manufacturer.

2.7 ACCESSORIES

- A. Non-Shrink Grout: Premixed compound with non-metallic aggregate, cement, water reducing and plasticizing agents; capable of minimum compressive strength of 2400 psi.
- B. Dovetail Anchor Slots: Minimum 22 gage thick galvanized steel; foam filled; release tapes; sealed slots; bent tap anchors;
 - 1. Manufacturers:
 - a. Dur-O-Wal, Inc. Type: DA100.
 - b. Heckman Building Products, Inc. Type: #100.
 - c. Hohmann & Banard Type: #305.
 - d. Substitutions: As approved by Engineer.
- C. Waterstops: Polyvinylchloride; minimum 3/16 inch thick by 6-inch wide; large center bulb at expansion joints; heat sealed joints;
 - 1. Manufacturers:
 - a. W. R. Meadows. Inc. Type: PVC Waterstop No. 6380.
 - b. Greenstreak Plastic Products Co. Type: PVC Waterstop: No. 705.
 - c. Vinylex Corp. Type: Ribbed Center Bulb – Waterstop No. RB638.
 - d. Substitutions: As approved by Engineer.
- D. Waterstops: Cold Joint Type;
 - 1. Manufacturers:
 - a. Volclay – Waterstop RX Series.
 - b. Greenstreak – Swellstop Waterstop Series.
 - c. Substitutions: As approved by Engineer.
- E. Joint Waterproofing for Electrical Room: Slurry Xypex crystalline waterproofing powder, 1.5 lbs./sq. yd. 5-parts powder to 2-parts water.
- F. Joint Filler: ASTM D1751, Bituminous fiber, 1/2-inch wide by depth of concrete less 1/8-inch.
- G. Form Release Agent: Colorless material which will not stain concrete, absorb moisture or impair natural bonding or color characteristics of coating, intended for use on concrete;
 - 1. Manufacturers:
 - a. Symons Corporation - Type: Magic Kote.
 - b. W. R. Meadows - Type: Duogard.
 - c. BASF Building Systems – Castoff.
 - d. Dayton Superior - Type: Clean Strip Ultra (J-3).

- e. Substitutions: As approved by Engineer.

2.8 CURING AND TREATMENT MATERIALS

- A. Water: Potable and clean.
- B. Evaporation Reducer: Thin monomolecular film to reduce rapid moisture loss from the concrete surfaces prior to curing;
 - 1. Manufacturers:
 - a. W. R. Meadows - Type: Evapre.
 - b. BASF Admixtures, Inc. – Type: Master Builders – Confilm.
 - c. Substitutions: As approved by Engineer.
- C. Curing and Sealing Compound: ASTM C309; Type I free of oil, wax, or grease;
 - 1. Manufacturers:
 - a. W. R. Meadows – Sealtight; Type: Vocomp-20.
 - b. Dayton Superior; Type: Safe Cure & Seal (J-18).
 - c. Symons Corporation - Type: Cure & Seal 309WB.
 - d. BASF Building Systems, Inc.: Kure-N-Seal WB.
 - e. Substitutions: As approved by Engineer.

2.9 CONCRETE MIXTURE

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture of field test data, or both, according to ACI 301.
- B. Mix concrete in accordance with ASTM C94.
- C. Concrete mix designs shall be designed and submitted in accordance with Division 01 and included as part of cost of this Work.
- D. Mix designs shall be prepared by a qualified agency acceptable to Engineer. Six (6) copies of mix designs shall be submitted for Engineer's review prior to placing any concrete.
- E. Mix design shall indicate brands, types, and quantities of admixtures included, compressive strength, slump, sieve analysis for fine and coarse aggregate, quantities of all ingredients, type and brand of cement, source of aggregate, whether fine aggregate is natural or manufactured.
- F. Design of mix shall assure placing and finishing characteristics that meet Project requirements.
- G. Mix designs contained in the Schedule of Mixes may be modified and submitted to Engineer for approval, by use of mid or high range water reducing admixtures to control slumps required for pumping of concrete. Strength, placing and finishing requirements shall be maintained.

- H. Concrete mixtures placed directly over vapor retarders shall be designed to have low shrinkage characteristics and designed to minimize slab curling.
- I. Initial and final set times of concrete mix designs shall be coordinated between the contractor and concrete supplier.
- J. Crystalline Waterproofing Mixture
 - 1. Ready Mix Plant-Dry Batching Operation:
 - a. Add admixture powder to drum of ready-mix truck, then add 60 percent to 70 percent of required water along with 300-500 lbs. of aggregate.
 - b. Confirm mixture meets requirements of waterproofing manufacturer.
 - c. Mix materials 2 to 3 minutes to ensure even distribution throughout mix.
 - d. Add balance of materials to ready-mix truck and mix in accordance with ACI standards.
 - 2. Ready Mix Plant-Central Mix Operations:
 - a. Mix admixture with water to form a thin slurry, 15 to 20 lbs. of powder mix with 3 gallons of water.
 - b. Pour required amount of material in drum of ready-mix truck.
 - c. Batch remaining aggregate, cement and water and mix at plant in accordance with ACI standards.
 - d. Pour concrete into truck and mix for at least 5 minutes to ensure even distribution of admixture throughout concrete.
 - 3. Comply with manufacturer's instructions for use and special installation requirements of admixture.
 - 4. Admixture shall be used for electrical room walls, floors, and roof.

2.10 SCHEDULE OF MIXES

- A. Footings: Proportion normal-weight concrete mix as follows:
 - 1. Compressive Strength (28 Days): 3000 psi.
 - 2. Maximum Aggregate Size: 1-1/2 inches.
 - 3. Maximum Water-Cement Ratio: 0.50.
- B. Lean Concrete: Proportion normal-weight concrete mix as follows:
 - 1. Compressive Strength (28 Days): 500 psi.
 - 2. Maximum Aggregate Size: 1-1/2 - inch.
- C. Beams, Walls and Structural Slabs: Proportion normal-weight concrete mix as follows:
 - 1. Compressive Strength (28 Days): 4000 psi.
 - 2. Maximum Aggregate Size: 3/4 - inch.
 - 3. Air Entrainment: A minimum of 6 percent air content is required with acceptable range of air content is plus or minus 1.5 percent.

- D. Foundation Walls, Grade Beams: Proportion normal-weight concrete mix as follows:
 - 1. Compressive Strength (28 Days): 4000 psi.
 - 2. Maximum Aggregate Size: 3/4 - inch.
 - 3. Air Entrainment: A minimum of 6 percent air content is required with acceptable range of air content is plus or minus 1.5 percent.

- E. Interior HHW Slab-on-Ground, Equipment Pads: Proportion normal-weight concrete mix as follows:
 - 1. Compressive Strength (28 Days): 4000 psi.
 - 2. Maximum Aggregate Size: 3/4 - inch.

- F. Interior Tipping Slab-on-Ground: Proportion normal-weight concrete mix as follows:
 - 1. Compressive Strength (28 Days): 6000 psi.
 - 2. Maximum Aggregate Size: 1-1/2 inch. Aggregate shall have a minimum Moh's Hardness Value of 7.0.
 - 3. Maximum Slump (Inch): 3
 - 4. Maximum Water-Cement Ratio: 0.45.
 - 5. Steel Fiber Reinforcement: 55 lbs/cy of Bekaert Corporation – Dramix RC 80/60 BN or approved equal.

- G. Topping Slab: Proportion normal-weight concrete mix as follows:
 - 1. Compressive Strength (28 Days): 4000 psi.
 - 2. Maximum Aggregate Size: 3/8-inch.
 - 3. Maximum Water-Cement Ratio: 0.35.

- H. Electrical Room Roof, Floors, and Walls:
 - 1. Compressive Strength (28 Days): 4000 psi.
 - 2. Maximum Aggregate Size: 3/4-inch.
 - 3. Maximum Slump (Inch): 3
 - 4. Minimum Cement content: 583 lbs/cy
 - 5. Air Entrainment: Minimum of 6 percent air content, plus or minus 1.5 percent.
 - 6. Maximum Water-Cement Ratio: 0.40
 - 7. Crystalline Waterproofing Powder: 17 lb/cy

PART 3 EXECUTION

3.1 FORMWORK

- A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until concrete structure can support such loads.

- B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits stated below.

- C. Verify lines, levels, and measurement before proceeding with formwork.
- D. Earth forms are not permitted.
- E. Align form joints.
- F. Do not apply form release agent where concrete surfaces receive special finishes or applied coatings which may be affected by agent.
- G. Coordinate work of other Sections in forming and setting openings, slots, recesses, chases, sleeves, bolts, anchors, and other inserts.

3.2 REINFORCEMENT

- A. Place, support, and secure reinforcement against displacement.
- B. Locate reinforcing splices as shown on Drawings.
- C. Cut ends of epoxy coated rebars shall be coated with epoxy material equivalent to factory coating.
- D. Damage to rebar coating as a result of bending shall be repaired with equivalent coating.

3.3 VAPOR RETARDERS

- A. Vapor retarders shall be provided where slabs will receive vapor-sensitive floor coverings or in humidity-controlled areas or as indicated on drawings.
 - 1. Install vapor retarders directly under concrete slab-on-ground at areas with vapor-sensitive floor coverings and where subgrade granular material is subject to future moisture infiltration.
 - 2. Where subgrade material is dry, and will not be subject to future moisture infiltration and where humidity will be controlled, place the vapor retarder beneath the dry granular material and the concrete slab-on-ground directly on the dry granular material.
 - 3. Areas to receive vapor retarder include the entire HHW Slab only.
- B. Installation of Water Vapor Retarders shall be in accordance with ASTM E1643.
- C. Edges shall be lapped 6 inches and sealed.
- D. Contractor is responsible for maintaining conditions to provide a dry subgrade material where the slab is cast on top of granular material.
- E. Contractor is responsible for maintaining a puncture free vapor retarder. Any punctures shall be sealed appropriately to prevent vapor transmission.

- F. Do not disturb vapor retarder while placing reinforcement.
- G. Remove all dirt, debris from precast hollow core plank prior to topping installation.

3.4 WATERSTOPS

- A. Provide a continuous PVC water stop in floors and roof of electrical room, in pits, and where detailed as shown on Drawings. Butt weld joints with hot iron in accordance with the manufacturer's recommendations.
- B. Provide a continuous water stop at end of each concrete pour joint.

3.5 PLACING CONCRETE

- A. Notify Engineer a minimum of 48 hours prior to commencement of concreting operations.
- B. Failure to notify Engineer may result in rejection of concrete placed without observation.
- C. Place concrete in accordance with ACI 301.
- D. Place pumped concrete in accordance with ACI 304.2R. Line coating mix to initiate pumping shall not be used in pour but shall be wasted.
- E. Ensure reinforcement and embedded items are not disturbed during concrete placement.
- F. Concrete with excessive honeycomb or embedded debris shall be rejected and replaced at no cost to OWNER.
- G. Application of surface retarders and sawcutting of joints shall be planned in advance.
- H. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures and mechanical injury.
- I. Placing During Hot Weather:
 - 1. Place concrete during hot weather conditions in accordance with ACI 305R.
- J. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.

3.6 FLOOR SLABS

- A. Place floor slabs-on-ground with contraction and construction joints as indicated on Drawings.
 - 1. WTS tipping slab to be poured in six separate pours. See Drawings for construction joint (C.J.) layout.

- B. Saw cut contraction joints as soon as possible, without raveling, after placement of concrete, but within 24 hours.
- C. Cut slabs with 3/16-inch thick blade, cutting one-fourth depth of slab thickness.
- D. Separate slabs on fill from vertical surfaces with a joint filler.
- E. Extend joint filler from bottom of slab to within 1/8-inch of finished slab surface.
- F. Floor Finishes shall be in accordance with ACI 302.1R. Immediately after finishing, begin curing. See Finish and Cure Schedule.

3.7 JOINT WATERPROOFING

- A. Slurry:
 - 1. Slurry shall be applied less than 48 hours prior to pouring concrete.
 - 2. Protect from rain and flooding.
 - 3. Brush apply at a rate of 1.5 lbs. per square yard. See Drawings for location at Electrical Room.

3.8 FLOOR CURING AND TREATMENT

- A. Curing shall begin promptly to prevent drying of concrete. Curing shall continue for 7 days after placing.
- B. Curing methods shall not be changed until after the third day, and then only with written approval of the Engineer.
- C. Do not allow concrete to cool rapidly.
- D. Keep forms covered and moist during the first 3 days of the curing period.
- E. Verify compatibility of floor treatment materials with mastics and finish materials to be applied to floor.
- F. Apply two coats of Type I curing and sealing compound, with first coat applied immediately after finishing and second coat just before final acceptance of building except where floor covering materials are to be applied.

3.9 REPAIR OF VERTICAL SURFACE DEFECTS

- A. Upon stripping of forms, vertical surfaces shall be inspected for defects caused by surface air voids, honeycombing, form tie holes, peeling, and fins.

- B. Surface air voids shall be repaired with a unit packaged mixture of sand and cement mixed on job site with water and a unit of acrylic. Mixture shall be brushed uniformly on to surface and into voids. Where surface is to be exposed, surface finish of repair shall match adjacent surface.
- C. Honeycombed and other defective concrete shall be removed down to sound concrete and patched to match adjacent surfaces.

3.10 PATCHING OF CRACKS AT ELECTRICAL ROOM

- A. Patch cracks that develop in floors, walls, and top slabs of electrical room.
- B. For cracks less than 1/16 inch in width, apply a coat of Xypex slurry to cracks.
- C. For cracks exceeding 1/16 inch in width, contact Engineer/Architect.

3.11 FINISHING OF FORMED SURFACES

- A. After removal of forms and repair of defects, surfaces of concrete shall be given finishes specified below.
- B. When finish is to match a sample furnished to Contractor, sample finish shall be reproduced on an area at least 100 square feet in size in an inconspicuous location designated by Engineer prior to application in the specified area. Application of finish shall not be made until approved by Engineer.
- C. Rough Form Finish: Surface left with texture imparted by forms; form facing material not specified; tie holes and defects shall be patched; fins exceeding 1/4-inch shall be chipped or rubbed off. This finish applies to all exposed interior surfaces of the WTS Building.
- D. Smooth Form Finish: Surface produced by form facing material shall be a smooth, hard, uniform texture on concrete; forms may be plywood, tempered form grade hardboard, metal, plastic, paper or other acceptable material capable of producing finish; arrangement of facing material shall be orderly and symmetrical with number of seams kept to practical minimum; forms supported to prevent deflection and to maintain tolerances; tie holes and defects shall be patched; all fins shall be removed. This finish applies to all interior surfaces of the HHW Building and the exterior surfaces of the WTS and HHW Buildings.
 - 1. Grout Cleaned Finish: produced on newly hardened concrete following form removal; no cleaning operation shall be undertaken until all contiguous surfaces to be cleaned are completed and accessible; cleaning as work progresses is not permitted; mix 1 part portland cement to 1-1/2 parts fine sand with sufficient water to produce grout having consistency of thick paint; white portland cement may be substituted for a part of gray cement to produce a color to match adjacent concrete as determined by a trial patch; wet surface of concrete sufficient to prevent absorption of water from

grout and apply grout uniformly with brush or spray gun; immediately after applying grout, scrub surface vigorously with a cork float or stone to coat surface and fill all air bubbles and holes; while grout is still plastic, remove excess grout by working surface with rubber float, burlap or other acceptable means; after surface whitens (approximately 30 minutes normal drying), rub vigorously with clean burlap; keep surface damp for at least 36 hours after final rubbing.

- E. Tops of walls or buttresses, horizontal offsets, and similar unformed surfaces occurring adjacent to formed surfaces shall be struck smooth after concrete is placed and shall be floated to a texture reasonably consistent with that of formed surface.
- F. Final finish on formed surfaces shall continue uniformly across unformed surfaces.

3.12 TOLERANCES

- A. All tolerances for concrete work shall be in accordance with ACI 117.
- B. Contractor shall employ construction techniques to provide the following tolerances:

		<u>Overall</u>		<u>Local Minimum</u>	
		<u>FF</u>	<u>FL</u>	<u>FF</u>	<u>FL</u>
1.	Interior Slabs on Ground	25	17	20	15

- C. Contractor shall set forms consistent with and is solely responsible for meeting requirements of F-numbers specified above.
- D. Testing:
 - 1. Floor tolerances will be tested by an independent testing agency paid for by Owner. Testing will be performed under provisions of Section 01 40 00.
 - 2. Contractor shall conduct its own F-number tests within 72 hours of placing each slab section to determine adequacy of placing operations.
 - 3. All tests performed shall conform to ASTM E1155. Equipment to be used for testing shall be dipstick.

3.13 FIELD QUALITY CONTROL

- A. Testing and analysis of concrete shall be performed under provisions of Division 01.
- B. Testing firm will cast test cylinders and perform slump and air entrainment tests in accordance with ACI 301.
- C. Four concrete test cylinders shall be cast from each increment of 100 cubic yards of each class of concrete placed each day or from each placement of each class if less than 100 cubic

yards.

- D. During hot or cold weather, as defined in Section 1.6, one additional test cylinder shall be cast from each increment of 100 cubic yards of each class of concrete placed each day or from each pour of each class if less than 100 cubic yards and be cured on site under same conditions as concrete it represents.
- E. One slump test will be taken for each set of tests cylinders cast and whenever consistency of concrete appears to vary.
- F. No water may be added to the concrete at the site unless pre-approved in writing by the Engineer for that specific mix. If pre-approved, the mix ticket must state how much water may be added.

3.14 FINISH AND CURE SCHEDULE

CLASS	TYPE OF FINISH	AREA DESIGNATION	TYPE OF CURE
5	Hard steel trowel finish	HHW and WTS Slabs	Type I Curing Compound

END OF SECTION

SECTION 03 41 13

PRECAST CONCRETE HOLLOW CORE PLANKS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Precast concrete hollow core floor planks.
 - 2. Connection plates brackets and hangers.
 - 3. Grouting plank joint keys.

- B. Related Sections:
 - 1. Applicable provisions of Division 01 shall govern all work under this Section.
 - 2. Section 03 31 00 – Structural Concrete: Topping slab for hollow core plank.
 - 3. Section 04 20 13 – Single Wythe Masonry.
 - 4. Section 13 34 19 – Metal Building Systems: Supporting steel.
 - 5. Division 22 – Plumbing: Anchorage devices for plumbing equipment and piping hangers.
 - 6. Division 23 – Heating, Venting and Air Conditioning: Anchorage devices for HVAC equipment and piping hangers.
 - 7. Division 26 – Electrical: Anchorage devices for electrical equipment and piping hangers.

1.2 REFERENCES

- A. American Concrete Institute (ACI):
 - 1. ACI 301 - Specifications for Structural Concrete.
 - 2. ACI 318 - Building Code Requirements for Structural Concrete.

- B. American Society for Testing and Materials (ASTM International):
 - 1. ASTM A36 - Standard Specification for Carbon Structural Steel.
 - 2. ASTM A153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 - 3. ASTM A416 - Standard Specification for Steel Strand, Uncoated Seven-Wire for Prestressed Concrete.
 - 4. ASTM A615 - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
 - 5. ASTM A666 - Standard Specification for Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.

- C. American Welding Society (AWS):
 - 1. AWS B2.1 - Specification for Welding Procedure and Performance Qualification.
 - 2. AWS D1.1 - Structural Welding Code - Steel.

3. AWS D1.4 - Structural Welding Code - Reinforcing Steel.
- D. Precast/Prestressed Concrete Institute (PCI):
1. PCI JR-307 - Tolerances for Precast and Prestressed Concrete.
 2. PCI MNL-116S - Manual for Quality Control for Plants and Production of Precast and Prestressed Concrete Products.
 3. PCI MNL-120 - PCI Design Handbook - Precast and Prestressed Concrete.
 4. PCI MNL-123 - Design and Typical Details of Connections for Precast and Prestressed Concrete.
 5. PCI MNL-124 - Design for Fire Resistance of Precast Prestressed Concrete.
 6. PCI MNL-126 - PCI Manual for the Design of Hollow-Core Slabs.
- E. Underwriters Laboratories Inc. (UL):
1. UL - Fire Resistance Directory.

1.3 DESIGN REQUIREMENTS

- A. Design components to withstand dead loads and live loads in unrestrained condition:
1. Uniform and concentrated loads as indicated on Drawings.
 2. Lateral Forces.
- B. Maximum Allowable Deflection of Floor Planks: 1/360 span.
- C. Design components to accommodate construction tolerances, deflection of other building structural members and clearances of intended openings.
- D. Grouted Keys: Capable of transmitting horizontal shear force of 2,000 lb/ft.
- E. Fire Resistance: Provide designs acceptable to code requirements of authorities having jurisdiction to achieve hourly ratings as follows:
1. Floor Assembly: 2 hour.

1.4 SUBMITTALS

- A. Division 01 - Submittal Procedures: Submittal procedures.
- B. Shop Drawings: Indicate plank layout, unit identification marks, connection details, edge conditions, bearing requirements, support conditions, dimensions, openings, openings intended to be field cut, and relationship to adjacent materials.
- C. Shop Drawings shall be submitted to State of Wisconsin for review and approval prior to any work related to precast concrete plank installation commencing on site.
- D. Shop Drawings shall also be submitted and reviewed by the Engineer prior to any work related to precast concrete plank installation commencing on site.

- E. Product Data: Indicate standard component configuration, design loads, individual plank weight, deflections, cambers, and fire ratings.
- F. Fabricator:
 - 1. Documented experience when required per paragraph 1.6.A.
 - 2. Precast concrete manufacturing plant certification by the Precast/Prestressed Concrete Institute (PCI) Plant Certification Program in Category C2.
- G. Erector: Documented experience when required per paragraph 1.6.B.
- H. Design Data: Indicate calculations for loadings including uniform loads, point loads, and special loadings resulting from openings, stresses of planks, and prestressing. Submit calculations for all embed materials/plates and hangers; signed and sealed by Professional Engineer licensed in the State of Wisconsin.
- I. Fabricator's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.

1.5 QUALITY ASSURANCE

- A. Design planks in accordance with requirements of:
 - 1. PCI MNL-120 - Design Handbook.
 - 2. PCI MNL-126 - Manual for the Design of Hollow Core Slabs.
 - 3. PCI MNL-124 - Design for Fire Resistance of Precast Prestressed Concrete.
 - 4. ACI 318.
 - 5. ACI 301.
- B. Design connections in accordance with PCI MNL-123 - Manual on Design of Connections for Precast Prestressed Concrete.
- C. Produce planks in accordance with requirements of PCI MNL-116S. Maintain plant records and quality control program during production of precast planks. Make records available upon request.

1.6 QUALIFICATIONS

- A. Fabricator: Company specializing in manufacturing Work of this section with five years documented experience.
 - 1. Precast concrete fabricator shall be certified by the Precast/Prestressed Concrete Institute (PCI) Plant Certification Program.
 - 2. Fabricator shall be certified at time of bidding in Category C2.
- B. Erector: Company specializing in erecting Work of this section with five years experience.
- C. Welder: Qualified within previous 12 months in accordance with AWS B2.1.

- D. Design planks under direct supervision of Professional Engineer experienced in design of this Work and licensed in State of Wisconsin.

1.7 PRE-INSTALLATION MEETINGS

- A. Division 01 - Administrative Requirements: Pre-installation meeting.
- B. Convene minimum one week prior to commencing work of this section.
- C. Discuss anchor and weld plate locations, sleeve locations, and cautions regarding cutting or core drilling.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Division 01 - Product Requirements: Product storage and handling requirements.
- B. Lifting or Handling Devices: Capable of supporting member in positions anticipated during manufacture, storage, transportation, and erection.
- C. Mark each member with date of production and final position in structure.

1.9 COORDINATION

- A. Division 01 - Administrative Requirements: Coordination and project conditions.
- B. Coordinate with framing components directly associated with the Work of this Section.
- C. Coordinate all openings with other contractors.
- D. Coordinate location of hanger tabs and devices for mechanical and electrical work.

PART 2 PRODUCTS

2.1 FABRICATORS

- A. Fabricators:
 - 1. Spancrete.
 - 2. Midstates Concrete Industries.
 - 3. County Materials Corporation.
 - 4. Substitutions: In accordance Division 01 - Product Requirements.

2.2 MATERIALS

- A. Concrete Materials: ACI 301.
- B. Tensioning Steel Tendons: ASTM A416 Grade 270, of diameter appropriate to member design.

- C. Reinforcing Steel: ASTM A615, deformed steel bars.
- D. Cement Grout: Minimum compressive strength of 3,000 psi at 28 days.

2.3 ACCESSORIES

- A. Connecting and Supporting Devices: Plates, angles, items cast into concrete, items connected to steel framing members, and inserts: ASTM A36 carbon steel; hot dip galvanized in accordance with ASTM A153 finish.
- B. Core Hole End Plugs: Cardboard insert with stiff concrete fill.
- C. Hanger Tabs: Galvanized steel, designed to fit into grouted key joints, capable of supporting 500 lbs. dead load, predrilled to receive hanger.
- D. Anchorage devices for plumbing equipment and piping hangers: Reference Division 22 - Plumbing.
- E. Anchorage devices for HVAC equipment and piping hangers: Reference Division 23 - Heating, Venting and Air Conditioning.
- F. Anchorage devices for electrical equipment and piping hangers: Reference Division 26 - Electrical.
- G. Bearing Pads: Hardboard bearing pad 1/8 inch thick.

2.4 FABRICATION

- A. Planks: Plant cast, prestressed, hollow core.
- B. Nominal thickness: 8 inches; nominal width: 48 inches.
- C. Weld reinforcing in accordance with AWS D1.4.
- D. Embed anchors, inserts, plates, angles, and other items at locations indicated.
- E. Fabricate openings required by other sections, at locations indicated.
- F. Plank manufacturer shall provide for openings 10 inches round, square or larger as indicated on structural drawings.
- G. All other openings shall be located and field drilled or cut by contractor requiring such work after hollow core slab units have been erected.
- H. Openings and/or cutting of prestressing strand shall be approved by Architect/Engineer and manufacturer before drilling or cutting.

- I. Cut exposed ends flush.
- J. Plant Finish: Finish members to PCI MNL-116S Standard Grade.
- K. Connecting and Supporting Steel Devices: Do not paint surfaces in contact with concrete or surfaces requiring field welding.
- L. At locations where topping slab for hollow core plank is specified, top of plank shall be broomed finish (1/4-inch profile) to insure bonding.

2.5 FABRICATION TOLERANCES

- A. Conform to PCI MNL-116S and PCI JR-307 - Tolerances for Precast and Prestressed Concrete.

2.6 SOURCE QUALITY CONTROL AND TESTS

- A. Division 01 - Quality Requirements: Testing and inspection services.
- B. Division 01 - Execution Requirements: Testing, adjusting, and balancing.
- C. Reference Section 03 31 00 – Structural Concrete for testing of concrete materials and mix designs.
- D. Inspect stressing tendons before delivery for compliance with specified standards.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Division 01 - Administrative Requirements: Coordination and project conditions.
- B. Verify site conditions are ready to receive Work and field measurements are as indicated on shop drawings.
- C. Verify supporting structure is ready to receive work.

3.2 PREPARATION

- A. Prepare support devices for erection procedure and temporary bracing.

3.3 ERECTION

- A. Erect members without damage to structural capacity, shape, or finish. Replace or repair damaged members.
- B. Align and maintain uniform horizontal and end joints, as erection progresses.

- C. Maintain temporary bracing in place until final connections are made. Protect members from staining.
- D. Install bearing pads at bearing ends of planks as indicated on Drawings.
- E. Adjust differential camber between precast members to tolerance before final attachment and grouting.
- F. Adjust differential elevation between precast members to tolerance before final attachment.
- G. Install hanger tabs in joints as required for plumbing, mechanical and electrical equipment. Coordinate with specific trades.
- H. Secure units in place. Perform welding in accordance with AWS D1.1.
- I. Grout longitudinal keys.
- J. Make plank-to-plank joints smooth using grout, troweled smooth. Transition differential elevation of adjoining planks with grout to maximum slope of 1: 12.
- K. Bonded Topping Slab:
 - 1. Properly clean plank to receive concrete topping.
 - 2. Pre-wet the slab for 12 hours prior to placing concrete topping. Substrate surface to be in a saturated surface dry condition prior to bonding agent application. At time of concrete placement, there shall be no standing water on the surface.
 - 3. Bonding Agents: Mix 4.5 gallons of water to a 94 lb. bag of cement. Scrub bonding agent into the surface just prior to concrete topping placement. Minimize area of scrub coat ahead of concrete placement to prevent bonding agent from drying out. Do not re-temper the bonding agent.
 - 4. Place, finish, and moist cure concrete topping.
 - 5. All defects shall be repaired by the general contractor such that final finish shall be cosmetically pleasing to the Engineer/Architect. Method of repair shall be determined by Precast Supplier.

3.4 ERECTION TOLERANCES

- A. Division 01 - Quality Requirements: Tolerances.
- B. Erect to the following tolerances:
 - 1. Maximum Variation from Plane or Location Indicated on Drawings: 1/4 inch in 10 feet and 3/8 inch in 100 feet, non-cumulative.
 - 2. Maximum Offset from Indicated Alignment Between Members: 1/4 inch.
 - 3. Maximum Variation From Dimensions Indicated on Reviewed Shop Drawings: Plus or minus 1/8 inch.

C. Exposed Joint Dimension: 3/8 inch plus or minus 1/4 inch.

3.5 CLEANING

A. Division 01 - Execution Requirements: Final cleaning.

B. Clean weld marks, dirt, and blemishes from surface of exposed members.

3.6 PROTECTION OF INSTALLED CONSTRUCTION

A. Division 01 - Execution Requirements: Protecting installed construction.

B. Protect members from damage caused by field welding or erection operations.

C. Use non-combustible shields during welding operations to protect adjacent Work.

END OF SECTION

SECTION 04 05 03
MASONRY MORTARING AND GROUTING

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes mortar and grout for masonry.
- B. Related Sections:
 - 1. Applicable provisions of Division 01 shall govern all work under this Section.
 - 2. Section 04 20 13 - Single-Wythe Unit Masonry: Installation of mortar and grout.
 - 3. Section 08 12 14 - Standard Steel Frames: Grouting steel door frames.

1.2 REFERENCES

- A. American Concrete Institute:
 - 1. ACI 530 - Building Code Requirements for Masonry Structures.
 - 2. ACI 530.1 - Specifications for Masonry Structures.
- B. ASTM International:
 - 1. ASTM C5 - Standard Specification for Quicklime for Structural Purposes.
 - 2. ASTM C94 - Standard Specification for Ready-Mixed Concrete.
 - 3. ASTM C143 - Standard Test Method for Slump of Hydraulic Cement Concrete.
 - 4. ASTM C144 - Standard Specification for Aggregate for Masonry Mortar.
 - 5. ASTM C150 - Standard Specification for Portland Cement.
 - 6. ASTM C206 - Standard Specification for Finishing Hydrated Lime.
 - 7. ASTM C270 - Standard Specification for Mortar for Unit Masonry.
 - 8. ASTM C404 - Standard Specification for Aggregates for Masonry Grout.
 - 9. ASTM C476 - Standard Specification for Grout for Masonry.
 - 10. ASTM C780 - Standard Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry.
 - 11. ASTM C1019 - Standard Test Method for Sampling and Testing Grout.
 - 12. ASTM C1314 - Standard Test Method for Constructing and Testing Masonry Prisms Used to Determine Compliance with Specified Compressive Strength of Masonry.
 - 13. ASTM C1357 - Standard Test Method for Evaluating Masonry Bond Strength.

1.3 SUBMITTALS

- A. Division 01 – General Requirements: Submittal requirements.
- B. Samples: Submit two samples of mortar, illustrating mortar color and color range.
- C. Design Data: Submit design mix when Property specification of ASTM C270 is to be used, required environmental conditions, and admixture limitations.

- D. Test Reports:
 - 1. Submit reports on mortar indicating conformance of mortar to property requirements of ASTM C270 and test and evaluation reports to ASTM C780 for aggregate ratio and water content, air content, consistency and compressive strength.
 - 2. Submit reports on grout indicating conformance of grout to property requirements of ASTM C476 and test and evaluation reports to ASTM C1019.
- E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 QUALITY ASSURANCE

- A. Perform Work in accordance with ACI 530 and ACI 530.1.

1.5 ENVIRONMENTAL REQUIREMENTS

- A. Division 01 – General Requirements.
- B. Cold Weather Requirements: In accordance with ACI 530.1 when ambient temperature or temperature of masonry units is less than 40 degrees F.
- C. Hot Weather Requirements: In accordance with ACI 530.1 when ambient temperature is greater than 100 degrees F or ambient temperature is greater than 90 degrees F with wind velocity greater than 8 mph.

PART 2 PRODUCTS

2.1 COMPONENTS

- A. Portland Cement: ASTM C150, Type I, gray color.
- B. Mortar Aggregate: ASTM C144, standard masonry type.
- C. Hydrated Lime: ASTM C206, Type S.
- D. Grout Aggregate: ASTM C404, fine and coarse.
- E. Water: Clean and potable.
- F. Mortar Color: Mineral oxide pigment; color as selected by Engineer/Architect.
- G. Calcium chloride is not permitted.

2.2 MIXES

- A. Mortar Mixes:
 - 1. Mortar For Masonry: ASTM C270, Type S using Property specification.

- B. Mortar Mixing:
 - 1. Thoroughly mix mortar ingredients in accordance with ASTM C270 in quantities needed for immediate use.
 - 2. Achieve uniformly damp sand immediately before mixing process.
 - 3. Add mortar color and admixtures to achieve uniformity of mix and coloration.
 - 4. Re-temper only within two hours of mixing.

- C. Grout Mixes:
 - 1. Grout for Non-Structural Masonry: 2,000 psi strength at 28 days; 8-11 inches slump; mixed in accordance with ASTM C476 Fine and Coarse grout.
 - 2. Application:
 - a. Coarse Grout: For grouting spaces with minimum 4 inches dimension in every direction.
 - b. Fine Grout: For grouting other spaces.

- D. Grout Mixing:
 - 1. Mix grout in accordance with ASTM C94 modified to use ingredients complying with ASTM C476.
 - 2. Add admixtures; mix uniformly.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Division 01 – General Requirements: Coordination and project conditions.
- B. Request inspection of spaces to be grouted.

3.2 INSTALLATION

- A. Install mortar and grout in accordance with ACI 530.1 Specifications for Masonry Structures.

3.3 FIELD QUALITY CONTROL

- A. Division 01 – General Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Establishing Mortar Mix: In accordance with ASTM C270.
- C. Testing Frequency: One set of specified tests for every 5,000 sf of completed wall area.
- D. Testing of Mortar Mix: In accordance with ASTM C780 for aggregate ratio and water content, air content, consistency, and compressive strength.
- E. Testing of Grout Mix: In accordance with ASTM C1019 for compressive strength, and in accordance with ASTM C143 for slump.

- F. Test flexural bond strength of mortar and masonry units to ASTM C1357; test in conjunction with masonry unit sections specified.
- G. Test compressive strength of mortar and masonry to ASTM C1314; test in accordance with masonry unit sections specified.

END OF SECTION

SECTION 04 20 13
SINGLE-WYTHER UNIT MASONRY

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes concrete masonry units; reinforcement, anchorage, and accessories.
- B. Related Sections:
 - 1. Applicable provisions of Division 01 shall govern all work under this Section.
 - 2. Section 03 31 00 – Structural Concrete.
 - 3. Section 03 41 00 – Plant Precast Structural Concrete.
 - 4. Section 04 05 03 - Masonry Mortaring and Grouting: Mortar and grout.
 - 5. Section 07 84 00 - Firestopping: Firestopping at penetrations of masonry work.
 - 6. Section 07 90 00 - Joint Protection: Rod and sealant at control and expansion joints.
 - 7. Section 08 12 14 – Standard Steel Frames.
 - 8. Section 13 34 19 – Metal Building Systems.

1.2 REFERENCES

- A. American Concrete Institute:
 - 1. ACI 530 - Building Code Requirements for Masonry Structures.
 - 2. ACI 530.1 - Specification for Masonry Structures.
- B. ASTM International:
 - 1. ASTM A153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 - 2. ASTM A240 - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
 - 3. ASTM A307 - Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength.
 - 4. ASTM A580 - Standard Specification for Stainless Steel Wire.
 - 5. ASTM A615 - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
 - 6. ASTM A653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - 7. ASTM A951 - Standard Specification for Masonry Joint Reinforcement.
 - 8. ASTM B370 - Standard Specification for Copper Sheet and Strip for Building Construction.
 - 9. ASTM B695 - Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel.
 - 10. ASTM C90 - Standard Specification for Loadbearing Concrete Masonry Units.

11. ASTM C129 - Standard Specification for Nonloadbearing Concrete Masonry Units.
12. ASTM E84 - Test Method for Surface Burning Characteristics of Building Materials.
13. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.

C. National Fire Protection Association:

1. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials.

D. Underwriters Laboratories Inc.:

1. UL 723 - Tests for Surface Burning Characteristics of Building Materials.

1.3 PERFORMANCE REQUIREMENTS

- A. Concrete Masonry Compressive Strength (f'm): 1,900 psi; determined by unit strength method.

1.4 SUBMITTALS

- A. Division 01 – General Requirements: Submittal requirements.

B. Product Data:

1. Submit data for concrete masonry units and accessories.

- C. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.5 QUALITY ASSURANCE

- A. Perform Work in accordance with ACI 530 and ACI 530.1.

B. Fire Rated Wall Construction: Rating as indicated on Drawings.

1. Tested Rating: Determined in accordance with ASTM E119.

C. Surface Burning Characteristics:

1. Foam Insulation: Maximum 75/450 flame spread/smoke developed index when tested in accordance with ASTM E84.

- D. Apply label from agency approved by authority having jurisdiction to identify each foam plastic insulation insert.

1.6 QUALIFICATIONS

- A. Installer: Company specializing in performing Work of this section with minimum five years experience.

1.7 PRE-INSTALLATION MEETINGS

- A. Division 01 – General Requirements: Pre-installation meeting.
- B. Convene minimum one week prior to commencing work of this section.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Division 01 – General Requirements: Product storage and handling requirements.
- B. Accept concrete masonry units on site. Inspect for damage.

1.9 ENVIRONMENTAL REQUIREMENTS

- A. Division 01 – General Requirements.
- B. Cold Weather Requirements: In accordance with ACI 530.1 when ambient temperature or temperature of masonry units is less than 40 degrees F.
- C. Hot Weather Requirements: In accordance with ACI 530.1 when ambient temperature is greater than 100 degrees F or ambient temperature is greater than 90 degrees F with wind velocity greater than 8 mph.

1.10 COORDINATION

- A. Division 01 – General Requirements: Coordination and project conditions.
- B. Coordinate Work with installation of window and door anchors.

PART 2 PRODUCTS

2.1 SINGLE-WYTHE UNIT MASONRY

- A. Manufacturers:
 - 1. County Materials.
 - 2. Oldcastle.
 - 3. Substitutions: Division 01 – General Requirements.

2.2 COMPONENTS

- A. Hollow Concrete Masonry Units (CMU): ASTM C90; normal weight.
- B. Solid Concrete Masonry Units (CMU): ASTM C90; normal weight.

2.3 ACCESSORIES

- A. Single Wythe Joint Reinforcement: ASTM A951; truss type; steel; 0.148 inch diameter side

rods with 0.148 inch diameter cross ties; hot dip galvanized.

- B. Reinforcing Steel: ASTM A615, 60 ksi yield grade, deformed billet bars, uncoated finish.
- C. Wall Ties: Corrugated formed sheet metal, 1-1/2 inch x 6 inch size x 22 gage thick.
- D. Mortar and Grout: As specified in Section 04 05 03 – Masonry Mortaring and Grouting.
- E. Preformed Control Joints: Polyvinyl chloride material. Furnish with corner and tee accessories, heat fused joints.
- F. Joint Filler: Closed cell polyvinyl chloride; oversized 50 percent to joint width; self-expanding; maximum lengths.
- G. Nailing Strips: Specified in Section 06 10 53 – Miscellaneous Rough Carpentry.
- H. Cleaning Solution: Non-acidic, not harmful to masonry work or adjacent materials.
- I. Precast Concrete Lintels: Size as indicated on Drawings.
- J. Steel Lintels: Size as indicated on Drawings.

2.4 SOURCE QUALITY CONTROL

- A. Section 01 40 00 – Quality Requirements: Testing, inspection and analysis requirements.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Division 01 – General Requirements: Coordination and project conditions.
- B. Verify field conditions are acceptable and are ready to receive work.
- C. Verify items provided by other sections of work are properly sized and located.
- D. Verify built-in items are in proper location, and ready for roughing into masonry support.

3.2 PREPARATION

- A. Direct and coordinate placement of metal anchors supplied to other Sections.
- B. Furnish temporary bracing during installation of masonry work. Maintain in place until building structure provides permanent support.
- C. Wet clay and shale brick before laying when initial rate of absorption is greater than 30 grams when tested in accordance with ASTM C67.

3.3 INSTALLATION

- A. Establish lines, levels, and coursing indicated. Protect from displacement.
- B. Maintain masonry courses to uniform dimension. Form bed and head joints of uniform thickness.
- C. Coursing of Concrete Masonry Units:
 - 1. Bond: Running.
 - 2. Coursing: One unit and one mortar joint to equal 8 inches.
 - 3. Mortar Joints: Concave.
- D. Placing and Bonding:
 - 1. Lay solid masonry units in full bed of mortar, with full head joints.
 - 2. Lay hollow masonry units with face shell bedding on head and bed joints.
 - 3. Buttering corners of joints or excessive furrowing of mortar joints are not permitted.
 - 4. Remove excess mortar as work progresses.
 - 5. Interlock intersections and external corners.
 - 6. Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment is required, remove mortar and replace.
 - 7. Perform job site cutting of masonry units with proper tools to assure straight, clean, unchipped edges. Prevent broken masonry unit corners or edges.
 - 8. Cut mortar joints flush where bitumen dampproofing is applied.
 - 9. Isolate masonry from vertical structural framing members with movement joint as indicated on Drawings.
 - 10. Isolate top of masonry from horizontal structural framing members and slabs or decks with compressible joint filler.
- E. Joint Reinforcement and Anchorage:
 - 1. Install horizontal joint reinforcement 16 inches oc.
 - 2. Place masonry joint reinforcement in first and second horizontal joints above and below openings. Extend minimum 16 inches each side of opening.
 - 3. Place joint reinforcement continuous in first and second joint below top of walls.
 - 4. Lap joint reinforcement ends minimum 6 inches.
 - 5. Reinforce joint corners and intersections with strap anchors 16 inches oc.
- F. Lintels:
 - 1. Install loose steel lintels as scheduled.
 - 2. Install reinforced unit masonry lintels over openings where precast concrete lintels are not scheduled.
 - 3. Openings Up To 42 inches Wide: Place two, No. 4 reinforcing bars 1 inch from bottom web.
 - 4. Openings From 42 inches Up To 78 inches Wide: Place two, No. 5 reinforcing bars 1 inch from bottom web.

5. Openings Over 78 inches: Reinforce openings as detailed.
 6. Do not splice reinforcing bars.
 7. Support and secure reinforcing bars from displacement.
 8. Place and consolidate grout fill without displacing reinforcing.
 9. Allow masonry lintels to attain specified strength before removing temporary supports.
 10. Maintain minimum 8 inch bearing on each side of opening.
- G. Grouted Components:
1. Reinforce bond beam with 2, No. 5 bars, 1 inch from bottom web.
 2. Lap splices bar diameters required by code.
 3. Support and secure reinforcing bars from displacement.
 4. Place and consolidate grout fill without displacing reinforcing.
 5. At bearing locations, fill masonry cores with grout for minimum 12 inches both side of opening.
- H. Control and Expansion Joints:
1. Install control and expansion joints at the following maximum spacings, unless otherwise indicated on Drawings:
 - a. Exterior Walls: 20 feet on center and within 24 inches on one side of each interior and exterior corner.
 - b. Interior Walls: 30 feet on center.
 - c. At changes in wall height.
 2. Do not continue horizontal joint reinforcement through control and expansion joints.
 3. Install preformed control joint device in continuous lengths. Seal butt and corner joints.
 4. Size control joint in accordance with Section 07 90 00 – Joint Protection for sealant performance.
 5. Form expansion joint by omitting mortar and cutting unit to form open space.
- I. Built-In Work:
1. As work progresses, install built-in metal door and glazed frames, fabricated metal frames, window frames, wood nailing strips, anchor bolts, plates and other items to be built-in the work and furnished by other sections.
 2. Install built-in items plumb and level.
 3. Bed anchors of metal door and glazed frames in adjacent mortar joints. Fill frame voids solid with grout or mortar. Fill adjacent masonry cores with grout minimum 12 inches from framed openings.
 4. Do not build in materials subject to deterioration.
- J. Cutting and Fitting:
1. Cut and fit for chases, pipes, conduit, sleeves and grounds. Coordinate with other sections of work to provide correct size, shape, and location.

2. Obtain Architect/Engineer's approval prior to cutting or fitting masonry work not indicated or where appearance or strength of masonry work may be impaired.

3.4 ERECTION TOLERANCES

- A. Division 01 – General Requirements: Tolerances.
- B. Maximum Variation From Alignment of Columns: 1/4 inch.
- C. Maximum Variation From Unit to Adjacent Unit: 1/16 inch.
- D. Maximum Variation from Plane of Wall: 1/4 inch in 10 feet and 1/2 inch in 20 feet or more.
- E. Maximum Variation from Plumb: 1/4 inch per story non-cumulative; 1/2 inch in two stories or more.
- F. Maximum Variation from Level Coursing: 1/8 inch in 3 feet and 1/4 inch in 10 feet; 1/2 inch in 30 feet.
- G. Maximum Variation of Joint Thickness: 1/8 inch in 3 feet.
- H. Maximum Variation from Cross Sectional Thickness of Walls: 1/4 inch.
- I. Maximum Variation for Steel Reinforcement:
 1. Install reinforcement within the tolerances specified in ACI 530.1 for foundation walls.
 2. Plus or minus 1/2 inch when distance from centerline of steel to opposite face of masonry is 8 inches or less.
 3. Plus or minus 1 inch when distance is between 8 and 24 inches.
 4. Plus or minus 1-1/4 inch when distance is greater than 24 inches.
 5. Plus or minus 2 inches from location along face of wall.

3.5 FIELD QUALITY CONTROL

- A. Division 01 – General Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Concrete Masonry Units: Test each type in accordance with ASTM C140.

3.6 CLEANING

- A. Division 01 – General Requirements : Final cleaning.
- B. Remove excess mortar and mortar smears as work progresses.
- C. Replace defective mortar. Match adjacent work.

- D. Clean soiled surfaces with cleaning solution.
- E. Use non-metallic tools in cleaning operations.

3.7 PROTECTION OF FINISHED WORK

- A. Division 01 – General Requirements: Requirements for protecting finished Work.
- B. Protect exposed external corners subject to damage.
- C. Protect base of walls from mud and mortar splatter.
- D. Protect masonry and other items built into masonry walls from mortar droppings and staining caused by mortar.
- E. Protect tops of masonry work with waterproof coverings secured in place without damaging masonry. Provide coverings where masonry is exposed to weather when work is not in progress.

END OF SECTION

SECTION 05 51 00

METAL STAIRS

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Steel stair frame of structural sections, with open risers and grate stair treads.
- B. Related Sections:
 - 1. Applicable provisions of Division 01 shall govern all work under this Section.
 - 2. Section 03 31 00 - Structural Concrete: Execution requirements for placement of metal anchors specified in this section in concrete.
 - 3. Section 04 20 13 – Single Wythe Unit Masonry: Execution requirements for placement of metal anchors specified in this section in masonry.
 - 4. Section 05 52 00 - Metal Railings: Handrails and balusters other than specified in this section.
 - 5. Section 09 90 00 - Painting and Coating: Paint finish.

1.2 REFERENCES

- A. American National Standards Institute:
 - 1. ANSI A117.1 - Accessible and Usable Buildings and Facilities.
- B. ASTM International (American Society for Testing and Materials):
 - 1. ASTM A36 - Standard Specification for Carbon Structural Steel.
 - 2. ASTM A123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - 3. ASTM A153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 - 4. ASTM A307 - Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength.
 - 5. ASTM A500 - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
 - 6. ASTM A563 - Standard Specification for Carbon and Alloy Steel Nuts.
 - 7. ASTM A653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - 8. ASTM B695 - Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel.
 - 9. ASTM F436 - Standard Specification for Hardened Steel Washers.
 - 10. ASTM E935 - Standard Test Methods for Performance of Permanent Metal Railing Systems and Rails for Buildings.

11. ASTM E985 - Standard Specification for Permanent Metal Railing Systems and Rails for Buildings.
- C. American Welding Society:
 1. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination.
 2. AWS D1.1 - Structural Welding Code - Steel.
 - D. National Association of Architectural Metal Manufacturers:
 1. NAAMM AMP 510 - Metal Stairs Manual.
 2. NAAMM MBG 531 - Metal Bar Grating Manual.
 - E. National Ornamental & Miscellaneous Metals Association:
 1. NOMMA Guideline 1 - Joint Finishes.
 - F. The Society for Protective Coatings:
 1. SSPC - Steel Structures Painting Manual.
 2. SSPC SP 1 - Solvent Cleaning.
 3. SSPC SP 10 - Near-White Blast Cleaning.
 4. SSPC Paint 15 - Steel Joist Shop Paint.
 5. SSPC Paint 20 - Zinc-Rich Primers (Type I - Inorganic and Type II - Organic).

1.3 DESIGN REQUIREMENTS

- A. Fabricate stair assembly to support uniform live load of 100 lb/sq ft and concentrated load of 300 lbs. with deflection of stringer or landing framing not to exceed 1/240 of span. Test in accordance with ASTM E935.
- B. Railing assembly, wall rails, and attachments to resist lateral force of 200 lbs. or 50 lb/ft at any point without damage or permanent set. Test in accordance with ASTM E935.
- C. Fabricate stair assembly to NAAMM AMP 510, Class Industrial.

1.4 SUBMITTALS

- A. Division 01 – General Requirements: Submittal requirements.
- B. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories.
- C. Shop Drawings: Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.
- D. Design Data: Submit design calculations.

- E. Welders Certificates: Certify welders employed on the Work, verifying AWS qualification within previous 12 months.

1.5 QUALITY ASSURANCE

- A. Perform Work in accordance with ASTM E985 - Permanent Metal Railing Systems and Rails for Buildings.
- B. Finish joints in accordance with NOMMA Guideline 1.

1.6 QUALIFICATIONS

- A. Prepare Shop Drawings under direct supervision of Professional Engineer experienced in design of this Work and licensed in State of Wisconsin.

1.7 PRE-INSTALLATION MEETINGS

- A. Division 01 – General Requirements: Pre-installation meeting.
- B. Convene minimum one week prior to commencing work of this section.

1.8 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

PART 2 PRODUCTS

2.1 COMPONENTS

- A. Steel Sections: ASTM A36, galvanized.
- B. Steel Plate: ASTM A36, galvanized.
- C. Hollow Structural Sections: ASTM A500, Grade B, galvanized.
- D. Steel Tubing: ASTM A500, Grade B, galvanized.
- E. Sheet Steel: ASTM A653, galvanized.
- F. Bolts: ASTM A307; Grade A or B.
 - 1. Finish: Mechanically galvanized.
- G. Nuts: ASTM A563 heavy hex type.
 - 1. Finish: Mechanically galvanized.
- H. Washers: ASTM F436; Type 1.
 - 1. Finish: Mechanically galvanized.

- I. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; consistent with design of stair structure.
- J. Welding Materials: AWS D1.1; type required for materials being welded.
- K. Touch-Up Primer: Match shop primer.
- L. Touch-Up Primer for Galvanized Surfaces: SSPC Paint 20 Type I Inorganic.
- M. Gratings: NAAMM MBG 531, welded type, galvanized.

2.2 FABRICATION

- A. Fit and shop assemble components in largest practical sections, for delivery to site.
- B. Fabricate components with joints tightly fitted and secured.
- C. Continuously seal joined pieces by continuous welds.
- D. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.
- E. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; unobtrusively located; consistent with design of component, except where specifically noted otherwise.
- F. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.
- G. Accurately form components required for anchorage of stairs, landings and railings to each other and to building structure.

2.3 FABRICATION - OPEN GRATING STAIRS

- A. Fabricate treads in accordance with NAAMM MBG 531, of welded steel bars, welded to supports; galvanized finish.
- B. Form hollow stringers with rolled steel channels or rectangular hollow sections, galvanized finish.
- C. Landings: Reference Section 03 41 13 – Precast Concrete Hollow Core Planks.
- D. Form balusters with 1-1/2 inch diameter steel sections, welded to stringers; galvanized finish.

2.4 SHOP FINISHING

- A. Prepare surfaces to be primed in accordance with SSPC SP 2.
- B. Do not prime surfaces in direct contact with concrete or where field welding is required.
- C. Prime paint items with two coats.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Division 01 – General Requirements: Coordination and project conditions.
- B. Verify field conditions are acceptable and are ready to receive work.
- C. Verify concealed blocking and reinforcement is installed and correctly located to receive wall mounted handrails.

3.2 PREPARATION

- A. Clean and strip primed steel items to bare metal where site welding is required.
- B. Supply items required to be cast into concrete or embedded in masonry with setting templates.

3.3 INSTALLATION

- A. Install components plumb and level, accurately fitted, free from distortion or defects.
- B. Install anchors, plates, angles, hangers and struts required for connecting stairs to structure.
- C. Allow for erection loads. Install sufficient temporary bracing to maintain framing safe, plumb, and in alignment.
- D. Field weld components indicated on shop drawings. Perform field welding in accordance with AWS D1.1.
- E. Field bolt and weld to match shop bolting and welding. Conceal bolts and screws whenever possible. Where not concealed, use flush countersunk fastenings.
- F. Mechanically fasten joints butted tight, flush, and hairline. Grind welds smooth and flush.
- G. Obtain approval of Architect/Engineer prior to site cutting or creating adjustments not scheduled.

- H. After erection, prime welds, abrasions, and surfaces not galvanized, except surfaces to be in contact with concrete.

3.4 ERECTION TOLERANCES

- A. Division 01 – General Requirements: Tolerances.
- B. Maximum Variation From Plumb: 1/4 inch per story, non-cumulative.
- C. Maximum Offset From Alignment: 1/4 inch.

3.5 FIELD QUALITY CONTROL

- A. Welding: Inspect welds in accordance with AWS D1.1.

END OF SECTION

SECTION 05 52 00

METAL RAILINGS

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes steel tube railings, balusters, and fittings; and handrails.
- B. Related Sections:
 - 1. Applicable provisions of Division 01 shall govern all work under this Section.
 - 2. Section 03 31 00 - Structural Concrete: Execution requirements for placement of anchors specified in this section in concrete.
 - 3. Section 03 41 13 – Precast Concrete Hollow Core Planks.
 - 4. Section 04 20 13 – Single Wythe Unit Masonry: Execution requirements for placement of anchors specified in this section in masonry.
 - 5. Section 05 51 00 - Metal Stairs: Handrails other than those specified in this section.
 - 6. Section 09 90 00 - Painting and Coating: Paint finish.

1.2 REFERENCES

- A. ASTM International (ASTM):
 - 1. ASTM A53 - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
 - 2. ASTM A500 - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
 - 3. ASTM A513 - Standard Specification for Electric-Resistance-Welded Carbon and Alloy Steel Mechanical Tubing.
 - 4. ASTM E935 - Standard Test Methods for Performance of Permanent Metal Railing Systems and Rails for Buildings.
- B. National Ornamental & Miscellaneous Metals Association:
 - 1. NOMMA Guideline 1 - Joint Finishes.
- C. The Society for Protective Coatings (SSPC)
 - 1. Volume 1 – Good Painting Practices, Current Edition.
 - 2. Volume 2 – Systems and Specifications.

1.3 DESIGN REQUIREMENTS

- A. Design handrail, guardrail, and attachments to resist forces as required by applicable code.
- B. Apply loads non-simultaneously to produce maximum stresses.
 - 1. Guard Top Rail and Handrail Concentrated Load: 200 pounds applied at any point in

- any direction.
 - 2. Guard Top Rail Uniform Load: 50 plf applied in any direction.
 - 3. Intermediate Rails, Panels, and Baluster Concentrated Load: 50 pounds applied to 1 sf area.
- C. Design Data: Shop Drawings shall be prepared under supervision of a Professional Engineer licensed in the State of Wisconsin.

1.4 SUBMITTALS

- A. Division 01 – General Requirements: Submittal requirements.
- B. Shop Drawings: Indicate profiles, sizes, connection attachments, anchorage, size and type of fasteners, and accessories.

1.5 QUALITY ASSURANCE

- A. Finish joints in accordance with NOMMA Guideline 1.

1.6 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

PART 2 PRODUCTS

2.1 STEEL RAILING SYSTEM COMPONENTS

- A. Tubing: ASTM A513, Type 5, minimum 50 ksi yield strength.
- B. Hollow Structural Sections: ASTM A500, Grade B.
- C. Rails and Posts: 1-1/2 inch diameter steel tubing; welded joints.
- D. Removable Guard Top Rail: 42 inches above traffic surface to top of rail.
- E. Stair Handrail: Mount 34 inches above tread nosing.
- F. Intermediate Rails: Spaced for maximum 21-inch clear opening between rail and toe plate.
- G. Toe Plate: Minimum 4-inch height above traffic surface.
- H. Fittings: Elbows, T-shapes, wall brackets, escutcheons; machined steel.
- I. Mounting: Adjustable brackets and flanges, with steel brackets for embedding in masonry.
- J. Exposed Fasteners: Flush countersunk screws or bolts; consistent with design of railing.

K. Splice Connectors: Steel concealed spigots.

L. Touch-Up Primer: SSPC.

2.2 FABRICATION

A. Fit and shop assemble components in largest practical sizes for delivery to site.

B. Fabricate components with joints tightly fitted and secured. Furnish spigots and sleeves to accommodate site assembly and installation.

C. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; unobtrusively located; consistent with design of component, except where specifically noted otherwise.

D. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

E. Interior Components: Continuously seal joined pieces by continuous welds.

F. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.

G. Accurately form components to suit stairs and landings, to each other and to building structure.

H. Accommodate for expansion and contraction of members and building movement without damage to connections or members.

PART 3 EXECUTION

3.1 EXAMINATION

A. Division 01 – General Requirements: Coordination and project conditions.

B. Verify field conditions are acceptable and are ready to receive work.

C. Verify concealed blocking and reinforcement is installed and correctly located to receive wall mounted handrails.

3.2 PREPARATION

A. Clean and strip primed steel items to bare metal where site welding is required.

- B. Supply items required to be cast into concrete or embedded in masonry with setting templates, to appropriate sections.

3.3 INSTALLATION

- A. Install components plumb and level, accurately fitted, free from distortion or defects.
- B. Anchor railings to structure with anchors, plates and angles.
- C. Field weld anchors as indicated on shop drawings. Touch-up welds with primer. Grind welds smooth.
- D. Conceal bolts and screws whenever possible. Where not concealed, use flush countersunk fastenings.
- E. Assemble with spigots and sleeves to accommodate tight joints and secure installation.

3.4 ERECTION TOLERANCES

- A. Division 01 – General Requirements: Tolerances.
- B. Maximum Variation From Plumb: 1/4 inch per story, non-cumulative.
- C. Maximum Offset From Alignment: 1/4 inch.
- D. Maximum Out-of-Position: 1/4 inch.

END OF SECTION

SECTION 06 10 53

MISCELLANEOUS ROUGH CARPENTRY

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes blocking in wall and roof openings; wood furring and grounds; telephone and electrical panel back boards; concealed wood blocking for support of toilet and bath accessories, wall cabinets; and preservative treatment of wood.
- B. Related Sections:
 - 1. Applicable provisions of Division 01 shall govern all work under this Section.
 - 2. Section 03 31 00 – Structural Concrete: Concrete openings to receive wood blocking.
 - 3. Section 04 20 13 – Single Wythe Unit Masonry: Masonry openings to receive wood blocking.
 - 4. Section 06 20 00 – Finish Carpentry.
 - 5. Section 08 12 14 – Standard Steel Frames: Window and door openings to receive wood blocking.
 - 6. Section 08 33 23 – Overhead Coiling Doors.
 - 7. Section 83 36 13 – Sectional Doors.

1.2 REFERENCES

- A. American National Standards Institute:
 - 1. ANSI A208.1 - Mat-Formed Wood Particleboard.
- B. American Wood-Preservers' Association:
 - 1. AWWPA C1 - All Timber Products - Preservative Treatment by Pressure Process.
 - 2. AWWPA C20 - Structural Lumber - Fire-Retardant Treatment by Pressure Processes.
- C. ASTM International:
 - 1. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
 - 2. ASTM F1667 - Standard Specification for Driven Fasteners: Nails, Spikes, and Staples.
- D. Forest Stewardship Council:
 - 1. FSC Guidelines - Forest Stewardship Council Guidelines.
- E. National Fire Protection Association:
 - 1. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials.

- F. The Redwood Inspection Service:
 - 1. RIS - Standard Specifications for Grades of California Redwood Lumber.
- G. Southern Pine Inspection Bureau:
 - 1. SPIB - Standard Grading Rules for Southern Pine Lumber.
- H. Underwriters Laboratories Inc.:
 - 1. UL 723 - Tests for Surface Burning Characteristics of Building Materials.
- I. U.S. Department of Commerce National Institute of Standards and Technology:
 - 1. DOC PS 1 - Construction and Industrial Plywood.
 - 2. DOC PS 2 - Performance Standard for Wood-Based Structural-Use Panels.
 - 3. DOC PS 20 - American Softwood Lumber Standard.
- J. West Coast Lumber Inspection Bureau:
 - 1. WCLIB - Standard Grading Rules for West Coast Lumber.
- K. Western Wood Products Association:
 - 1. WWPA G-5 - Western Lumber Grading Rules.

1.3 SUBMITTALS

- A. Division 01 – General Requirements: Submittal procedures.
- B. Product Data: Submit technical data on wood preservative and fire retardant treatment materials and application instructions.

1.4 QUALITY ASSURANCE

- A. Perform Work in accordance with the following:
 - 1. Lumber Grading Agency: Certified by DOC PS 20.
 - 2. Wood Structural Panel Grading Agency: Certified per IBC 2306.
 - 3. Lumber: DOC PS 20.
 - 4. Wood Structural Panels: DOC PS 1 or DOC PS 2.
- B. Surface Burning Characteristics:
 - 1. Fire Retardant Treated Materials: Maximum 25/450 flame spread/smoke developed index when tested in accordance with ASTM E84.
- C. Apply label from agency approved by authority having jurisdiction to identify each preservative treated and fire retardant treated material.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Plywood: APA/EWA Rated Sheathing, Grade C-D; Exposure Durability 1; sanded.
 - 1. Interior Composite Wood Products: Contain no added urea-formaldehyde resins.

2.2 ACCESSORIES

- A. Fasteners and Anchors:
 - 1. Fasteners: Hot dipped galvanized steel for high humidity and treated wood locations, unfinished steel elsewhere.
 - 2. Nails and Staples: ASTM F1667.
 - 3. Anchors: Toggle bolt type for anchorage to hollow masonry, expansion shield and lag bolt type for anchorage to solid masonry or concrete, or bolt or ballistic fastener for anchorages to steel as required.

2.3 FACTORY WOOD TREATMENT

- A. Wood Preservative (Pressure Treatment): AWPA C1 using water borne preservative with 0.25 percent retainage.
- B. Wood Preservative (Surface Application): Clear.
- C. Fire Retardant Treatment: Pressure treatment, AWPA C20 for lumber and AWPA C27 for plywood, Interior Type, chemically treated and pressure impregnated.
- D. Moisture Content after Treatment: Kiln dried (KDAT).
 - 1. Lumber: Maximum 19 percent.
 - 2. Structural Panels: Maximum 15 percent.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Division 01 – General Requirements: Verification of existing conditions before starting work.
- B. Verify substrate conditions are ready to receive blocking, curbing and framing.

3.2 PREPARATION

- A. Coordinate placement of blocking, curbing and framing items.

3.3 INSTALLATION

- A. Set members level and plumb, in correct position.

- B. Place horizontal members, crown side up.
- C. Construct curb members of solid wood sections.
- D. Space framing and furring 16 inches oc.
- E. Secure sheathing to framing members with ends over firm bearing and staggered.
- F. Install telephone and electrical panel back boards with plywood sheathing material where required. Size back boards 12 inches beyond size of electrical and telephone panel.

3.4 SITE APPLIED WOOD TREATMENT

- A. Apply preservative treatment.
- B. Brush apply two coats of preservative treatment on wood in contact with cementitious materials, roofing and related metal flashings. Treat site-sawn cuts.
- C. Allow preservative to dry prior to erecting members.

3.5 SCHEDULES

- A. Telephone and Electrical Panel Boards: 3/4 inch thick, square edges, site brush applied preservative treated.

END OF SECTION

SECTION 06 20 00

FINISH CARPENTRY

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Finish carpentry items.
 - 2. Wood cabinets.
 - 3. Hardware and attachment accessories.

- B. Related Sections:
 - 1. Section 06 10 53 – Miscellaneous Rough Carpentry: Grounds and support framing.
 - 2. Section 06 61 16 – Solid Surfacing Fabrications: Countertop.
 - 3. Section 09 90 00 - Painting and Coating: Painting and finishing of finish carpentry items.

1.2 REFERENCES

- A. American National Standards Institute:
 - 1. ANSI A156.9 - Cabinet Hardware.

- B. APA-The Engineered Wood Association:
 - 1. APA/EWA PS 1 - Voluntary Product Standard for Construction and Industrial Plywood.

- C. ASTM International:
 - 1. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
 - 2. ASTM F1667 - Standard Specification for Driven Fasteners: Nails, Spikes, and Staples.

- D. Architectural Woodwork Institute:
 - 1. AWI - Quality Standards Illustrated.

- E. American Wood-Preservers' Association:
 - 1. AWPAC1 - All Timber Products - Preservative Treatment by Pressure Process.

- F. Hardwood Plywood and Veneer Association:
 - 1. HPVA HP-1 - American National Standard for Hardwood and Decorative Plywood.

- G. U.S. Department of Commerce National Institute of Standards and Technology:
 - 1. DOC PS 1 - Construction and Industrial Plywood.
 - 2. DOC PS 2 - Performance Standard for Wood-Based Structural-Use Panels.

1.3 SUBMITTALS

- A. Division 01 - Submittal Procedures: Submittal procedures.
- B. Shop Drawings: Indicate materials, component profiles, fastening methods, jointing details, and accessories, to minimum scale of 1-1/2 inch to 1 ft.
- C. Product Data:
 - 1. Submit data on fire retardant treatment materials and application instructions.
 - 2. Submit data on attachment hardware and finish hardware.
- D. Samples:
 - 1. Submit two samples of finish plywood, 8 x 10 inch in size illustrating wood grain and specified finish.
 - 2. Submit two samples of finish hardwood, 8 x 10 inch in size illustrating wood grain and specified finish.
 - 3. Submit two samples of hardware items and shop finishes.
- E. Certification: Submit copy of fabricator's authorization to use AWI Grade Stamps.

1.4 QUALITY ASSURANCE

- A. Perform work in accordance with AWI (Architectural Woodwork Institute) Architectural Woodwork Quality Standards Illustrated, Custom Grade.
- B. Surface Burning Characteristics: Maximum 25/450 flame spread/smoke developed index when tested in accordance with ASTM E84.
- C. Apply label from agency approved by authority having jurisdiction to identify each fire retardant treated material.

1.5 QUALIFICATIONS

- A. Fabricator: Authorized to use AWI Grade Stamps.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect work from moisture damage.

1.7 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

1.8 SEQUENCING

- A. Sequence work to ensure utility connections are achieved in orderly and expeditious manner.

1.9 COORDINATION

- A. Coordinate work with plumbing rough-in, electrical rough-in, and installation of associated and adjacent components.

PART 2 PRODUCTS

2.1 COMPONENTS

- A. Hardwood Lumber: DOC PS 20. AWI Grade II; maximum moisture content of 6-8 percent; and the following:
 - 1. Species of Wood: Oak.
 - 2. Cut or Slicing of Wood: Plain
 - 3. Matching of Individual Leaves to Each Other: Book matching.
- B. Hardwood Plywood: HPVA HP-1 Grade hardwood plywood. AWI Grade A veneer; with lumber core; type of glue recommended for application; and the following:
 - 1. Species of Veneer: Oak.
 - 2. Cut or Slicing of Veneer: Plain.
 - 3. Matching of Individual Leaves to Each Other: Book matching.
 - 4. Matching Across Panel Face: Balanced matching.
 - 5. Matching or Relationship of Panels to Each Other: Pre-manufactured sets, sequence matched uniform size sets, blueprint matched panels and components matching.
- C. Sheet Metal Components: Stainless steel, Type 304 with #4 satin finish.

2.2 ACCESSORIES

- A. Fasteners and Anchors:
 - 1. Fasteners: Electro-galvanized steel for high humidity and treated wood locations, unfinished steel elsewhere.
 - 2. Nails and Staples: ASTM F1667.
- B. Concealed Joint Fasteners: Threaded steel.
- C. Lumber for Shimming and Blocking: Softwood lumber of Pine or Fir species.
- D. Veneer Edge Band: Standard wood veneer edge band matching face veneer.
- E. Primer: Alkyd primer sealer type.
- F. Wood Filler: Oil base, tinted to match surface finish color.
- G. Wood Treatment:
 - 1. Fire Retardant (FR-S Type): Chemically treated and pressure impregnated.
 - 2. Wood Preservative by Pressure Treatment (PT Type): AWPA Treatment C1 using water borne preservative with 0.25 lbs/cu ft retention.

3. Water Repellant Preservative Treatment by Dipping Method: WDMA I.S.4, with 0.25 cubic lbs/in/ft of chromated copper arsenate.
 4. Shop pressure treat or dip treatment to wood materials requiring fire rating preservatives to concealed wood blocking.
 5. Provide identification on fire retardant treated material.
 6. Deliver fire retardant treated materials cut to required sizes. Minimize field cutting.
 7. Moisture Content after Treatment: Redried.
 - a. Lumber: As specified for components in this section.
 - b. Structural Panels: Maximum 15 percent.
- H. Hardware: BHMA A156.9 as follows:
1. Hinges: Style and finish as selected by Owner.
 2. Pulls: Style and finish as selected by Owner.
 3. Latches: Style and finish as selected by Owner.
 4. Shelf Standards: Style and finish as selected by Owner.
 5. Shelf Brackets: Style and finish as selected by Owner.
 6. Drawer Slides: Style and finish as selected by Owner.

2.3 FABRICATION

- A. Fabricate to AWI Custom standards.
- B. Shop assemble work for delivery to site, permitting passage through building openings.
- C. Fit exposed sheet material edges with matching hardwood edging. Use one piece for full length only.
- D. Shop prepare and identify components for book match grain matching during site erection.
- E. When necessary to cut and fit on site, fabricate materials with ample allowance for cutting. Furnish trim for scribing and site cutting.

2.4 SHOP FINISHING

- A. Sand work smooth and set exposed nails and screws.
- B. Apply wood filler in exposed nail and screw indentations.
- C. On items to receive transparent finishes, use wood filler matching surrounding surfaces and of types recommended for applied finishes.
- D. Finish work in accordance with AWI - Section 1500 Factory Finishing; Custom Quality; Stained Transparent Type:
 1. Postcatalyzed Lacquer.
- E. Stain, seal, and varnish exposed to view surfaces.

- F. Seal internal surfaces and semi-concealed surfaces.
- G. Seal surfaces in contact with cementitious materials.

2.5 SOURCE QUALITY CONTROL

- A. Inspect Work performed at fabricator's facility to verify conformance to Contract Documents.
- B. When fabricator is approved by authority having jurisdiction, submit certificate of compliance indicating Work performed at fabricator's facility conforms to Contract Documents.
 - 1. Specified shop inspections are not required for Work performed by approved fabricator.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify adequacy of backing and support framing.
- B. Verify mechanical, electrical, and building items affecting work of this section are placed and ready to receive this work.

3.2 EXISTING WORK

- A. Modify and extend existing finish carpentry installations using materials and methods as specified.

3.3 INSTALLATION

- A. Install work in accordance with AWI Custom quality standard.
- B. Set and secure materials and components in place, plumb and level.
- C. Carefully scribe work abutting other components, with maximum gaps of 1/32 inch. Do not use additional overlay trim to conceal larger gaps.
- D. Install components and trim with nails, screws, bolts with blind fasteners and wall adhesive by gun application.

3.4 ERECTION TOLERANCES

- A. Maximum Variation from Indicated Position: 1/16 inch.
- B. Maximum Offset from Alignment with Abutting Materials: 1/32 inch.

END OF SECTION

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SECTION 06 61 16

SOLID SURFACING FABRICATIONS

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes cast plastic fabrications as scheduled at end of section.
- B. Related Sections:
 - 1. Applicable provisions of Division 01 shall govern all work under this Section.
 - 2. Section 06 10 53 - Miscellaneous Rough Carpentry: Wood blocking and supports for wall cabinets.
 - 3. Section 06 20 00 – Finish Carpentry.
 - 4. Section 07 90 00 - Joint Protection: Perimeter sealant to adjacent construction.
 - 5. Section 22 42 00 - Plumbing Fixtures: Sink, plumbing drains and fixture trim.

1.2 REFERENCES

- A. ASTM International:
 - 1. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

1.3 SUBMITTALS

- A. Division 01 – General Requirements: Submittal procedures.
- B. Shop Drawings: Indicate dimensions, thicknesses, required clearances, tolerances, materials, colors, finishes, fabrication details, field jointing, adjacent construction, methods of support, integration of plumbing components and anchorages.
- C. Samples: Submit two (2) samples representative of counter top, 4 inch x 4 inch in size illustrating color, texture, and finish.

1.4 QUALITY ASSURANCE

- A. Surface Burning Characteristics: Maximum 25/450 flame spread/smoke developed index when tested in accordance with ASTM E84.

1.5 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

1.6 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.
- B. Verify field measurements are as indicated on shop drawings and instructed by manufacturer.

1.7 SEQUENCING

- A. Division 01 – General Requirements: Work sequence.
- B. Sequence Work to permit installation of adjacent affected construction and plumbing rough-in.

1.8 MAINTENANCE

- A. Division 01 – General Requirements: Spare parts and maintenance products.
- B. Furnish two (2) containers of 16 oz of polishing cream.

PART 2 PRODUCTS

2.1 PLASTIC FABRICATIONS

- A. Fabricators:
 - 1. Corian by DuPont.
 - 2. Wilsonart Solid Surfacing.
 - 3. Formica Solid Surfacing.
 - 4. Substitutions: Division 01 – General Requirements.

2.2 COMPONENTS

- A. Resin: Polyester type, with integral coloring, stain resistant to domestic chemicals and cleaners.
- B. Polishing Cream: Compatible polishing cream to achieve specified sheen to gel coat.
- C. Adhesive: Approved by surface manufacturer.

2.3 FABRICATION

- A. Fabricate components by mold to achieve shape and configuration.
- B. Gel coat exposed finish surfaces smooth and polish to low sheen.
- C. Radius corners and edges.
- D. Cure components prior to shipment.

2.4 SHOP FINISHING

- A. Color: Color as selected from standard colors.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Division 01 – General Requirements: Coordination and project conditions.
- B. Verify joint preparation and affected dimensions are acceptable.

3.2 PREPARATION

- A. Provide anchoring devices for installation.
- B. Provide templates and rough-in measurements.

3.3 INSTALLATION

- A. Align work plumb and level.
- B. Rigidly anchor to substrate to prevent misalignment.
- C. Seal to adjacent construction in accordance with Section 07 90 00.

3.4 ERECTION TOLERANCES

- A. Division 01 – General Requirements: Tolerances.
- B. Maximum Variation From Indicated Dimension: 1/8 inch.
- C. Maximum Offset From Indicated Position: 1/8 inch.

3.5 CLEANING

- A. Division 01 – General Requirements: Final cleaning.
- B. Clean and polish fabrication surfaces.

3.6 SCHEDULE

- A. Product Area: Counter.
- B. Product Area: Counter.

C. Breakroom: Counter.

END OF SECTION

SECTION 07 13 00

SHEET WATERPROOFING

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes horizontal sheet membrane waterproofing and protective cover.
- B. Related Sections:
 - 1. Applicable provisions of Division 01 shall govern all work under this Section.
 - 2. Section 03 31 00 – Structural Concrete.
 - 3. Section 07 90 00 - Joint Protection.
 - 4. Section 31 23 15 – Excavation, Backfill and Compaction for Buildings and Structures.

1.2 REFERENCES

- A. ASTM International:
 - 1. ASTM D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers -Tension.
 - 2. ASTM D449 - Standard Specification for Asphalt Used in Dampproofing and Waterproofing.
 - 3. ASTM D624 - Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers.
 - 4. ASTM D2240 - Standard Test Method for Rubber Property-Durometer Hardness.
 - 5. ASTM D4637 - Standard Specification for EPDM Sheet Used in Single-Ply Roof Membrane.
 - 6. ASTM E96 - Standard Test Methods for Water Vapor Transmission of Materials.
- B. National Roofing Contractors Association:
 - 1. NRCA - The NRCA Waterproofing and Dampproofing Manual.

1.3 SUBMITTALS

- A. Division 01 – General Requirements: Submittal procedures.
- B. Shop Drawings: Indicate special joint or termination conditions and conditions of interface with other materials.
- C. Product Data: Submit data for surface conditioner/primer, flexible flashings, joint cover sheet, and joint and crack sealants, with temperature range for application of waterproofing membrane.

- D. Manufacturer's Installation Instructions: Submit special procedures and perimeter conditions requiring special attention.
- E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.
- F. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.4 QUALITY ASSURANCE

- A. Perform Work in accordance with NRCA Waterproofing Manual.
- B. Test material samples in accordance with ASTM D449.

1.5 QUALIFICATIONS

- A. Membrane Manufacturer: Company specializing in waterproofing sheet membranes with minimum five years documented experience.
- B. Applicator: Company specializing in performing work of this section with minimum five years experience.

1.6 ENVIRONMENTAL REQUIREMENTS

- A. Division 01 – General Requirements.
- B. Maintain ambient temperatures above 40 degrees F for 24 hours before and during application and until liquid or mastic accessories have cured.

1.7 WARRANTY

- A. Division 01 – General Requirements: Product warranties and product bonds.
- B. Furnish five year manufacturer warranty for waterproofing failing to resist penetration of water.
- C. For warranty repair work, remove and replace materials concealing waterproofing.

PART 2 PRODUCTS

2.1 SHEET MEMBRANE WATERPROOFING

- A. Manufacturers:
 - 1. Carlisle Waterproofing Systems.
 - 2. Sarnafil.
 - 3. Substitutions: In accordance with Division 01 – General Requirements.

2.2 COMPONENTS

- A. Rubber Membrane: EPDM conforming to ASTM D4637 Type I conforming to ASTM D4637 Type II; 45 mils thick; roll width shall be 2 feet wider than pit opening in every direction; with compatible seam tape and termination bar; conforming to following criteria:
- B. Seaming Materials: As recommended by membrane manufacturer.

2.3 ACCESSORIES

- A. Surface Conditioner/Primer: Type compatible with membrane and recommended by membrane manufacturer.
- B. Adhesives: As recommended by membrane manufacturer.
- C. Thinner and Cleaner: As recommended by adhesive manufacturer, compatible with sheet membrane.
- D. Sealant: As recommended by membrane manufacturer.
- E. Protection Board: 1/4- inch thick biodegradable hardboard.
- F. Flexible Flashings: Match membrane type and thickness..

PART 3 EXECUTION

3.1 EXAMINATION

- A. Division 01 – General Requirements: Coordination and project conditions.
- B. Verify substrate surfaces are durable; free of matter detrimental to adhesion or application of waterproofing system.
- C. Verify items penetrating surfaces to receive waterproofing are securely installed.
- D. Verify substrate surface slopes to drain for horizontal waterproofing applications.

3.2 PREPARATION

- A. Protect adjacent surfaces not designated to receive waterproofing.
- B. Clean and prepare surfaces to receive waterproofing.
- C. Do not apply waterproofing to surfaces unacceptable to manufacturer or applicator.
- D. Seal joints with sealant materials using depth to width ratio as recommended by sealant manufacturer.

- E. Apply surface conditioner/primer at rate recommended by manufacturer. Protect conditioner/primer from rain or frost until dry.

3.3 INSTALLATION - ADHESIVE BONDED MEMBRANE WATERPROOFING

- A. Roll out membrane. Minimize wrinkles and bubbles.
- B. Apply adhesive at rates required by membrane manufacturer. Bond sheet to substrate except those areas directly over or within 3 inches of control or expansion joint.
- C. Lap sides and ends.
- D. Overlap edges and ends and seal with contact adhesive, minimum 3 inches. Seal permanently waterproof. Apply uniform bead of sealant to joint edge.
- E. Reinforce membrane with multiple thickness of membrane material over joints, whether joints are static or dynamic.
- F. Install flexible flashings. Seal watertight to membrane.
- G. Seal membrane and flashings to adjoining surfaces.
- H. Seal items protruding to or penetrating through membrane and install Counterflashing membrane material.

3.4 INSTALLATION - PROTECTION BOARD

- A. Place protection board directly against membrane; butt joints.
- B. Adhere protection board to substrate with mastic. Scribe and cut boards around projections, penetrations, and interruptions.

3.5 FIELD QUALITY CONTROL

- A. Division 01 – General Requirements: Field inspecting, testing, adjusting, and balancing.

3.6 PROTECTION OF INSTALLED CONSTRUCTION

- A. Do not permit traffic over unprotected or uncovered membrane.
- B. Protect membrane from damage by adhering protection board, applied with mastic over membrane surface. Scribe and cut boards around projections and interruptions.

END OF SECTION

SECTION 07 14 00

FLUID-APPLIED WATERPROOFING

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes fluid applied elastomeric membrane waterproofing.
- B. Related Sections:
 - 1. Applicable provisions of Division 01 shall govern all work under this Section.
 - 2. Section 03 31 00 – Structural Concrete.
 - 3. Section 31 23 15 – Excavation, Backfill and Compaction for Buildings and Structures.

1.2 REFERENCES

- A. ASTM International:
 - 1. ASTM C836 - Standard Specification for High Solids Content, Cold Liquid-Applied Elastomeric Waterproofing Membrane for Use with Separate Wearing Course.
 - 2. ASTM D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers -Tension.
 - 3. ASTM D624 - Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers.
 - 4. ASTM D746 – Standard Test Method for Brittleness Temperature of Plastics and Elastomers by Impact.
 - 5. ASTM D903 – Standard Test Method for Peel or Stripping Strength of Adhesive Bonds.
 - 6. ASTM D2240 - Standard Test Method for Rubber Property-Durometer Hardness.
 - 7. ASTM E96 - Standard Test Methods for Water Vapor Transmission of Materials.

1.3 SUBMITTALS

- A. Division 01 – General Requirements: Submittal procedures.
- B. Shop Drawings: Indicate special joint or termination conditions and conditions of interface with other materials.
- C. Product Data: Submit data for surface conditioner, flexible flashings, joint cover sheet, and joint and crack sealants, with temperature range for application of waterproofing membrane.
- D. Manufacturer's Installation Instructions: Submit special procedures and perimeter conditions requiring special attention.
- E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

- F. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.4 QUALITY ASSURANCE

- A. Perform Work in accordance with NRCA Waterproofing Manual.

1.5 QUALIFICATIONS

- A. Waterproofing Material Manufacturer: Company specializing in waterproofing membrane with minimum five years documented experience.
- B. Applicator: Company specializing in performing the work of this section with minimum five years experience.

1.6 MOCKUP

- A. Division 01 – General Requirements: Requirements for mockup.
- B. Construct Mockup, 100 sq ft of horizontal and vertical waterproofed panel; to represent finished work including internal and external corners, jointing, attachment method, flashings, drainage panel, base flashings, control and expansion joints, protective cover.
- C. Locate where directed by Architect/Engineer.
- D. Incorporate accepted mockup as part of Work.

1.7 PRE-INSTALLATION MEETINGS

- A. Division 01 – General Requirements: Pre-installation meeting.
- B. Convene minimum one week prior to commencing work of this section.

1.8 ENVIRONMENTAL REQUIREMENTS

- A. Division 01 – General Requirements.
- B. Maintain ambient temperatures above 40 degrees F for 24 hours before and during application and until liquid or mastic accessories have cured.

1.9 WARRANTY

- A. Division 01 – General Requirements: Product warranties and product bonds.
- B. Furnish five year manufacturer warranty for waterproofing failing to resist penetration of water.

- C. For warranty repair work, remove and replace materials concealing waterproofing.

PART 2 PRODUCTS

2.1 FLUID APPLIED WATERPROOFING

- A. Manufacturers:
 - 1. Carlisle Coatings & Waterproofing, Model 525
 - 2. Other Approved:
 - a. American Hydrotech, Inc.
 - b. Tremco Sealants & Waterproofing.
 - 3. Substitutions: In accordance with Division 01 – General Requirements.

2.2 COMPONENTS

- A. Waterproofing Membrane: ASTM C836; one component elastomeric compound.
- B. Cured Membrane Characteristics:

Properties	Test	Results
Tensile Strength - Horizontal	ASTM D412	250 psi
Tensile Strength - Vertical	ASTM D412	400 psi
Elongation - Horizontal	ASTM D412	575%
Elongation - Vertical	ASTM D412	600%
Hardness - Shore A	ASTM D2240	30 Shore A (minimum)
Moisture Vapor (perms) - Horizontal	ASTM E96	0.07384 perms
Moisture Vapor (perms) - Vertical	ASTM E96	0.07176 perms
Adhesion - Horizontal	ASTM D903	14.9 lbs/in
Adhesion - Vertical	ASTM D903	19.0 lbs/in

2.3 ACCESSORIES

- A. Surface Conditioner or Primer: Type compatible with membrane compound; as recommended by membrane manufacturer.
- B. Elastic Flashings: As recommended by membrane manufacturer.
- C. Joint Cover Sheet: Elastic sheet material designated for and compatible with membrane.
- D. Joint and Crack Sealant: CCW 201 Two component polyurethane sealant, as recommended by membrane manufacturer.

- E. Back-up Material: Closed cell polyethylene foam road as recommended by membrane manufacturer.
- F. Protection Board: 1/8 inch thick asphalt-impregnated organic mat; manufactured by Carlisle.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Division 01 – General Requirements: Coordination and project conditions.
- B. Verify substrate surfaces are free of frozen matter, dampness, loose particles, cracks, pits, projections, penetrations, or foreign matter detrimental to adhesion or application of waterproofing system.
- C. Verify substrate surfaces are smooth, free of honeycomb or pitting, and not detrimental to full contact bond of waterproofing materials.
- D. Verify items penetrating surfaces to receive waterproofing are securely installed.
- E. Verify substrate surface slopes to drain for horizontal waterproofing applications.
- F. Concrete shall be water cured, followed by light hair broom trowel finish or cured for 14 days minimum, 28 days preferred.

3.2 PREPARATION

- A. Protect adjacent surfaces not designated to receive waterproofing.
- B. Clean and prepare surfaces to receive waterproofing.
- C. Do not apply waterproofing to surfaces unacceptable to manufacturer or applicator.
- D. Seal cracks and joints with sealant materials using depth to width ratio as recommended by sealant manufacturer.

3.3 INSTALLATION

- A. Apply surface conditioner at rate recommended by manufacturer. Protect conditioner/primer from rain or frost until dry.
- B. Apply 12 inch wide strip of joint cover sheet over cracks, non-working joints, and expansion joints over 1/16 inch but not exceeding 1/2 inch in width.
- C. At expansion joints from 1/2 to 1 inch in width, loop cover sheet down into joint between 1-1/4 and 1-3/4 inch. Extend sheet 6 inches on both sides of expansion joint.

- D. Center cover sheet over crack or joints. Roll sheet into 1/8 inch coating of waterproofing material. Apply second coat over sheet extending minimum of 6 inches beyond sheet edges. Apply this procedure to expansion joints between horizontal and vertical surfaces.
- E. Apply waterproofing material.
- F. Apply and spread waterproofing material to minimum cured thickness recommended by Manufacturer to achieve warranty requirements.
- G. Extend membrane over cants and up intersecting surfaces at membrane perimeter minimum 12 inches above horizontal surface for first ply and 18 inches at subsequent plies laid in shingle fashion.
- H. Install cant strips at inside corners.
- I. Apply extra thickness of waterproofing material at corners, intersections, angles, and over all joints.
- J. Seal items protruding to or penetrating through membrane and install Counterflashing membrane material.
- K. Extend waterproofing material and flexible flashing into drain clamp flange, apply adequate coating of liquid membrane to assure clamp ring seal. Coordinate with drain installation, Section 07 90 00 – Joint Protection.
- L. Install membrane flashings and seal into waterproofing material.
- M. Place protection board directly against membrane; butt joints.
- N. Adhere protection board to substrate as recommended by manufacturer. Scribe and cut boards around projections, penetrations, and interruptions.

3.4 FIELD QUALITY CONTROL

- A. Division 01 – General Requirements: Field inspecting, testing, adjusting, and balancing.
- B. On completion of membrane installation, dam installation area as directed by Architect/Engineer, in preparation for flood testing.
- C. After membrane has cured 36 to 72 hours, flood to minimum depth of 1 inch with clean water. After 48 hours, verify no leaks with Architect/Engineer
- D. When leaking is found, remove water, patch leaking areas with new waterproofing materials as directed by Architect/Engineer; repeat flood test. Repair damage to building.
- E. When area is proven watertight, drain water and remove dam.

3.5 PROTECTION OF INSTALLED CONSTRUCTION

- A. Division 01 – General Requirements: Protecting installed construction.
- B. Do not permit traffic over unprotected or uncovered membrane.

END OF SECTION

SECTION 07 21 13

BOARD INSULATION

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes rigid and semi-rigid board insulation and integral vapor retarder at perimeter foundation wall and underside of floor slabs.
- B. Related Sections:
 - 1. Applicable provisions of Division 01 shall govern all work under this Section.

1.2 REFERENCES

- A. ASTM International:
 - 1. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation.
 - 2. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
 - 3. ASTM C1289 - Standard Specification for Faced Rigid Cellular Thermal Insulation Board.
 - 4. ASTM D2842 - Standard Test Method for Water Absorption of Rigid Cellular Plastics.
 - 5. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- B. Green Seal:
 - 1. GS-36 - Aerosol Adhesives.
- C. National Fire Protection Association:
 - 1. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials.
- D. South Coast Air Quality Management District:
 - 1. SCAQMD Rule 1168 - Adhesive and Sealant Applications.
- E. Underwriters Laboratories Inc.:
 - 1. UL 723 - Tests for Surface Burning Characteristics of Building Materials.

1.3 SUBMITTALS

- A. Division 01 – General Requirements: Submittal procedures.
- B. Product Data: Submit data on product characteristics, performance criteria, limitations, and adhesives.

- C. Manufacturer's Installation Instructions: Submit special environmental conditions required for installation and installation techniques.

1.4 QUALITY ASSURANCE

- A. Insulation Installed in Concealed Locations Surface Burning Characteristics:
 - 1. Foam Plastic Insulation: Maximum 75/450 flame spread/smoke developed index when tested in accordance with ASTM E84.
 - 2. Other Insulation: Maximum 25/450 flame spread/smoke developed index when tested in accordance with ASTM E84.
- B. Insulation Installed in Exposed Locations Surface Burning Characteristics: Maximum 25/450 flame spread/smoke developed index when tested in accordance with ASTM E84.
- C. Apply label from agency approved by authority having jurisdiction to identify each foam plastic insulation board.

1.5 SEQUENCING

- A. Division 01 – General Requirements: Work sequence.
- B. Sequence Work to ensure fireproofing and firestopping materials are in place before beginning Work of this section.

1.6 COORDINATION

- A. Division 01 – General Requirements: Coordination and project conditions.

PART 2 PRODUCTS

2.1 BOARD INSULATION

- A. Manufacturers:
 - 1. DiversiFoam Products - Extruded-Polystyrene Insulation.
 - 2. Dow Chemical - Extruded-Polystyrene Insulation, Model Styrofoam SE.
 - 3. Tenneco Foam Products - Extruded-Polystyrene Insulation.
 - 4. UC Industries/Owens Corning - Extruded-Polystyrene Insulation.
 - 5. Substitutions: In accordance with Division 01 – General Requirements.

2.2 COMPONENTS

- A. Extruded Polystyrene Insulation: ASTM C578 Type VI; cellular type, conforming to the following:
 - 1. Board Density: 1.8 lb/cu ft.
 - 2. Board Thickness: 2 inches.
 - 3. Thermal Resistance: R of 5.0.

4. Water Absorption: In accordance with ASTM D2842 0.3 percent by volume maximum.
5. Compressive Strength: Minimum 40 psi.
6. Board Edges: Square edges.

2.3 ACCESSORIES

- A. Adhesive: Type recommended by insulation manufacturer for application.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Division 01 – General Requirements: Coordination and project conditions.
- B. Verify substrate, adjacent materials, and insulation boards are dry and ready to receive insulation and adhesive.
- C. Verify substrate surface is flat, free of honeycomb, fins, irregularities, materials or substances affecting adhesive bond.

3.2 INSTALLATION - FOUNDATION PERIMETER

- A. Apply adhesive in three (3) continuous beads per board length.
- B. Install boards on foundation wall, grade beam perimeter, as shown on Drawings.
 1. Place boards in method to maximize contact bedding.
 2. Stagger side and end joints.
 3. Butt edges and ends tight to adjacent board and to protrusions.
- C. Extend boards over control and expansion joints, unbonded to foundation six (6) inches on one side of joint.
- D. Cut and fit insulation tight to protrusions or interruptions to insulation plane.

3.3 INSTALLATION - UNDER CONCRETE SLABS

- A. Place insulation under slabs on grade after base for slab has been compacted.
- B. Cut and fit insulation tight to protrusions or interruptions to insulation plane.
- C. Prevent insulation from being displaced or damaged while placing vapor retarder and placing slab.

3.4 PROTECTION OF INSTALLED CONSTRUCTION

- A. Division 01 – General Requirements: Protecting installed construction.

- B. Do not permit damage to insulation prior to covering.

END OF SECTION

SECTION 07 84 00

FIRESTOPPING

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes firestopping and through-penetration protection system materials and accessories; firestopping tops of fire rated walls; and smoke sealing at joints between floor slabs and exterior walls.
- B. Related Sections:
 - 1. Applicable provisions of Division 01 shall govern all work under this Section.
 - 2. Section 04 05 03 - Masonry Mortaring and Grouting: Mortar used for firestopping.
 - 3. Section 21 05 00 – Basic Fire Suppression Materials and Methods: Fire protection work requiring firestopping.
 - 4. Section 22 05 00 – Basic Plumbing Materials and Methods: Plumbing work requiring firestopping.
 - 5. Section 23 05 00 – Basic HVAC Requirements: HVAC work requiring firestopping.
 - 6. Section 23 07 00 – HVAC Insulation.
 - 7. Section 23 33 00 – Air Duct Accessories.
 - 8. Section 26 00 00 – Basic Electrical Requirements: Electrical work requiring firestopping.

1.2 REFERENCES

- A. ASTM International:
 - 1. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
 - 2. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.
 - 3. ASTM E814 - Standard Test Method for Fire Tests of Through-Penetration Fire Stops.
 - 4. ASTM E1966 - Standard Test Method for Fire-Resistive Joint Systems.
- B. Forest Stewardship Council:
 - 1. FSC Guidelines - Forest Stewardship Council Guidelines.
- C. Intertek Testing Services (Warnock Hersey Listed):
 - 1. WH - Certification Listings.
- D. National Fire Protection Association:
 - 1. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials.

- E. South Coast Air Quality Management District:
 - 1. SCAQMD Rule 1168 - Adhesive and Sealant Applications.
- F. Underwriters Laboratories Inc.:
 - 1. UL 263 - Fire Tests of Building Construction and Materials.
 - 2. UL 723 - Tests for Surface Burning Characteristics of Building Materials.
 - 3. UL 1479 - Fire Tests of Through-Penetration Firestops.
 - 4. UL 2079 - Tests for Fire Resistance of Building Joint Systems.
 - 5. UL - Fire Resistance Directory.

1.3 DEFINITIONS

- A. Firestopping (Through-Penetration Protection System): Sealing or stuffing material or assembly placed in spaces between and penetrations through building materials to arrest movement of fire, smoke, heat, and hot gases through fire rated construction.

1.4 PERFORMANCE REQUIREMENTS

- A. Conform to applicable code for fire resistance ratings and surface burning characteristics.
- B. Provide certificate of compliance from authority having jurisdiction indicating approval of materials used.

1.5 SUBMITTALS

- A. Division 01 – General Requirements: Submittal procedures.
- B. Product Data: Submit data on product characteristics, performance and limitation criteria.
- C. Schedule: Submit schedule of opening locations and sizes, penetrating items, and required listed design numbers to seal openings to maintain fire resistance rating of adjacent assembly.
- D. Manufacturer's Installation Instructions: Submit preparation and installation instructions.
- E. Manufacturer's Certificate: Certify products meet or exceed applicable code requirements.
- F. Engineering Judgements: For conditions not covered by UL or WH listed designs, submit judgements by licensed professional engineer suitable for presentation to authority having jurisdiction for acceptance as meeting code fire protection requirements.

1.6 QUALITY ASSURANCE

- A. Through Penetration Firestopping of Fire Rated Assemblies: UL 1479 or ASTM E814 with 0.10 inch water gage minimum positive pressure differential to achieve fire F-Ratings and temperature T-Ratings as indicated on Drawings, but not less than 1-hour.
 - 1. Wall Penetrations: Fire F-Ratings as indicated on Drawings, but not less than 1-hour.

2. Floor and Roof Penetrations: Fire F-Ratings and temperature T-Ratings as indicated on Drawings, but not less than 1-hour.
 - a. Floor Penetrations Within Wall Cavities: T-Rating is not required.
- B. Through Penetration Firestopping of Non-Fire Rated Floor and Roof Assemblies: Materials to resist free passage of flame and products of combustion.
 1. Noncombustible Penetrating Items: Noncombustible materials for penetrating items connecting maximum of three stories.
 2. Penetrating Items: Materials approved by authorities having jurisdiction for penetrating items connecting maximum of two stories.
- C. Fire Resistant Joints in Fire Rated Floor, Roof, and Wall Assemblies: ASTM E1966 or UL 2079 to achieve fire resistant rating as indicated on Drawings for assembly in which joint is installed.
- D. Fire Resistant Joints Between Floor Slabs and Exterior Walls: ASTM E119 with 0.10 inch water gage minimum positive pressure differential to achieve fire resistant rating as indicated on Drawings for floor assembly.
- E. Surface Burning Characteristics: Maximum 25/450 flame spread/smoke developed index when tested in accordance with ASTM E84.

1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.
- B. Applicator: Company specializing in performing Work of this section with minimum three years documented experience, and approved by manufacturer.

1.8 ENVIRONMENTAL REQUIREMENTS

- A. Division 01 – General Requirements.
- B. Do not apply materials when temperature of substrate material and ambient air is below 60 degrees F.
- C. Maintain this minimum temperature before, during, and for minimum 3 days after installation of materials.

PART 2 PRODUCTS

2.1 FIRESTOPPING

- A. Manufacturers:
 1. Hilti Corp.

2. 3M Fire Protection Products.
 3. Tremco.
 4. Substitutions: In accordance with Division 01 – General Requirements.
- B. Product Description: Different types of products by multiple manufacturers are acceptable as required to meet specified system description and performance requirements; provide only one type for each similar application.
1. Silicone Firestopping Elastomeric Firestopping: Single component silicone elastomeric compound and compatible silicone sealant.
 - a. Interior Sealants and Sealant Primers: Maximum volatile organic compound content in accordance with SCAQMD Rule 1168.
 2. Foam Firestopping Compounds: Single component foam compound.
 3. Formulated Firestopping Compound of Incombustible Fibers: Formulated compound mixed with incombustible non-asbestos fibers.
 4. Fiber Stuffing and Sealant Firestopping: Composite of mineral fiber stuffing insulation with silicone elastomer for smoke stopping.
 5. Mechanical Firestopping Device with Fillers: Mechanical device with incombustible fillers and silicone elastomer, covered with sheet stainless steel jacket, joined with collars, penetration sealed with flanged stops.
 6. Intumescent Firestopping: Intumescent putty compound which expands on exposure to surface heat gain.
 7. Firestop Pillows: Formed mineral fiber pillows.
 8. Mortar as specified in Section 04 05 03 where permitted by applicable code.
- C. Color: As selected from manufacturer’s full range of colors.

2.2 ACCESSORIES

- A. Primer: Type recommended by firestopping manufacturer for specific substrate surfaces and suitable for required fire ratings.
- B. Dam Material: Permanent:
1. Mineral fiberboard.
 2. Mineral fiber matting.
 3. Sheet metal.
- C. Installation Accessories: Provide clips, collars, fasteners, temporary stops or dams, and other devices required to position and retain materials in place.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Division 01 – General Requirements: Coordination and project conditions.

- B. Verify openings are ready to receive firestopping.

3.2 PREPARATION

- A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter affecting bond of firestopping material.
- B. Remove incompatible materials affecting bond.
- C. Install backing and damming materials to arrest liquid material leakage.

3.3 APPLICATION

- A. Install material at fire rated construction perimeters and openings containing penetrating sleeves, piping, ductwork, conduit and other items, requiring firestopping.
- B. Apply primer where recommended by manufacturer for type of firestopping material and substrate involved, and as required for compliance with required fire ratings.
- C. Apply firestopping material in sufficient thickness to achieve required fire and smoke rating.
- D. Compress fibered material to maximum 40 percent of its uncompressed size.
- E. Place foamed material in layers to ensure homogenous density, filling cavities and spaces. Place sealant to completely seal junctions with adjacent dissimilar materials.
- F. Place intumescent coating in sufficient coats to achieve rating required.
- G. Dam material to remain.

3.4 FIELD QUALITY CONTROL

- A. Division 01 – General Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Inspect installed firestopping for compliance with specifications and submitted schedule.

3.5 CLEANING

- A. Division 01 – General Requirements: Final cleaning.
- B. Clean adjacent surfaces of firestopping materials.

3.6 PROTECTION OF INSTALLED CONSTRUCTION

- A. Division 01 – General Requirements: Protecting installed construction.

- B. Protect adjacent surfaces from damage by material installation.

END OF SECTION

SECTION 07 90 00

JOINT PROTECTION

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes;
 - 1. Sealants and joint backing.
 - 2. Precompressed foam sealers.
 - 3. Hollow gaskets.
 - 4. Accessories.

- B. Related Sections:
 - 1. Applicable provisions of Division 01 shall govern all work under this Section.
 - 2. Section 07 84 00 - Firestopping: Firestopping sealants.
 - 3. Section 08 80 00 - Glazing: Glazing sealants and accessories.
 - 4. Section 09 21 16 - Gypsum Board Assemblies: Acoustic sealant.
 - 5. Section 13 34 19 – Metal Building Systems: Roofing and siding.

1.2 REFERENCES

- A. ASTM International:
 - 1. ASTM C834 - Standard Specification for Latex Sealants.
 - 2. ASTM C919 - Standard Practice for Use of Sealants in Acoustical Applications.
 - 3. ASTM C920 - Standard Specification for Elastomeric Joint Sealants.
 - 4. ASTM C1193 - Standard Guide for Use of Joint Sealants.
 - 5. ASTM D1056 - Standard Specification for Flexible Cellular Materials-Sponge or Expanded Rubber.
 - 6. ASTM D1667 - Standard Specification for Flexible Cellular Materials-Vinyl Chloride Polymers and Copolymers (Closed-Cell Foam).
 - 7. ASTM D2628 - Standard Specification for Preformed Polychloroprene Elastomeric Joint Seals for Concrete Pavements.

1.3 SUBMITTALS

- A. Division 01 – General Requirements: Submittal procedures.

- B. Products Data: Submit data indicating sealant chemical characteristics, performance criteria, substrate preparation, limitations, and color availability.

- C. Manufacturer's Installation Instructions: Submit special procedures, surface preparation, and perimeter conditions requiring special attention.

- D. Warranty: Include coverage for installed sealants and accessories failing to achieve watertight seal, exhibit loss of adhesion or cohesion, and sealants which do not cure.

1.4 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum five years experience.
- B. Applicator: Company specializing in performing Work of this section with minimum five years documented experience, and approved by manufacturer.

1.5 MOCKUP

- A. Division 01 – General Requirements: Requirements for mockup.
- B. Construct mockup of sealant joints in conjunction with window and metal wall and roof mockups specified in other sections
- C. Construct mockup with specified sealant types and with other components noted.
 - 1. Determine preparation and priming requirements based on manufacturers recommendations; take action necessary for correction of failure of sealant tests on mock-up.
 - 2. Verify sealants, primers, and other components do not stain adjacent materials.
- D. Locate where directed by Architect/Engineer.
- E. Incorporate accepted mockup as part of Work.

1.6 ENVIRONMENTAL REQUIREMENTS

- A. Division 01 – General Requirements.
- B. Maintain temperature and humidity recommended by sealant manufacturer during and after installation.

1.7 COORDINATION

- A. Division 01 – General Requirements.
- B. Coordinate Work with sections referencing this section.

PART 2 PRODUCTS

2.1 JOINT SEALERS

- A. Manufacturers:
 - 1. Dow Corning Corp.

2. Sika Corp.
3. Tremco Sealants & Waterproofing.
4. BASF.
5. Sonneborn.
6. Substitutions: In accordance with Division 01 – General Requirements.

B. Products Description:

1. (Type 1) - High Performance General Purpose Exterior (Nontraffic) Sealant: Polysulfide; ASTM C920, Grade NS, Class 25, Uses M, G, and A; multi-component.
 - a. Type: Sonolastic Polysulfide Sealant manufactured by Sonneborn.
 - b. Color: Standard colors matching finished surfaces.
 - c. Applications: Use for:
 - 1) Control, expansion, and soft joints in masonry.
 - 2) Joints between concrete and other materials.
 - 3) Joints between metal frames and other materials.
 - 4) Other exterior nontraffic joints for which no other sealant is indicated.
2. (Type 2) - General Purpose Traffic Bearing Sealant: Polyurethane; ASTM C920, Grade P, Class 25, Use T; multi-component.
 - a. Type: Sonolastic SL2 manufactured by Sonneborn.
 - b. Color: Standard colors matching finished surfaces.
 - c. Applications: Use for exterior and interior pedestrian and vehicular traffic bearing joints.
3. (Type 3) - Exterior Foam Expansion Joint Sealer: Precompressed foam sealer; Polyurethane with water-repellent; products recommended by manufacturer for traffic-bearing use.
 - a. Type: Illmod 600 manufactured by Tremco.
 - b. Color: Black color.
 - c. Size: As required to provide weathertight seal when installed.
 - d. Applications: Use for exterior wall expansion joints.
4. (Type 4) - Bathtub/Tile Sealant: White silicone; ASTM C920, Uses M and A; single component, mildew resistant.
 - a. Type: Tub, Tile and Ceramic Silicone Sealant manufactured by Dow Corning, Inc.
 - b. Applications: Use for joints between plumbing fixtures and floor and wall surfaces, and joints between break room, and toilet room counter tops and wall surfaces.
 - c. Comply with FS-TT-S0021543, Class A.

2.2 ACCESSORIES

- A. Primer: Non-staining type, recommended by sealant manufacturer to suit application.

- B. Joint Cleaner: Non-corrosive and non-staining type, recommended by sealant manufacturer; compatible with joint forming materials.
- C. Joint Backing: Round foam rod compatible with sealant; ASTM D1056, sponge or expanded rubber; oversized 30 to 50 percent larger than joint width.
 - 1. Type: Expand-O-Foam 1380 manufactured by Williams Everlastic.
- D. Bond Breaker: Pressure sensitive tape recommended by sealant manufacturer to suit application.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Division 01 – General Requirements: Coordination and project conditions.
- B. Verify substrate surfaces and joint openings are ready to receive work.
- C. Verify joint backing and release tapes are compatible with sealant.

3.2 PREPARATION

- A. Remove loose materials and foreign matter impairing adhesion of sealant.
- B. Clean and prime joints.
- C. Perform preparation in accordance with ASTM C1193.
- D. Protect elements surrounding Work of this section from damage or disfiguration.

3.3 INSTALLATION

- A. Perform installation in accordance with ASTM C1193.
- B. Measure joint dimensions and size joint backers to achieve width-to-depth ratio, neck dimension, and surface bond area as recommended by manufacturer, except where specific dimensions are indicated.
- C. Install bond breaker where joint backing is not used.
- D. Install sealant free of air pockets, foreign embedded matter, ridges, and sags.
- E. Apply sealant within recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.
- F. Tool joints concave.

- G. Precompressed Foam Sealant: Do not stretch; avoid joints except at corners, ends, and intersections; install with face 1/8 to 1/4 inch below adjoining surface.
- H. Compression Gaskets: Avoid joints except at ends, corners, and intersections; seal joints with adhesive; install with face 1/8 to 1/4 inch below adjoining surface.

3.4 CLEANING

- A. Division 01 – General Requirements: Final cleaning.
- B. Clean adjacent soiled surfaces.

3.5 PROTECTION OF INSTALLED CONSTRUCTION

- A. Division 01 – General Requirements: Protecting installed construction.
- B. Protect sealants until cured.

3.6 SCHEDULE

- A. Exterior Joints for Which No Other Sealant Type is Indicated: Type 1.
- B. Control and Expansion Joints in Paving: Type 2.
- C. Exterior Wall Expansion Joints: Type 3.
- D. Joints Between Concrete Panels and Between Panels and Adjacent Work: Type 3.
- A. Lap Joints in Exterior Sheet Metal Work: Type as required by Metal Building System manufacturer.
- B. Butt Joints in Exterior Metal Work and Siding: Type as required by Metal Building System manufacturer.
- C. Control and Expansion Joints in Interior Concrete Slabs and Floors: Type 2.
- D. Joints Between Plumbing Fixtures and Walls and Floors, and Between Counter tops and Walls: Type 4.

END OF SECTION

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SECTION 08 12 14
STANDARD STEEL FRAMES

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes fire rated and non-rated steel frames.
 - 1. Provide frames for interior glazed lights.
- B. Related Sections:
 - 1. Applicable provisions of Division 01 shall govern all work under this Section.
 - 2. Section 03 31 00 - Structural Concrete: Placement of anchors into masonry wall construction.
 - 3. Section 04 20 13 – Single Wythe Unit Masonry: Masonry grout fill of metal frames and placement of anchors into masonry wall construction.
 - 4. Section 08 13 14 - Standard Steel Doors.
 - 5. Section 08 71 00 - Door Hardware: Hardware, silencers, and weatherstripping.
 - 6. Section 08 80 00 - Glazing.

1.2 REFERENCES

- A. American National Standards Institute:
 - 1. ANSI A250.8 - Recommended Specifications for Standard Steel Doors and Frames.
- B. ASTM International:
 - 1. ASTM A653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- C. National Fire Protection Association:
 - 1. NFPA 80 - Standard for Fire Doors, Fire Windows.
 - 2. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies.
- D. Underwriters Laboratories Inc.:
 - 1. UL 10B - Fire Tests of Door Assemblies.
 - 2. UL 10C - Positive Pressure Fire Tests of Door Assemblies.
 - 3. UL 1784 - Air Leakage Tests of Door Assemblies.

1.3 SUBMITTALS

- A. Division 01 – General Requirements: Submittal procedures.
- B. Shop Drawings: Indicate frame elevations, reinforcement, anchor types and spacing, location of cut-outs for hardware, and finish.

- C. Product Data: Submit frame configuration and finishes.
- D. Manufacturer's Installation Instructions: Submit special installation instructions.

1.4 QUALITY ASSURANCE

- A. Conform to requirements of ANSI A250.8.
- B. Fire Rated Frame Construction: Conform to NFPA 252.
- C. Installed Fire Rated Frame Assembly: Conform to NFPA 80 for fire rated class same as fire door.
- D. Attach label from agency approved by authority having jurisdiction to identify each fire rated door frame.
 - 1. Attach smoke label to smoke and draft control door frames.

1.5 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Division 01 – General Requirements: Product storage and handling requirements.
- B. Accept frames on site in manufacturer's packaging. Inspect for damage.
- C. Break seal on-site to permit ventilation.

1.7 COORDINATION

- A. Division 01 – General Requirements: Coordination and project conditions.
- B. Coordinate Work with frame opening construction, door, and hardware installation.
- C. Sequence installation to accommodate required door hardware electric wire connections.

PART 2 PRODUCTS

2.1 STANDARD STEEL FRAMES

- A. Manufacturers:
 - 1. Ceco Door Products.
 - 2. Kewanee Corp.
 - 3. Republic Builders Products.
 - 4. Steelcraft.

5. Substitutions: In accordance with Division 01 – General Requirements.
- B. Product Description: Standard shop fabricated steel frames, fire rated and non-rated types.
 1. Exterior Frames:
 - a. Level 2 for Door Models 2, nominal 16 gage/0.053 inch thick material, base metal thickness.
 2. Interior Frames:
 - a. Level 2 for Door Models 2, nominal 16 gage/0.053 inch thick material, base metal thickness.

2.2 ACCESSORIES

- A. Removable Stops: Rolled steel channel shape, mitered corners; prepared for countersink style tamper proof screws.
- B. Bituminous Coating: Non-asbestos fibered asphalt emulsion.
- C. Primer: ANSI A250.10 rust inhibitive type.
- D. Silencers: Specified in Section 08 71 00.
- E. Weatherstripping: Specified in Section 08 71 00.

2.3 FABRICATION

- A. Fabricate frames for knock down field assembly.
- B. Mullions for Double Doors: Removable type, of same profiles as jambs.
- C. Transom Bars for Glazed Lights: Fixed type, of same profiles as jamb and head.
- D. Fabricate frames with hardware reinforcement plates welded in place. Provide mortar guard boxes.
- E. Reinforce frames wider than 48 inches with roll formed steel channels fitted tightly into frame head, flush with top.
- F. Prepare frames for silencers. Provide three single silencers for single doors and mullions of double doors on strike side. Provide two single silencers on frame head at double doors without mullions.
- G. Attach fire rated label to each fire rated frame.
- H. Fabricate frames to suit masonry wall coursing with 4 inch head member.

2.4 SHOP FINISHING

- A. Steel Sheet: Galvanized to ASTM A653 A60.
- B. Primer: Baked.
- C. Factory Finish: Baked enamel, color as selected.
- D. Coat inside of frame profile with bituminous coating to minimum thickness of 1/16 inch.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Division 01 – General Requirements: Coordination and project conditions.
- B. Verify opening sizes and tolerances are acceptable.

3.2 INSTALLATION

- A. Install frames in accordance with ANSI A250.8.
- B. Coordinate with masonry wall construction for anchor placement.
- C. Coordinate installation of glass and glazing specified in Section 08 80 00.
- D. Coordinate installation of frames with installation of hardware specified in Section 08 71 00 and doors in Section 08 13 14.
- E. Install roll formed steel reinforcement channels between two abutting frames. Anchor to structure and floor.

3.3 ERECTION TOLERANCES

- A. Division 01 – General Requirements: Tolerances.
- B. Maximum Diagonal Distortion: 1/16 inch measured with straight edges, crossed corner to corner.

END OF SECTION

SECTION 08 13 14
STANDARD STEEL DOORS

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes non-rated and fire rated steel doors and panels and door louvers.
- B. Related Sections:
 - 1. Applicable provisions of Division 01 shall govern all work under this Section.
 - 2. Section 08 12 14 - Standard Steel Frames.
 - 3. Section 08 71 00 - Door Hardware.
 - 4. Section 08 80 00 - Glazing: Glass for doors.
 - 5. Section 09 90 00 - Painting and Coating: Field painting of doors.
 - 6. Section 23 37 13 – Diffusers, Registers, and Grilles: Door grilles.

1.2 REFERENCES

- A. American National Standards Institute:
 - 1. ANSI A250.8 - Recommended Specifications for Standard Steel Doors and Frames.
- B. ASTM International:
 - 1. ASTM A653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - 2. ASTM C1363 - Standard Test Method for the Thermal Performance of Building Assemblies by Means of a Hot Box Apparatus.
 - 3. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- C. National Fire Protection Association:
 - 1. NFPA 80 - Standard for Fire Doors, Fire Windows.
 - 2. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies.
 - 3. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials.
- D. Steel Door Institute:
 - 1. SDI 108 - Recommended Selection and Usage Guide for Standard Steel Doors.
- E. Underwriters Laboratories Inc.:
 - 1. UL 10C - Positive Pressure Fire Tests of Door Assemblies.
 - 2. UL 723 - Tests for Surface Burning Characteristics of Building Materials.
 - 3. UL 1784 - Air Leakage Tests of Door Assemblies.

1.3 SUBMITTALS

- A. Division 01 – General Requirements: Requirements for submittals.
- B. Shop Drawings: Indicate door elevations, internal reinforcement, closure method, and cut-outs for glazing, louvers, and finishes.
- C. Product Data: Submit door configurations, location of cut-outs for hardware reinforcement.
- D. Manufacturer's Installation Instructions: Submit special installation instructions.

1.4 QUALITY ASSURANCE

- A. Perform Work in accordance with ANSI A250.8.
- B. Fire Rated Door Construction: Conform to one of the following:
 - 1. NFPA 252; with neutral pressure level at 40 inches maximum above sill at 5 minutes into test.
 - 2. UL 10C.
- C. Installed Fire Rated Door Assembly: Conform to NFPA 80 for fire rated class as indicated on Drawings.
- D. Attach label from agency approved by authority having jurisdiction to identify each fire rated door.
- E. Surface Burning Characteristics:
 - 1. Foam Insulation: Maximum 75/450 flame spread/smoke developed index when tested in accordance with ASTM E84.
- F. Apply label from agency approved by authority having jurisdiction to identify each foam plastic insulation board.

1.5 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three (3) years documented experience.
- B. Installer: Company specializing in performing work of this section with minimum three (3) years documented experience and approved by manufacturer.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Division 01 – General Requirements: Requirements for transporting, handling, storing, and protecting products.

- B. Accept doors on site in manufacturer's packaging. Inspect for damage.
- C. Break seal on site to permit ventilation.

1.7 COORDINATION

- A. Division 01 – General Requirements: Requirements for coordination.
- B. Coordinate Work with door opening construction, door frame, and door hardware installation.
- C. Coordinate installation to accommodate door hardware electric wire connections.

PART 2 PRODUCTS

2.1 STANDARD STEEL DOORS

- A. Manufacturers:
 - 1. Ceco Door Products.
 - 2. Kewanee Corp.
 - 3. Republic Builders Products.
 - 4. Steelcraft.
 - 5. Substitutions: In accordance with Division 01 – General Requirements.
- B. Product Description:
 - 1. Exterior Doors (Insulated): ANSI A250.8, 1-3/4 inch thick.
 - a. Level 3 – Extra Heavy Duty, Model 2, seamless design.
 - 2. Interior Doors (Non-Rated): ANSI A250.8, 1-3/4 inch thick.
 - a. Level 3 – Extra Heavy Duty, Model 2, seamless design.
 - 3. Interior Doors (Fire Rated): ANSI A250.8, 1-3/4 inch thick.
 - a. Level 3 – Extra Heavy Duty, Model 2, seamless design.

2.2 COMPONENTS

- A. Face: Steel sheet in accordance with ANSI A250.
- B. End Closure: Channel, 0.04 inches thick, flush.
- C. Core:
 - 1. Exterior: Honeycomb, polystyrene or polyurethane.
 - 2. Interior Non-Rated: Honeycomb.
 - 3. Interior Rated: Mineral fiber.

2.3 ACCESSORIES

- A. Grilles: As specified in Section 23 37 13 – Diffusers, Registers and Grilles.

B. Removable Stops: Rolled steel, channel shape, mitered corners; prepared for countersink style tamper proof screws.

C. Primer: ANSI A250.10 rust inhibitive type.

2.4 FABRICATION

A. Fabricate doors with hardware reinforcement welded in place.

2.5 SHOP FINISHING

A. Steel Sheet: Galvanized to ASTM A653 A60.

B. Primer: Baked.

C. Factory Finish: Baked enamel, color as selected.

PART 3 EXECUTION

3.1 EXAMINATION

A. Division 01 – General Requirements: Verification of existing conditions before starting work.

B. Verify opening sizes and tolerances are acceptable.

3.2 INSTALLATION

A. Install doors in accordance with ANSI A250.8.

B. Install door louvers, plumb and level.

C. Coordinate installation of glass and glazing specified in Section 08 80 00.

D. Coordinate installation of doors with installation of frames specified in Section 08 12 14 and hardware specified in Section 08 71 00.

E. Touch-up damaged shop finishes.

3.3 ERECTION TOLERANCES

A. Division 01 – General Requirements: Tolerances.

B. Maximum Diagonal Distortion: 1/16 inch measured with straight edge, corner to corner.

3.4 ADJUSTING

A. Division 01 – General Requirements: Requirements for adjusting.

- B. Adjust door for smooth and balanced door movement.

END OF SECTION

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SECTION 08 33 23

OVERHEAD COILING DOORS

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes overhead coiling door, operating hardware, and electric operation.
 - 1. Provide wiring from electric circuit disconnect to door operator to control station.
- B. Related Sections:
 - 1. Applicable provisions of Division 01 shall govern all work under this Section.
 - 2. Division 00 – Alternate Bid Items.
 - 3. Section 08 71 00 - Door Hardware: Product Requirements for cylinder core and keys for placement by this section.
 - 4. Section 09 90 00 - Painting and Coating: Field paint finish.
 - 5. Section 13 34 19 – Metal Building Systems.
 - 6. Section 26 00 00 – Basic Electrical Requirements: Power to disconnect.
 - 7. Section 26 05 33 - Raceway and Boxes: Conduit from electric circuit to door operator and from door operator to control station.
 - 8. Division 28 – Electronic Safety and Security: Conduit from fire alarm control to fusible link activator.
- C. Related Documents:
 - 1. Division 00 – Procurement and Contracting Requirements: Alternate Bid requirements.

1.2 REFERENCES

- A. ASTM International:
 - 1. ASTM A653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - 2. ASTM A924 - Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.
 - 3. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- B. National Electrical Manufacturers Association:
 - 1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
 - 2. NEMA ICS 2 - Industrial Control and Systems: Controllers, Contactors, and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC.
 - 3. NEMA MG 1 - Motors and Generators.

- C. National Fire Protection Association:
 - 1. NFPA 80 - Standard for Fire Doors, Fire Windows.
 - 2. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies.
 - 3. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials.

1.3 SYSTEM DESCRIPTION

- A. Electric Operation: Electric motor operated unit with manual override in case of power failure.

1.4 DESIGN REQUIREMENTS

- A. Wind Loads: Design door assembly to withstand wind/suction load of 20 psf, with maximum deflection of 1/120, and without damage to door or assembly components.
- B. Operation: Design door assembly, including operator, to operate for not less than 20,000 cycles and 10 cycles per day.

1.5 SUBMITTALS

- A. Division 01 – General Requirements: Submittal procedures.
- B. Shop Drawings: Indicate pertinent dimensioning, anchorage methods, hardware locations, and installation details.
- C. Product Data: Submit general construction, component connections and details, wiring diagram and electrical equipment.
- D. Samples: Submit two door slats, 12 x 12 inch in size illustrating shape, color and finish texture.
- E. Manufacturer's Installation Instructions: Indicate installation sequence and procedures, and adjustment and alignment procedures.

1.6 CLOSEOUT SUBMITTALS

- A. Division 01 – General Requirements: Closeout procedures.
- B. Operation and Maintenance Data: Submit lubrication requirements and frequency, and periodic adjustments required.

1.7 QUALITY ASSURANCE

- A. Products Requiring Electrical Connection: Listed and classified by UL or another testing firm acceptable to authority having jurisdiction.

- B. Surface Burning Characteristics:
 - 1. Foam Insulation: Maximum 75/450 flame spread/smoke developed index when tested in accordance with ASTM E84.
- C. Apply label from agency approved by authority having jurisdiction to identify each foam plastic insulation board.

1.8 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.
- B. Installer: Company specializing in performing work of this section with minimum three (3) years documented experience and approved by manufacturer.

PART 2 PRODUCTS

2.1 OVERHEAD COILING DOORS

- A. Manufacturers:
 - 1. Cookson Co., Model FCM and FMWL.
 - 2. Cornell Iron Works, Inc., Model ESD10 and ESD20.
 - 3. Wayne-Dalton, Model 800 and 800C.
 - 4. Substitutions: Division 01 – General Requirements.
- B. Product Description:
 - 1. Electric Operation: Electric motor operated unit with manual override in case of power failure.

2.2 COMPONENTS

- A. Curtain: Conform to following: insulated and/or fire rated in accordance with requirements indicated on Drawings:
 - 1. Steel Slats: Interlocking, minimum 22 gage of ASTM A653 steel;
 - a. Type A: Single thickness S-configuration slat.
 - b. Type B: Sandwich slat construction with manufacturer's standard insulated core.
 - 2. Nominal Slat Size: 2 to 3 inches wide by required length.
 - 3. Slat Ends: Each slat fitted with end locks to act as wearing surface in guides and to prevent lateral movement.
 - 4. Curtain Bottom: Fitted with angles, channels, or tubes to provide reinforcement and positive contact with floor in closed position.
- B. Guides: Minimum 3/16 inch; galvanized steel conforming to ASTM A653, minimum galvanized coating designation G90 in accordance with ASTM A924.
 - 1. Furnish continuous angles of profile to retain door in place; mounting brackets of

same metal.

- C. Roller Shaft Counterbalance: Steel pipe and helical steel spring system, capable of producing torque sufficient to ensure smooth operation of curtain from any position and capable of holding position at mid-travel; with adjustable spring tension.
- D. Hood Enclosure and Fascia: Square and round shape, minimum 24 gage galvanized steel; internally reinforced to maintain rigidity and shape.
 - 1. Provide minimum 1/4-inch steel intermediate support brackets to prevent sags.
- E. Hardware:
 - 1. Locks: Furnish locks to allow doors to be secured.
 - a. Electric Doors: Manufacturer's standard cylinder locking system to secure door; interlock with motor to prevent motor from operating when lock is activated.
 - 2. Cylinders: Furnished under Section 08 71 00, installed as part of Work of this section; doors keyed, master keyed.
 - 3. Handle: Inside side mounted, adjustable keeper, spring activated latch bar with feature to keep in locked or retracted position; interior and exterior handle.
 - 4. Weatherstripping (Exterior Assemblies): Moisture and rot proof, resilient type for complete weathertight installation as indicated on Schedule.
- F. Fire Alarm Release Mechanism: Electric operated from fire alarm system.
- G. Electric Operator:
 - 1. Description: UL 325, side or center mounted, totally enclosed, nonventilated or fan-cooled motor.
 - 2. Motor Enclosure: NEMA MG1 Type 1 enclosure.
 - 3. Motor Rating: 1 hp; continuous duty.
 - 4. Motor Voltage: 208-230/460 VAC, 3 phase
 - 5. Motor Controller: NEMA ICS 2, full voltage, reversing magnetic motor starter.
 - 6. Controller Enclosure: NEMA 250 Type 1.
 - 7. Door Speed: 8 inches per second.
 - 8. Brake: Adjustable friction clutch type, activated by motor controller.
- H. Control Station: Standard three button (Open-Stop-Close) momentary control for each operator; 24 volt circuit; surface mounted.
- I. Safety Edge: Manufacturer's standard safety edge and weatherseal located at door bottom, full width, sensitized type, wired to reverse upon striking object.
- J. Insulation: Manufacturer's standard to meet minimum R-value noted on Drawings.

2.3 SHOP FINISHING

- A. Curtain Slats: Steel, galvanized with precoated paint finish, manufacturer's standard type; color as selected.
- B. Steel Guides and Hood Enclosure: Prime paint.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Division 01 – General Requirements: Coordination and project conditions.
- B. Verify opening sizes, tolerances and conditions are acceptable.

3.2 INSTALLATION

- A. Use anchorage devices to securely fasten assembly to wall construction and building framing without distortion or stress.
- B. Securely and rigidly brace components suspended from structure. Secure guides to structural members only.
- C. Fit and align assembly including hardware; level and plumb, to provide smooth operation.
- D. Install fire rated door assemblies in accordance with NFPA 80 and requirements for fire listing.
- E. Coordinate installation of electrical service with Division 26. Complete wiring from disconnect to unit components and from fire alarm system to door operator.
- F. Coordinate installation of sealants and backing materials at frame perimeter as specified in Section 07 90 00.
- G. Install perimeter trim and closures.

3.3 ERECTION TOLERANCES

- A. Division 01 – General Requirements: Tolerances.
- B. Maintain dimensional tolerances and alignment with adjacent Work.
- C. Maximum Variation From Plumb: 1/16 inch.
- D. Maximum Variation From Level: 1/16 inch.
- E. Longitudinal or Diagonal Warp: Plus or minus 1/8 inch per 10 ft straight edge.

3.4 ADJUSTING

- A. Division 01 – General Requirements: Testing, adjusting, and balancing.
- B. Adjust door, hardware and operating assemblies for smooth and noiseless operation.
- C. Test smoke activated assemblies for proper activation.

3.5 CLEANING

- A. Division 01 – General Requirements: Final cleaning.
- B. Clean door and components.
- C. Remove labels and visible markings.

END OF SECTION

SECTION 08 36 13

SECTIONAL DOORS

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes manual and electric overhead insulated sectional door, operating hardware and factory installed glazing.
- B. Related Sections:
 - 1. Applicable provisions of Division 01 shall govern all work under this Section.
 - 2. Section 06 10 53 - Miscellaneous Rough Carpentry: Rough wood blocking for door opening.
 - 3. Section 07 90 00 - Joint Protection: Perimeter sealant and backup materials.
 - 4. Section 08 71 00 - Door Hardware: Cylinder locks.
 - 5. Section 08 80 00 - Glazing: Glass for door lights.
 - 6. Section 09 90 00 - Painting and Coating: Field paint finish.
 - 7. Section 13 34 19 – Metal Building System: Steel framed opening.
 - 8. Section 26 05 33 - Raceway and Boxes: Empty conduit from control stations to door operator.
 - 9. Section 26 27 26 - Wiring Devices: Electrical service to disconnect located near door operator.

1.2 REFERENCES

- A. ASTM International:
 - 1. ASTM A653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - 2. ASTM A924 - Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.
 - 3. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- B. Door and Access Systems Manufacturers Association International:
 - 1. DASMA 102 - Specifications for Sectional Overhead Type Doors.
- C. National Electrical Manufacturers Association:
 - 1. NEMA MG 1 - Motors and Generators.
- D. National Fire Protection Association:
 - 1. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials.

1.3 SUBMITTALS

- A. Division 01 – General Requirements: Submittal procedures.
- B. Shop Drawings: Indicate opening dimensions and required tolerances, connection details, anchorage spacing, hardware locations, and installation details.
- C. Product Data: Submit component construction, anchorage method, and hardware.
- D. Samples: Submit two exterior panel finish samples, 4 inch x 4 inch in size, illustrating color and finish.
- E. Manufacturer's Installation Instructions: Submit special procedures, and perimeter conditions requiring special attention.

1.4 CLOSEOUT SUBMITTALS

- A. Division 01 – General Requirements: Closeout procedures.
- B. Operation and Maintenance Data:
 - 1. Include electrical control adjustment recommendations.
 - 2. Include data for motor and transmission, shaft and gearing, lubrication frequency, periodic adjustments required, and spare part sources.

1.5 QUALITY ASSURANCE

- A. Perform Work in accordance with DASMA 102, Application Type Industrial.
- B. Products Requiring Electrical Connection: Listed and classified by testing firm acceptable to authority having jurisdiction as suitable for purpose specified.
- C. Surface Burning Characteristics:
 - 1. Foam Insulation: Maximum 75/450 flame spread/smoke developed index when tested in accordance with ASTM E84.
- D. Apply label from agency approved by authority having jurisdiction to identify each foam plastic insulation board.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.
- B. Installer: Company specializing in performing Work of this section with minimum three years experience approved by manufacturer.

1.7 WARRANTY

- A. Division 01 – General Requirements: Product warranties and product bonds.
- B. Furnish five year manufacturer warranty for electric operating equipment.

PART 2 PRODUCTS

2.1 SECTIONAL OVERHEAD DOORS

- A. Manufacturers:
 - 1. Clopay Building Products Co., Model 3200.
 - 2. Holmes-Hally Industries.
 - 3. Raynor Garage Door.
 - 4. Substitutions: Division 01 – General Requirements.
- B. Product Description: Steel overhead sectional doors, manual and electric operation, stock configuration and hardware.
 - 1. Door Nominal Thickness: 2 inches thick.
 - 2. Flush Steel Panel Construction: Outer steel sheet of minimum 0.058 inch thick, flat or v-grooved profile; inner steel sheet of minimum 0.058 inch thick, flat profile; core reinforcement of sheet steel roll formed to channel or Z-shape, rabbeted weather joints at meeting rails; insulated.

2.2 COMPONENTS

- A. Sheet Steel: ASTM A653 galvanized to G90, pre-coated with manufacturer's standard thermosetting finish, plain or stucco embossed surface.
- B. Insulation: Rigid polystyrene, R-Value as noted on Drawings.
- C. Metal Primer Paint: Zinc chromate type.
- D. Glazing: Fully tempered insulated clear float glass.
- E. Glazed Lights: Three glazed lights for each panel; set in place with security glazing stops.

2.3 ACCESSORIES

- A. Track: Galvanized steel angles; 2-5/16 x 4 inch size, continuous one piece for each side; galvanized steel mounting brackets minimum 1/4 inch thick.
 - 1. Vertical Track: Minimum 16 gauge galvanized steel tapered and mounted for wedge type opening.
 - 2. Horizontal Tracks: Minimum 14 gauge galvanized steel, reinforced with minimum 13 gauge angles.

- B. Hinge and Roller Assemblies: Heavy duty hinges and adjustable roller holders of hot-dipped 14 gauge minimum galvanized steel; floating hardened steel bearing rollers, located at top and bottom of each panel, each side.
- C. Lift Mechanism: Torsion spring on cross head shaft, with braided galvanized steel lifting cables.
- D. Jamb Weatherstripping: Roll formed steel section full height of jamb, fitted with resilient weatherstripping, placed in moderate contact with door panels.
- E. Head Weatherstripping: EPDM rubber seal, one piece full length.
- F. Panel Joint Weatherstripping: Neoprene foam seal, one piece full length.

2.4 ELECTRICAL CHARACTERISTICS AND COMPONENTS

- A. Electrical Characteristics: In accordance with Division 26 and the following:
 1. 1/2 hp; manually operable in case of power failure; transit speed of nominal 12 inches per second.
 2. 115 volts, single phase, 60 Hz.
- B. Motor Type: NEMA MG1.
- C. Wiring Terminations: Furnish terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated.
- D. Disconnect Switch: Factory mount disconnect switch in control panel.
- E. Electric Operator: Side mounted on cross head shaft, adjustable safety friction clutch; brake system actuated by independent voltage solenoid controlled by motor starter; enclosed gear driven limit switch; enclosed magnetic cross line reversing starter; mounting brackets and hardware. Provide means to disengage motor to allow manual operation in event of power failure.
- F. Control Station: Standard three button (open-close-stop) momentary type, control for each electric operator; 24 volt circuit, surface mounted. Include keypad switch located at inside door jamb.
- G. Radio Control Antenna Detector: Manufacturer's standard system.
- H. Loop Detector: Manufacturer's standard system.
- I. Hand Held Transmitter: Digital control, resettable.
- J. Safety Edge: At bottom of door panel, full width; electro-mechanical sensitized type, wired to reverse door upon striking object; hollow neoprene covered to provide weatherstrip seal.

- K. Photoelectric Sensor: Furnish system which detects obstruction and reverses door without requiring door to contact obstruction.

2.5 FACTORY FINISHING

- A. Exterior Surfaces: Prime paint for finish specified in Section 09 90 00. Color as selected.
- B. Interior Surfaces: Prime paint for finish specified in Section 09 90 00. Color as selected.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Division 01 – General Requirements: Coordination and project conditions.
- B. Verify wall openings are ready to receive work and opening dimensions and tolerances are within specified limits.
- C. Verify electric power is available and of correct characteristics.

3.2 PREPARATION

- A. Prepare opening to permit correct installation of door unit to perimeter air and vapor retarder seal.
- B. Apply primer to wood frame.

3.3 INSTALLATION

- A. Anchor assembly to wall construction and building framing without distortion or stress.
- B. Securely brace door tracks suspended from structure. Secure tracks to structural members only.
- C. Fit and align door assembly including hardware.
- D. Coordinate installation of electrical service. Complete power and control wiring from disconnect to unit components.
- E. Coordinate installation of sealants and backing materials at frame perimeter as specified in Section 07 90 00.
- F. Install perimeter weatherstripping.

3.4 ERECTION TOLERANCES

- A. Division 01 – General Requirements: Tolerances.

- B. Maximum Variation from Plumb: 1/16 inch.
- C. Maximum Variation from Level: 1/16 inch.
- D. Longitudinal or Diagonal Warp: Plus or minus 1/8 inch from 10 ft straight edge.
- E. Maintain dimensional tolerances and alignment with adjacent work.

3.5 MANUFACTURER'S FIELD SERVICES

- A. Division 01 – General Requirements: Manufacturers' field services.
- B. Ensure operation and adjustments to door assembly for specified operation.

3.6 ADJUSTING

- A. Division 01 – General Requirements: Testing, adjusting, and balancing.
- B. Adjust door assembly to smooth operation and in full contact with weatherstripping.

3.7 CLEANING

- A. Division 01 – General Requirements: Final cleaning.
- B. Clean doors, frames and glass.
- C. Remove temporary labels and visible markings.

3.8 PROTECTION OF INSTALLED CONSTRUCTION

- A. Division 01 – General Requirements: Protecting installed construction.
- B. Do not permit construction traffic through overhead door openings after adjustment and cleaning.

END OF SECTION

SECTION 08 51 14

INTERIOR ALUMINUM WINDOWS

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes interior aluminum window, sliding, factory glazed.
- B. Related Sections:
 - 1. Applicable provisions of Division 01 shall govern all work under this Section.
 - 2. Section 06 10 53 - Miscellaneous Rough Carpentry: Wood perimeter shims.
 - 3. Section 07 90 00 - Joint Protection: Perimeter sealant and back-up materials.
 - 4. Section 08 80 00 - Glazing.
 - 5. Section 09 21 16 – Gypsum Board Assemblies: Openings in interior stud wall.
 - 6. Section 13 34 19 – Metal Building Systems.

1.2 REFERENCES

- A. Aluminum Association:
 - 1. AA DAF-45 - Designation System for Aluminum Finishes.
- B. American Architectural Manufacturers Association:
 - 1. AAMA 101 - Voluntary Performance Specification for Windows, Skylights and Glass Doors.
 - 2. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum.
 - 3. AAMA 2603 - Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels.
 - 4. AAMA 2604 - Voluntary specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels.
- C. ASTM International:
 - 1. ASTM A123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - 2. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
 - 3. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
- D. Consumer Product Safety Commission:
 - 1. CPSC 16 CFR 1201; Safety Standard for Architectural Glazing.
- E. Glass Association of North America:
 - 1. GANA - Glazing Manual.

1.3 SYSTEM DESCRIPTION

- A. Windows: Tubular aluminum sections, factory fabricated, factory finished, factory glazed vision glass, anchorage and attachment devices.
- B. Glazing: Interior.

1.4 SUBMITTALS

- A. Division 01 – General Requirements: Submittal procedures.
- B. Shop Drawings: Indicate opening dimensions, framed opening tolerances, affected related Work; and installation requirements.
- C. Product Data: Submit component dimensions, anchorage and fasteners, glass, internal drainage, and typical details.

1.5 QUALITY ASSURANCE

- A. Perform Work in accordance with the following:
 - 1. Aluminum Windows: Fabricate and label window assemblies in accordance with AAMA 101 for types of windows required.
 - 2. Safety Glass: Conform to CPSC 16 CFR 1201 and applicable codes.
 - 3. Maintain one copy of each document on site.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing commercial aluminum windows with minimum five years experience.
- B. Installer: Company specializing in installation of commercial aluminum windows with minimum five years experience.

1.7 DELIVERY, STORAGE, AND PROTECTION

- A. Division 01 – General Requirements: Product storage and handling requirements.
- B. Protect factory finished aluminum surfaces with wrapping and strippable coating.
- C. Do not use adhesive papers or sprayed coatings.

1.8 WARRANTY

- A. Division 01 – General Requirements: Product warranties and product bonds.
- B. Furnish five year manufacturer warranty for glass and aluminum finish coating failure.

PART 2 PRODUCTS

2.1 ALUMINUM WINDOWS

- A. Manufacturers:
 - 1. EFCO Corp.
 - 2. Kawneer Co., Inc.
 - 3. St. Cloud Windows Inc.
 - 4. Wausau Metals.
 - 5. YKK AP America, Inc.
 - 6. Substitutions: Division 01 – General Requirements.
- B. Product Description: Aluminum windows non-thermally broken; applied glass stops of screw fastened type.

2.2 COMPONENTS

- A. Extruded Aluminum: ASTM B221; 6063 alloy, T5 temper.
- B. Sheet Aluminum: ASTM B209; 5005 alloy, H15 or H34 temper.
- C. Single Pane Glass: Single pane of clear float glass, safety type, 1/4 inch thick.
 - 1. Furnish fixed single pane.
- D. Stools: Brake formed aluminum; sloped for positive wash; fit under sash to Project 1/2 inch beyond wall face; one piece full width of opening.

2.3 ACCESSORIES

- A. Fasteners and Anchors: Galvanized steel.

2.4 FABRICATION

- A. Fabricate components with minimum clearances and shim spacing around perimeter of assembly, yet enabling installation and dynamic movement of perimeter seal.
- B. Accurately fit and secure joints and corners. Make joints flush and hairline tight.
- C. Prepare components to receive anchor devices. Fabricate anchors.
- D. Arrange fasteners and attachments to ensure concealment from view.
- E. Factory glaze window units.

2.5 SHOP FINISHING

- A. Finish Coatings: Conform to AAMA 2604 or 2605.

- B. Frame Surfaces: Anodized to medium bronze finish.
- C. Concealed Steel Items: Galvanized to ASTM A123; minimum 2.0 oz/sq ft coating thickness; galvanize after fabrication.
- D. Galvanizing for Nuts, Bolts and Washers: ASTM A153.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Division 01 – General Requirements: Coordination and project conditions.
- B. Verify wall openings materials are ready to receive Work of this section.

3.2 INSTALLATION

- A. Attach window frame and shims to perimeter opening to accommodate construction tolerances and other irregularities.
- B. Align window plumb and level, free of warp or twist. Maintain dimensional tolerances and alignment with adjacent Work.

3.3 ERECTION TOLERANCES

- A. Division 01 – General Requirements: Tolerances.
- B. Maximum Variation from Level or Plumb: 1/16 inches every 3 ft non-cumulative or 1/8 inches per 10 ft, whichever is less.

3.4 CLEANING

- A. Division 01 – General Requirements: Final cleaning.
- B. Remove protective material from factory finished aluminum surfaces.
- C. Wash surfaces by method recommended and acceptable to sealant and window manufacturer; rinse and wipe surfaces clean.
- D. Remove excess sealant by moderate use of mineral spirits or other solvent acceptable to sealant and window manufacturer.

END OF SECTION

SECTION 08 71 00

DOOR HARDWARE

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes hardware for steel doors.
 - 1. Provide door gaskets, including weatherstripping and seals, and thresholds.
- B. Related Sections:
 - 1. Applicable provisions of Division 01 shall govern all work under this Section.
 - 2. Section 06 20 00 - Finish Carpentry.
 - 3. Section 08 12 14 - Standard Steel Frames: Silencers integral with steel frames.
 - 4. Section 08 13 14 - Standard Steel Doors.
 - 5. Section 08 33 23 - Overhead Coiling Doors: Lockable coiling doors.
 - 6. Section 10 14 00 - Signage.
 - 7. Division 26 – Electrical: Low-Voltage Electrical Power Conductors and Cables: Power supply to electric hardware devices.
 - 8. Section 28 31 00 - Fire Detection and Alarm System: Electrical connection to activate door closers, and release magnetic holders.

1.2 REFERENCES

- A. American National Standards Institute:
 - 1. ANSI A156.1 - Butts and Hinges.
 - 2. ANSI A156.2 - Bored and Preassembled Locks and Latches.
 - 3. ANSI A156.3 - Exit Devices.
 - 4. ANSI A156.4 - Door Controls - Closures.
 - 5. ANSI A156.5 - Auxiliary Locks and Associated Products.
 - 6. ANSI A156.6 - Architectural Door Trim.
 - 7. ANSI A156.7 - Template Hinge Dimensions.
 - 8. ANSI A156.8 - Door Controls - Overhead Holders.
 - 9. ANSI A156.12 - Interconnected Locks and Latches.
 - 10. ANSI A156.13 - Mortise Locks and Latches.
 - 11. ANSI A156.15 - Closer Holder Release Devices.
 - 12. ANSI A156.16 - Auxiliary Hardware.
 - 13. ANSI A156.18 - Materials and Finishes
 - 14. ANSI A156.23 - Electromagnetic Locks.
 - 15. ANSI A156 - Complete Set of 24 BHMA Standards (A156 Series) with Binder.
- B. Builders Hardware Manufacturers Association:
 - 1. BHMA Directory of Certified Products.

- C. National Fire Protection Association:
 - 1. NFPA 80 - Standard for Fire Doors, Fire Windows.
 - 2. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies.
- D. Underwriters Laboratories Inc.:
 - 1. UL 10B - Fire Tests of Door Assemblies.
 - 2. UL 305 - Panic Hardware.
 - 3. UL - Building Materials Directory.

1.3 PERFORMANCE REQUIREMENTS

- A. Fire Rated Openings: Provide door hardware listed by UL, or other testing laboratory approved by applicable authorities.
 - 1. Hardware: Tested in accordance with NFPA 252.

1.4 SUBMITTALS

- A. Division 01 – General Requirements: Submittal procedures.
- B. Shop Drawings:
 - 1. Indicate locations and mounting heights of each type of hardware, schedules, catalog cuts, electrical characteristics and connection requirements.
 - 2. Submit manufacturer's parts lists and templates.
- C. Manufacturer's Installation Instructions: Submit special procedures, and perimeter conditions requiring special attention.

1.5 CLOSEOUT SUBMITTALS

- A. Division 01 – General Requirements: Closeout procedures.
- B. Project Record Documents: Record actual locations of installed cylinders and their master key code.
- C. Operation and Maintenance Data: Submit data on operating hardware, lubrication requirements, and inspection procedures related to preventative maintenance.
- D. Keys: Deliver with identifying tags to Owner by security shipment direct from hardware supplier.

1.6 QUALITY ASSURANCE

- A. Perform Work in accordance with the following requirements:
 - 1. ANSI A156 series.
 - 2. NFPA 80.
 - 3. UL 305.

1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum five years documented experience.
- B. Hardware Supplier: Company specializing in supplying commercial door hardware with minimum five years documented experience and approved by primary hardware manufacturer.
- C. Hardware Supplier Personnel: Employ qualified person to assist in work of this section.
- D. Products Requiring Electrical Connection: Listed and classified by Underwriters' Laboratories, Inc. as suitable for purpose specified and indicated.

1.8 PRE-INSTALLATION MEETINGS

- A. Division 01 – General Requirements: Pre-installation meeting.
- B. Convene minimum one week prior to commencing work of this section.
- C. Include persons involved with installation of doors, frames, and hardware.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Division 01 – General Requirements: Product storage and handling requirements.
- B. Package hardware items individually with necessary fasteners, instructions, and installation templates, when necessary; label and identify each package with door opening code to match hardware schedule.

1.10 COORDINATION

- A. Division 01 – General Requirements: Coordination and project conditions.
- B. Coordinate Work with other directly affected sections involving manufacture or fabrication of internal reinforcement for door hardware and recessed items.
 - 1. Provide templates or actual hardware as required to ensure proper preparation of doors and frames.
- C. Sequence installation to accommodate required utility connections.
- D. Coordinate Owner's keying requirements during course of Work.

1.11 MAINTENANCE MATERIALS

- A. Division 01 – General Requirements: Maintenance materials.

- B. Furnish special wrenches and tools applicable for each different and for each special hardware component.

PART 2 PRODUCTS

2.1 COMPONENTS

- A. General Hardware Requirements: Where not specifically indicated, comply with applicable ANSI A156 standard for type of hardware required. Furnish each type of hardware with accessories as required for applications indicated and for complete, finished, operational doors.
 - 1. Templates: Furnish templates or physical hardware items to door and frame manufacturers sufficiently in advance to avoid delay in Work.
 - 2. Reinforcing Units: Furnished by door and frame manufacturers; coordinated by hardware supplier or hardware manufacturer.
 - 3. Fasteners: Furnish as recommended by hardware manufacturer and as required to secure hardware.
 - a. Finish: Match hardware item being fastened.
 - 4. Fire Ratings: Provide hardware with UL listings for type of application involved.
 - 5. Electrical Devices: Make provisions and coordinate requirements for electrical devices and connections for hardware.

- B. Hinges: ANSI A156.1, full mortise type, template type, ANSI A156.7, complying with following general requirements unless otherwise scheduled.
 - 1. Widths: Sufficient to clear trim projection when door swings 180 degrees.
 - 2. Number: Furnish minimum three hinges to 90 inches high, four hinges to 120 inches high for each door leaf.
 - a. Fire Rated Doors To 86 inches High: Minimum three hinges.
 - 3. Size and Weight: 4-1/2 inch heavy weight typical for 1-3/4 inch doors.
 - a. Doors Over 40 inches Wide: Extra heavy weight ball or oilite bearing hinges.
 - b. Doors 1-3/8 inch Thick: 3-1/2 inch size.
 - c. Doors 2 inch Thick: 5 inch extra heavy weight ball or oilite bearing.
 - d. Doors Over 48 inches Wide: 5 inch extra heavy weight ball or oilite bearing.
 - 4. Pins: Furnish nonferrous hinges with non-removable pins (NRP) at exterior and locked outswinging doors, non-rising pins at interior doors.

- C. Locksets: Furnish locksets compatible with specified cylinders. Typical 2-3/4 inch backset. Furnish standard strikes with extended lips to protect trim from being marred by latch bolt, verify type of cutouts provided in metal frames.
 - 1. Mortise Locksets: ANSI A156.13, Series 1000, Grade 1 unless otherwise indicated.
 - 2. Bored (Cylindrical) Locksets: ANSI A156.2, Series 4000, Grade 1 unless otherwise indicated.
 - 3. Preassembled (Unit) Locksets: ANSI A156.12, Series 2000, Grade 1 unless

- otherwise indicated.
4. Interconnected Locksets: ANSI A156.12, Series 5000, Grade 1 unless otherwise indicated.
- D. Latch Sets: Match locksets. Typical 2-3/4 inch backset. Furnish standard strikes with extended lips to protect trim from being marred by latch bolt, verify type of cutouts provided in metal frames.
1. Mortise Latch Sets: ANSI A156.13, Series 1000, Grade 1 unless otherwise indicated.
 2. Bored (Cylindrical) Latch Sets: ANSI A156.2, Series 4000, Grade 1 unless otherwise indicated.
- E. Exit Devices: ANSI A156.3, Grade 1 rim type, with cross bar, unless otherwise indicated. Furnish standard strikes with extended lips to protect trim from being marred by latch bolt, verify type of cutouts provided in metal frames, with dust-proof floor strikes.
1. Types: Suitable for doors requiring exit devices.
 2. Coordinators: Furnish overhead type at pairs of doors.
- F. Cylinders: ANSI A156.5, Grade 6 pin type, removable cylinders and interchangeable core type cylinders.
1. Keying: Keyed as directed by Owner.
 2. Include construction keying.
 3. Keys: Nickel silver. Stamp keys with "DO NOT DUPLICATE".
 4. Supply keys in the following minimum quantities:
 - a. 5 master keys.
 - b. 3 grand master keys.
 - c. 3 great grand master keys.
 - d. 3 construction keys.
 - e. 3 control keys and 10 extra cylinder cores.
 - f. 3 change keys for each lock.
- G. Closers: ANSI A156.4 modern type with cover, surface mounted closers; full rack and pinion type with steel spring and non-freezing hydraulic fluid; closers required for fire rated doors unless otherwise indicated.
1. Adjustability: Furnish controls for regulating closing, latching, speeds, and back checking.
 2. Arms: Type to suit individual condition; parallel-arm closers at reverse bevel doors and where doors swing full 180 degrees.
 3. Location: Mount closers on inside of exterior doors, room side of interior doors typical; mount on pull side of other doors.
 4. Operating Pressure: Maximum operating pressure as follows.
 - a. Interior Doors: Maximum 5 pounds.
 - b. Exterior Doors: Maximum 8.5 pound.
 - c. Fire Rated Doors: As required for fire rating, maximum 15 pounds.

- H. Door Controls and Overhead Holders: Furnish with accessories as required for complete operational installation.
 - 1. Closer Holder Release Devices: ANSI A156.15 door mounted closer holder release devices closers with single point hold open designed to make swing doors close upon receiving electrical signal.

- I. Push/Pulls, Protection Plates, Gaskets, Thresholds and Trim: Furnish as indicated in Schedule, with accessories as required for complete operational door installations.
 - 1. Push/Pulls: ANSI A156.6; push plates minimum 0.050 inch thick. Furnish push-pull plate type pulls with bolts to secure from opposite door face; furnish with minimum 0.050 inch pull plates unless otherwise indicated.
 - 2. Kickplates: ANSI A156.6, metal; height indicated in Schedule by 1 inch less than door width; minimum 0.050 inch thick stainless steel.
 - 3. Weatherstripping: Furnish continuous weatherstripping at top and sides of exterior doors.
 - 4. Fire Rated Gaskets: Furnish continuous fire rated gaskets at top and sides of fire rated doors.
 - 5. Thresholds: Maximum 1/2 inch height.
 - 6. Wall Stops: ANSI A156.1, Grade 1, 3 inch wall stop.

2.2 ACCESSORIES

- A. Lock Trim: Furnish levers as selected from manufacturer's full range of levers and roses.

2.3 FINISHING

- A. Finishes: ANSI A156.18; furnish following finishes except where otherwise indicated in Schedule at end of section.
 - 1. Hinges:
 - a. BHMA 630 and 626, satin finish.
 - 2. Typical Exterior Exposed and High Use Interior Door Hardware:
 - a. BHMA 630, satin finished stainless steel.
 - 3. Typical Interior Door Hardware:
 - a. BHMA 630, satin finished stainless steel.
 - 4. Closers: Finish appearance to match door hardware on same face of door.
 - 5. Thresholds:
 - a. BHMA 630, satin finished stainless steel.
 - 6. Other Items: Furnish manufacturer's standard finishes to match similar hardware types on same door, and maintain acceptable finish considering anticipated use and BHMA category of finish.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Division 01 – General Requirements: Coordination and project conditions.
- B. Verify doors and frames are ready to receive door hardware and dimensions are as indicated on shop drawings.
- C. Verify electric power is available to power operated devices and is of correct characteristics.

3.2 INSTALLATION

- A. Coordinate mounting heights with door and frame manufacturers. Use templates provided by hardware item manufacturer.
- B. Mounting Heights From Finished Floor to Center Line of Hardware Item: Comply with manufacturer recommendations and applicable codes where not otherwise indicated.
 - 1. Locksets: 38 inch.
 - 2. Push/Pulls: 42 inch.
 - 3. Dead Locks: 48 inch.
 - 4. Push Pad Type Exit Devices: 42 inch.
 - 5. Cross Bar Type Exit Devices: 38 inch.
 - 6. Top Hinge: Jamb manufacturer's standard, but not greater than 10 inches from head of frame to center line of hinge.
 - 7. Bottom Hinge: Jamb manufacturer's standard, but not greater than 12-1/2 inches from floor to center line of hinge.
 - 8. Intermediate Hinges: Equally spaced between top and bottom hinges and from each other.
 - 9. Hinge Mortise on Door Leaf: 1/4 inch. to 5/16 inch from stop side of door.

3.3 FIELD QUALITY CONTROL

- A. Division 01 – General Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Primary Hardware Manufacturer's Representatives inspect installation and certify hardware and installation has been furnished and installed in accordance with manufacturer's instructions and as specified.

3.4 ADJUSTING

- A. Division 01 – General Requirements: Testing, adjusting, and balancing.
- B. Adjust hardware for smooth operation.

3.5 PROTECTION OF INSTALLED CONSTRUCTION

- A. Division 01 – General Requirements: Protecting installed construction.
- B. Do not permit adjacent work to damage hardware or hardware finish.

3.6 SCHEDULES

- A. Reference Door Hardware Schedule indicated on Drawings.

END OF SECTION

SECTION 08 80 00

GLAZING

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Glass glazing for doors and windows.
 - 2. Glass glazing materials and installation requirements are included in this section for other sections referencing this section.

- B. Related Sections:
 - 1. Applicable provisions of Division 01 Shall govern all work under this Section.
 - 2. Section 07 90 00 - Joint Protection: Sealant and back-up material other than glazing sealants.
 - 3. Section 08 13 14 - Standard Steel Doors: Glazed doors.
 - 4. Section 08 33 23 – Overhead Coiling Doors.
 - 5. Section 08 36 13 - Sectional Doors.
 - 6. Section 08 51 14 – Interior Aluminum Windows: Glazed windows.
 - 7. Section 10 28 00 - Toilet, Bath, and Laundry Accessories: Metal framed mirrors.

1.2 REFERENCES

- A. American National Standards Institute:
 - 1. ANSI Z97.1 - Safety Glazing Materials Used in Buildings Safety.

- B. American Society of Civil Engineers:
 - 1. ASCE 7 - Minimum Design Loads for Buildings and Other Structures.

- C. ASTM International:
 - 1. ASTM C509 - Standard Specification for Elastomeric Cellular Preformed Gasket and Sealing Material.
 - 2. ASTM C864 - Standard Specification for Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers.
 - 3. ASTM C920 - Standard Specification for Elastomeric Joint Sealants.
 - 4. ASTM C1036 - Standard Specification for Flat Glass.
 - 5. ASTM C1048 - Standard Specification for Heat-Treated Flat Glass-Kind HS, Kind FT Coated and Uncoated Glass.
 - 6. ASTM C1172 - Standard Specification for Laminated Architectural Flat Glass.
 - 7. ASTM C1193 - Standard Guide for Use of Joint Sealants.
 - 8. ASTM C1376 - Standard Specification for Pyrolytic and Vacuum Deposition Coatings on Flat Glass.
 - 9. ASTM D4802 - Standard Specification for Poly (Methyl Methacrylate) Acrylic

- Plastic Sheet.
10. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
 11. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.
 12. ASTM E1300 - Standard Practice for Determining Load Resistance of Glass in Buildings.
 13. ASTM E1425 - Standard Practice for Determining the Acoustical Performance of Exterior Windows and Doors.
 14. ASTM E2190 - Standard Specification for Insulating Glass Unit Performance and Evaluation.
- D. Consumer Products Safety Commission:
1. CPSC 16 CFR 1201 - Safety Standard for Architectural Glazing.
- E. Glass Association of North America:
1. GANA - Sealant Manual.
 2. GANA - Glazing Manual.
 3. GANA - Laminated Glass Design Guide.
- F. National Fenestration Rating Council Incorporated:
1. NFRC 100 - Procedures for Determining Fenestration Product U-Factors.
 2. NFRC 200 - Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence.
 3. NFRC 300 - Test Method for Determining the Solar Optical Properties of Glazing Materials and Systems.
- G. National Fire Protection Association:
1. NFPA 80 - Standard for Fire Doors, Fire Windows.
 2. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies.
 3. NFPA 257 - Standard on Fire Test for Window and Glass Block Assemblies.

1.3 PERFORMANCE REQUIREMENTS

- A. Provide glass and glazing materials for continuity of building enclosure vapor retarder and air barrier:
1. To utilize inner pane of multiple pane sealed units for continuity of air barrier and vapor retarder seal.
 2. To maintain continuous air barrier and vapor retarder throughout glazed assembly from glass pane to heel bead of glazing sealant.
- B. Glass Thickness: Select minimum thickness in accordance with ASTM E1300 to resist specified design loads with the following maximum probability of breakage:
1. Vertical Glass: 8 lites per 1000 for wind loads with 60 seconds maximum load duration.

2. Minimum Thickness: 1/4 inch for exterior glass.
- C. Structural Design: Design in accordance with applicable code for most critical combination of wind, snow, seismic, and dead loads.
- D. Wind Loads: Design and size glass to withstand positive and negative wind loads acting normal to plane of wall, including increased loads at building corners.
 1. Design Wind Load: As calculated in accordance with applicable code.
- E. Wind-Borne Debris Loads: Design and size glass located less than 60 feet above grade to withstand the following loads:
 1. Glass within 30 feet of Grade: ASTM 1996; large missile impact test.
 2. Glass within 30 feet of Grade: ASTM 1996; small missile impact test.
- F. Exterior Glass Deflection: Maximum of 1/175 of glass edge length or 3/4 inch, which ever is less with full recovery of glazing materials.
- G. Interior Glass Deflection: Maximum differential deflection for two adjacent unsupported edges when 50 plf force is applied to one panel at any point up to 42 inches above finished floor less than thickness of glass.
- H. Thermal and Solar Optical Performance: Measured or calculated in accordance with the following:
 1. U-Values: NFRC 100.
 2. Solar Heat Gain Coefficients: NFRC 200.
 3. Solar Optical Properties: NFRC 300.

1.4 SUBMITTALS

- A. Division 01 – General Requirements: Submittal procedures.
- B. Shop Drawings:
 1. Indicate sizes, layout, and thicknesses for glass.
- C. Product Data:
 1. Glass: Provide structural, physical, and thermal and solar optical performance characteristics, size limitations, special handling or installation requirements.
 2. Glazing Sealants, Compounds and Accessories: Provide chemical, functional, and environmental characteristics, limitations, special application requirements. Identify available colors where exposed.
- D. Installer's Certificate: Certify glass furnished without identification label is installed in accordance with Construction Documents and applicable code.

1.5 QUALITY ASSURANCE

- A. Perform Work in accordance with GANA Glazing Manual, GANA Sealant Manual, and GANA Laminated Glass Design Guide for glazing installation methods.
- B. Fire Rated Wall Glazing: Rating as indicated on Drawings.
 - 1. Tested Rating: Determined in accordance with ASTM E119.
- C. Fire Rated Window Glazing: Tested in accordance with NFPA 257 and complying with NFPA 80.
 - 1. NFPA 257; adjusted so two-thirds of test specimen is above neutral pressure plane at 10 minutes into test.
- D. Fire Rated Door Glazing: Tested in accordance with one of the following and complying with NFPA 80.
 - 1. NFPA 252; with neutral pressure level at 40 inches maximum above sill at 5 minutes into test.
- E. Apply label from agency approved by authority having jurisdiction to identify each fire rated glass lite.

1.6 QUALIFICATIONS

- A. Installer: Company specializing in performing Work of this section with minimum three years documented experience approved by manufacturer.

1.7 ENVIRONMENTAL REQUIREMENTS

- A. Division 01 – General Requirements.
- B. Do not install glazing when ambient temperature is less than 50 degrees F.
- C. Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.

1.8 WARRANTY

- A. Division 01 – General Requirements: Product warranties and product bonds.
- B. Furnish five year warranty to include coverage for sealed glass units from seal failure, interpane dusting or misting, and replacement of same.
- C. Furnish five year warranty to include coverage for delamination of laminated glass and replacement of same.

PART 2 PRODUCTS

2.1 FLOAT GLASS MATERIALS

- A. Annealed Glass: ASTM C1036, Type 1 transparent flat, Quality Q3, float glass.
 - 1. Furnish annealed glass except where heat strengthened or tempered glass is required to meet specified performance requirements.
- B. Heat Strengthened Glass: ASTM C1048, Type 1 transparent flat, Quality Q3, Kind HS heat strengthened, Condition A uncoated, float glass.
 - 1. Furnish heat strengthened glass where annealed glass cannot meet specified performance requirements.
- C. Tempered Glass: ASTM C1048, Type 1 transparent flat, Quality Q3, Kind FT fully tempered, Condition A uncoated, float glass with horizontal tempering.
 - 1. Furnish tempered glass where heat strengthened glass cannot meet specified performance requirements.
 - 2. Furnish tempered glass conforming to CPSC 16 CFR 1201 Category II at locations where safety glass is required by applicable code.

2.2 FLOAT GLASS PRODUCTS

- A. Clear Glass: Annealed, Heat strengthened, and Tempered float glass as specified; Class 1 clear.
 - 1. Clear annealed glass (FG-CA).
 - 2. Clear heat strengthened glass (FG-CH).
 - 3. Clear tempered glass (FG-CT).
 - 4. Minimum Thickness: 1/4 inch.
- B. Tinted Glass: Annealed, Heat strengthened, and Tempered float glass as specified; Class 2 tinted.
 - 1. Tinted annealed glass (FG-TA).
 - 2. Tinted heat strengthened glass (FG-TH).
 - 3. Tinted tempered glass (FG-TT).
 - 4. Minimum Thickness: 1/4 inch.
- C. Low E Glass: Annealed, Heat strengthened, and Tempered float glass as specified; Class 1 clear.
 - 1. Clear Low E annealed glass (FG-ECA).
 - 2. Clear Low E heat strengthened glass (FG-ECH).
 - 3. Clear Low E tempered glass (FG-ECT).
 - 4. Tinted Low E annealed glass (FG-ETA).
 - 5. Tinted Low E heat strengthened glass (FG-ETH).
 - 6. Tinted Low E tempered glass (FG-ETT).
 - 7. Minimum Thickness: 1/4 inch.

- D. Coated Vision Glass: Heat strengthened and Tempered float glass as specified; Condition C, ceramic frit coated glass; Class 1 clear.
 - 1. Clear heat strengthened coated vision glass (FG-CVH).
 - 2. Clear tempered coated vision glass (FG-CVT).
 - 3. Tinted heat strengthened coated vision glass (FG-TVH).
 - 4. Tinted tempered coated vision glass (FG-TVT).
 - 5. Minimum Thickness: 1/4 inch.

2.3 LAMINATED GLASS PRODUCTS

- A. Clear Laminated Glass: ASTM C1172; with plastic interlayer.
 - 1. Clear laminated annealed glass (LG-CA): Kind LA, with 2 lites of annealed glass as specified.
 - 2. Clear laminated heat strengthened glass (LG-CH): Kind LHS with 2 lites of heat strengthened glass as specified.
 - 3. Clear laminated tempered glass (LG-CT): Kind LT with 2 lites of tempered glass as specified.
 - 4. Minimum Total Thickness: 1/2 inch unless otherwise indicated.
 - 5. Plastic Interlayer: Manufacturer's standard, minimum 0.060 inch thick.
 - 6. Safety Glass: Conform to CPSC 16 CFR 1201 Category II.

2.4 FIRE RESISTIVE GLASS PRODUCTS

- A. Wired Glass: ASTM C1036, Type II wired flat, Class 1 clear, polished both sides, Quality Q6 glazing; Mesh M1 diamond of woven stainless steel wire, manufacturer's standard grid size; conforming to ANSI Z91.7.
 - 1. Clear Wired Glass (FRG-CW): Polished both sides.
 - 2. Minimum Thickness: 1/4 inch unless otherwise indicated.
- B. Fire Resistive Ceramic Glass: Transparent polished both surfaces.
 - 1. Clear fire resistive ceramic glass (FRG-CC).
 - 2. Thickness: Manufacturer's standard.
 - 3. Fire Rating: 90 minute rating as listed in UL Building Materials Directory and approved by authority having jurisdiction for applications indicated.
- C. Fire Resistive Film Faced Ceramic Safety Glass (FRG-FC): Transparent polished both surfaces, faced one side with clear plastic glazing film.
 - 1. Thickness: Manufacturer's standard.
 - 2. Fire Rating: 60 minute rating as listed in UL Building Materials Directory and approved by authority having jurisdiction for applications indicated.
 - 3. Safety Glazing: Comply with CPSC 16 CFR 1201 Category II.

2.5 INSULATING GLASS PRODUCTS

- A. Insulating Glass: ASTM E2190; with silicone sealant edge seal; purge interpane space with

dry air.

1. Total Unit Thickness: 1 inch.
2. Insulating Glass Unit Edge Seal Construction: Thermally broken, mitered and spigoted corners.

2.6 GLAZING SEALANTS

- A. Elastomeric Glazing Sealants: Materials compatible with adjacent materials including glass, and glazing channels.
 1. Silicone Glazing Sealant: ASTM C920, Type S, Grade NS, Class and Use suitable for glazing application indicated; single component; solvent curing; capable of water immersion without loss of properties; non-bleeding, non-staining, cured Shore A hardness of 15 to 25.
- B. Dense Gaskets: Resilient extruded shape to suit glazing channel retaining slot; black color.
 1. Neoprene: ASTM C864.
 2. EPDM: ASTM C864.
 3. Silicone: ASTM C1115.
- C. Soft Gaskets: ASTM C509 Type II; resilient extruded shape to suit glazing channel retaining slot; black color.
 1. Neoprene.
 2. EPDM.
 3. Silicone.
- D. Pre-Formed Glazing Tape: Size to suit application.
 1. Preformed butyl compound with integral resilient tube spacing device; 10 to 15 Shore A durometer hardness; coiled on release paper; black color.
 - a. Butyl Corner Sealant: ASTM C920 single component non-skinning butyl compatible with glazing tape; color to match tape.

2.7 GLAZING ACCESSORIES

- A. Setting Blocks: Elastomeric material recommended by glass manufacturer, 80 to 90 Shore A durometer hardness, length of 0.1 inch for each square foot of glazing or minimum 4 inch x width of glazing rabbet space minus 1/16 inch x height to suit glazing method and pane weight and area.
- B. Spacer Shims: Elastomeric material recommended by glass manufacturer, 50 to 60 Shore A durometer hardness, minimum 3 inch long x one half the height of glazing stop x thickness to suit application, self adhesive on one face.
- C. Glazing Clips: Manufacturer's standard type.
- D. Fire-Resistant Glazing Materials: Materials used to obtain required fire-resistant rating.

2.8 SOURCE QUALITY CONTROL AND TESTS

- A. Provide shop inspection and testing for safety and insulating glass.
- B. Test insulating glass samples in accordance with ASTM E2190.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Division 01 – General Requirements: Coordination and project conditions.
- B. Verify openings for glazing are correctly sized and within acceptable tolerance.
- C. Verify surfaces of glazing channels or recesses are clean, free of obstructions impeding moisture movement, weeps are clear, and ready to receive glazing.

3.2 PREPARATION

- A. Clean contact surfaces with solvent and wipe dry.
- B. Seal porous glazing channels or recesses with substrate compatible primer or sealer.
- C. Prime surfaces scheduled to receive sealant.

3.3 INSTALLATION

- A. Perform installation in accordance with GANA Glazing Manual.
 - 1. Glazing Sealants: Comply with ASTM C1193.
 - 2. Fire Rated Openings: Comply with NFPA 80.
- B. Exterior Dry Method (Gasket Glazing):
 - 1. Cut glazing gasket to length; install on glazing pane. Seal corners by butting tape and sealing junctions with compatible butyl sealant.
 - 2. Place setting blocks at 1/4 points with edge block no more than 6 inches from corners.
 - 3. Rest glazing on setting blocks and push against fixed stop with sufficient pressure to attain full contact.
 - 4. Install removable stops without displacing glazing spline. Exert pressure for full continuous contact.
- C. Interior Wet/Dry Method (Tape and Sealant) Installation:
 - 1. Cut glazing tape to length and install against permanent stops, projecting 1/16 inch above sight line.
 - 2. Place setting blocks at 1/4 points with edge block no more than 6 inches from corners.

3. Rest glazing on setting blocks and push against tape to ensure full contact at perimeter of pane or unit.
4. Install removable stops, spacer shims inserted between glazing and applied stops at 24 inch intervals, 1/4 inch below sight line.
5. Fill gaps between pane and applied stop with elastomeric glazing sealant to depth equal to bite on glazing, to uniform and level line.
6. Trim protruding tape edge.

3.4 MANUFACTURER'S FIELD SERVICES

- A. Division 01 – General Requirements: Manufacturers' field services.
- B. Monitor and report installation procedures, and unacceptable conditions.

3.5 CLEANING

- A. Division 01 – General Requirements: Final cleaning.
- B. Remove glazing materials from finish surfaces.
- C. Remove labels after Work is complete.
- D. Clean glass and adjacent surfaces.

3.6 PROTECTION OF INSTALLED CONSTRUCTION

- A. Division 01 – General Requirements: Protecting installed construction.
- B. After installation, mark pane with an 'X' by using removable plastic tape or paste. Do not mark heat absorbing or reflective glass units.

3.7 SCHEDULE

- A. Exterior Windows: Reference Section 13 34 19 – Metal Building Systems.
- B. Exterior Entrances: Type FG-TT gray tint, exterior wet/dry method with silicone glazing sealant exterior.
- C. Interior Non-Fire Rated Metal Doors: Type FG-CT, interior wet method with paintable polyurethane glazing sealant.
- D. Interior Fire Rated Metal Doors and Windows: Type FRG-CW, with fire rated glazing system.

END OF SECTION

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SECTION 09 21 16
GYPSUM BOARD ASSEMBLIES

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes metal stud wall framing; metal channel ceiling framing; gypsum board and joint treatment; gypsum sheathing; cementitious backer board; acoustic insulation; and textured finish.
- B. Related Sections:
 - 1. Applicable provisions of Division 01 shall govern all work under this Section.
 - 2. Section 10 28 00 – Toilet, Bath, and Laundry Accessories: Product requirements for frames for recessed washroom accessories and anchors for placement by this section.

1.2 REFERENCES

- A. ASTM International:
 - 1. ASTM C475 - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board.
 - 2. ASTM C514 - Standard Specification for Nails for the Application of Gypsum Board.
 - 3. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.
 - 4. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products.
 - 5. ASTM C1002 - Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases.
 - 6. ASTM C1178 - Standard Specification for Glass Mat Water-Resistant Gypsum Backing Panel.
 - 7. ASTM C1396 - Standard Specification for Gypsum Board.
 - 8. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
 - 9. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
 - 10. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.
- B. Gypsum Association:
 - 1. GA 214 - Recommended Levels of Gypsum Board Finish.
 - 2. GA 216 - Application and Finishing of Gypsum Board.

- C. National Fire Protection Association:
 - 1. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials.
- D. Underwriters Laboratories Inc.:
 - 1. UL - Fire Resistance Directory.

1.3 PERFORMANCE REQUIREMENTS

- A. Select stud thickness to resist minimum 5 psf uniform load and maximum 1/360 deflection.
- B. Acoustic Attenuation for Identified Interior Partitions: 48 STC in accordance with ASTM E90.

1.4 SUBMITTALS

- A. Division 01 – General Requirements: Submittal procedures.
- B. Product Data: Submit data on metal framing, gypsum board, joint tape, and acoustic accessories.

1.5 QUALITY ASSURANCE

- A. Perform Work in accordance with GA-214 and GA-216.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.
- B. Installer: Company specializing in performing Work of this section with minimum three years documented experience.

1.7 PRE-INSTALLATION MEETINGS

- A. Division 01 – General Requirements: Pre-installation meeting.
- B. Convene minimum one week prior to commencing work of this section.

PART 2 PRODUCTS

2.1 GYPSUM BOARD ASSEMBLIES

- A. Manufacturers:
 - 1. G-P Gypsum Corp.
 - 2. National Gypsum Co.
 - 3. United States Gypsum Co.

4. Substitutions: Division 01 – General Requirements.

2.2 COMPONENTS

- A. Framing Materials:
 1. Studs and Tracks: GA-216; galvanized sheet steel, 0.021 inch thick, C shape, with knurled faces.
 2. Furring, Framing, and Accessories: GA-216.
 3. Fasteners: ASTM C1002; Type S; length to suit application.
 4. Anchorage to Substrate: Tie wire, nails, screws, and other metal supports, of type and size to suit application; to rigidly secure materials in place.
- B. Gypsum Board Materials: ASTM C1396; Type X fire resistant where indicated on Drawings.
 1. Standard Gypsum Board: 5/8 inch thick, maximum available length in place; ends square cut, tapered edges.
 2. Moisture Resistant Gypsum Board: 5/8 inch thick, maximum available length in place; ends square cut, tapered edges.

2.3 ACCESSORIES

- A. Acoustic Insulation: ASTM C665, Type 1; preformed glass fiber, friction fit type, unfaced.
- B. Acoustic Sealant: Non-hardening, non-skinning, for use in conjunction with gypsum board.
- C. Gypsum Board Accessories: ASTM C1047; metal and paper combination; corner beads, edge trim, and expansion joints.
 1. Metal Accessories: Galvanized steel.
 2. Edge Trim: Type L bead.
- D. Joint Materials: GA-216; reinforcing tape, joint compound, and water.
- E. Gypsum Board Screws: ASTM C1002; length to suit application.
 1. Screws for Steel Framing: Type S.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Division 01 – General Requirements: Coordination and project conditions.
- B. Verify site conditions are ready to receive work and opening dimensions are as indicated on shop drawings and as instructed by manufacturer.

3.2 INSTALLATION

- A. Metal Stud Installation:
 - 1. Install studs in accordance with ASTM C754 and GA-216.
 - 2. Refer to Drawings for indication of partitions extending stud framing through ceiling to structure above. Maintain clearance under structural building members to avoid deflection transfer to studs. Provide extended leg ceiling runners.
 - 3. Door Opening Framing: Install double studs at door frame jambs. Install stud tracks on each side of opening, at frame head height, and between studs and adjacent studs.
 - 4. Blocking: Bolt or screw steel channels to studs. Install blocking for support of plumbing fixtures, wall cabinets, toilet accessories, and hardware.

- B. Acoustic Accessories Installation:
 - 1. Install resilient channels at maximum 16 inches on center. Locate joints over framing members.
 - 2. Place acoustic insulation in partitions tight within spaces, around cut openings, behind and around electrical and mechanical items within or behind partitions, and tight to items passing through partitions.
 - 3. Install acoustic sealant at gypsum board perimeter at:
 - a. Metal Framing: Two beads.
 - b. Base Layer.
 - c. Face Layer.
 - d. Seal penetrations of partitions by conduit, pipe, duct work, rough-in boxes, and anchors.

- C. Gypsum Board Installation:
 - 1. Install gypsum board in accordance with GA-216.
 - 2. Erect single layer standard gypsum board vertical, with ends and edges occurring over firm bearing.
 - 3. Use screws when fastening gypsum board to metal furring or framing.
 - 4. Treat cut edges and holes in moisture resistant gypsum board with sealant.
 - 5. Place corner beads at external corners. Use longest practical length. Place edge trim where gypsum board abuts dissimilar materials.

- D. Joint Treatment:
 - 1. Tape, fill, and sand exposed joints, edges, and corners to produce smooth surface ready to receive finishes.
 - 2. Feather coats on to adjoining surfaces so that camber is maximum 1/32 inch.

- E. Texture Finish: Spray apply finish texture coating.

3.3 ERECTION TOLERANCES

- A. Division 01 – General Requirements: Tolerances.

- B. Maximum Variation of Finished Gypsum Board Surface from Flat Surface: 1/8 inch in 10 feet.

END OF SECTION

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SECTION 09 65 00

RESILIENT FLOORING

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes resilient base.
- B. Related Sections:
 - 1. Applicable provisions of Division 01 shall govern all work under this Section.
 - 2. Section 09 68 13 – Tile Carpeting.

1.2 REFERENCES

- A. ASTM International:
 - 1. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
 - 2. ASTM E662 - Standard Test Method for Specific Optical Density of Smoke Generated by Solid Materials.
 - 3. ASTM F1861 - Standard Specification for Resilient Wall Base.
- B. National Fire Protection Association:
 - 1. NFPA 253 - Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source.

1.3 SUBMITTALS

- A. Division 01 – General Requirements: Submittal procedures.
- B. Shop Drawings: Indicate seaming plan, custom patterns and inlay designs.
- C. Product Data: Submit data describing physical and performance characteristics; including sizes, patterns and colors available; and installation instructions.
- D. Samples:
 - 1. Submit manufacturer's complete set of color samples for initial selection.

1.4 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum five years experience.
- B. Installer: Company specializing in performing Work of this section with minimum five years experience.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Division 01 – General Requirements: Product storage and handling requirements.
- B. Protect roll materials from damage by storing on end.

1.6 ENVIRONMENTAL REQUIREMENTS

- A. Division 01 – General Requirements.
- B. Maintain temperature in storage area between 55 degrees F and 90 degrees F.
- C. Store materials for not less than 48 hours prior to installation in area of installation at temperature of 70 degrees F to achieve temperature stability. Thereafter, maintain conditions above 55 degrees F.

PART 2 PRODUCTS

2.1 RESILIENT BASE

- A. Manufacturers:
 - 1. Armstrong.
 - 2. Johnsonite.
 - 3. Roppe.
 - 4. Substitutions: Division 01 – General Requirements and as approved by Architect.
- B. Base: ASTM F1861 Vinyl; top set toeless:
 - 1. Height: 4 inch.
 - 2. Thickness: 0.125 inch thick.
 - 3. Finish: Matte.
 - 4. Length: Roll.

2.2 ACCESSORIES

- A. Primers and Adhesives: Waterproof; types recommended by manufacturer.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Division 01 – General Requirements: Verification of existing conditions before starting work.
- B. Verify lower wall surfaces are free of substances capable of impairing adhesion of new adhesive and finish materials.

3.2 PREPARATION

- A. Clean substrate.
- B. Apply primer as required to prevent "bleed-thru" or interference with adhesion by substances cannot be removed.

3.3 INSTALLATION - BASE

- A. Fit joints tightly and make vertical. Maintain minimum dimension of 18 inches between joints.
- B. Miter internal corners. At external corners, 'V' cut back of base strip to 2/3 of its thickness and fold. At exposed ends, use premolded units.
- C. Install base on solid backing. Bond tightly to wall and floor surfaces.
- D. Scribe and fit to door frames and other interruptions.

3.4 CLEANING

- A. Division 01 – General Requirements: Final cleaning.
- B. Remove excess adhesive from base and wall surfaces without damage.

3.5 PROTECTION OF INSTALLED CONSTRUCTION

- A. Division 01 – General Requirements: Protecting installed construction.
- B. Prohibit traffic on resilient flooring for 48 hours after installation.

END OF SECTION

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SECTION 09 68 13

TILE CARPETING

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes carpet tile, fully adhered.
- B. Related Sections:
 - 1. Applicable provisions of Division 01 shall govern all work under this Section.
 - 2. Section 09 65 00 – Resilient Flooring: Resilient base.

1.2 REFERENCES

- A. Carpet and Rug Institute:
 - 1. CRI 104 - Standard for Installation of Commercial Carpet.
 - 2. CRI Green Label Plus Testing Program.
- B. Consumer Products Safety Commission:
 - 1. CPSC 16 CFR 1630 - Standard for the Surface Flammability of Carpets and Rugs.
- C. National Fire Protection Association:
 - 1. NFPA 253 - Standard Method of Test for Critical Radiant Flux for Floor Covering Systems Using a Radiant Heat Energy Source.

1.3 SUBMITTALS

- A. Division 01 – General Requirements: Submittal procedures.
- B. Product Data: Submit data on specified products, describing physical and performance characteristics; sizes, patterns, colors available, and method of installation.
- C. Samples:
 - 1. Submit two 12 inch x 12 inch carpet tiles illustrating color and pattern design for each carpet color selected. Matching roll carpet samples.
- D. Manufacturer's Installation Instructions: Submit special procedures, and perimeter conditions requiring special attention.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: Submit maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning.

1.5 QUALITY ASSURANCE

- A. Surface Burning Characteristics:
 - 1. Floor Finishes: Comply with one of the following:
 - a. Class I, minimum 0.45 watts/sq cm when tested in accordance with NFPA 253.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum five years experience.
- B. Installer: Company specializing in performing work of this section with minimum five years experience.
 - 1. FCIB or IFCI certified carpet installers.

1.7 EXTRA MATERIALS

- A. Supply 10 percent extra carpet tiles of each color and pattern selected.

PART 2 PRODUCTS

2.1 CARPET TILE

- A. Manufacturers:
 - 1. Lees Faculty IV.
 - 2. Other approved manufacturers:
 - a. Collins & Aikman Floor Coverings.
 - b. Interface Flooring Systems, Inc.
 - c. Mannington Commercial Carpet.
 - d. Milliken Carpet.
 - 3. Substitutions: As approved by Architect/Engineer.

2.2 COMPONENTS

- A. Carpet Tile: Tufted performance loop pile, manufactured in one color dye lot; conforming to the following criteria:
 - 1. Tile Size: 24 inch x 24 inch, nominal.
 - 2. Dye Method: Yard-dyed.
 - 3. Face Yarn: Antron® Legacy Nylon.
 - 4. Color: As selected from manufacturer's standard colors.
 - 5. Gage: 1/8 inch.
 - 6. Stitches: 8.3 per inch.
 - 7. Pile Weight: 26 oz/sq yd.
 - 8. Finished Pile Thickness: 0.145 inch.
 - 9. Primary Backing Material: Fiberglass-reinforced thermoplastic composite.

2.3 ACCESSORIES

- A. Sub-Floor Filler: Latex type recommended by flooring material manufacturer.
- B. Contact Adhesive: Recommended by carpet manufacturer.
 - 1. Adhesives: Maximum volatile organic compound content in accordance with SCAQMD Rule 1168.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify floor surfaces are smooth and flat and are ready to receive work.

3.2 PREPARATION

- A. Remove sub-floor ridges and bumps. Fill minor or local low spots, cracks, joints, holes, and other defects with sub-floor filler.
- B. Apply, trowel, and float filler to achieve smooth, flat, hard surface. Prohibit traffic until filler is cured.
- C. Clean substrate.

3.3 INSTALLATION

- A. Install carpet tile in accordance with CRI 104.
- B. Do not mix carpet from different cartons unless from same dye lot.
- C. Cut carpet tile clean. Fit carpet tight to intersection with vertical surfaces without gaps.
- D. Locate change of color or pattern between rooms under door centerline.
- E. Fully adhere carpet tile to substrate.
- F. Trim carpet tile neatly at walls and around interruptions.

3.4 CLEANING

- A. Remove excess adhesive from floor, base, and wall surfaces without damage.
- B. Clean and vacuum carpet surfaces.

END OF SECTION

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SECTION 09 90 00

PAINTING AND COATING

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes surface preparation and field application of paints, stains, varnishes, and other coatings.
- B. Related Sections:
 - 1. Applicable provision of Division 01 shall govern all work under this Section.
 - 2. Section 05 51 00 - Metal Stairs: Shop primed items.
 - 3. Section 09 96 00 - High-Performance Coatings.
 - 4. Division 22 - Basic Plumbing Materials and Methods: Identification.
 - 5. Section 23 05 53 - Identification for HVAC Piping and Equipment.
 - 6. Section 26 05 53 - Electrical Identification.
 - 7. Section 32 17 23 - Pavement Markings.

1.2 REFERENCES

- A. ASTM International:
 - 1. ASTM D358 – Standard Specification for Wood to be Used as Panels in Weathering Tests of Coatings.
 - 2. ASTM D522 - Standard Test Methods for Mandrel Bend Test of Attached Organic Coatings.
 - 3. ASTM D2486 – Standard Test Methods for Scrub Resistance of Wall Paints.
 - 4. ASTM D3273 – Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber.
 - 5. ASTM D3274 – Standard Test Method for Evaluating Degree of Surface Disfigurement of Paint Films by Fungal or Algal Growth, or Soil and Dirt Accumulation.
 - 6. ASTM D3359 - Standard Test Methods for Measuring Adhesion by Tape Test.
 - 7. ASTM D4442 - Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Base Materials.
 - 8. ASTM D4587 – Standard Practice for Fluorescent UV-Condensation Exposures of Paint and Related Coatings.
 - 9. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- B. ASTM International (Paint Standards Collection):
 - 1. ASTM Volume 06.01 Paint – Test Method for Chemical, Physical, and Optical Properties; Appearance.
 - 2. ASTM Volume 06.02 Paint – Material, Products and Applications; Protective

- Coatings. Pipeline Coatings.
- 3. ASTM Volume 06.03 Paint – Pigments, Drying Oils, Polymers, Resins, Naval Stores, Cellulosic Esters and Ink Vehicles.
- 4. ASTM Volume 06.04 Paint – Solvents; Aromatic Hydrocarbons.
- C. Green Seal:
 - 1. GC-43 – Environmental Standards for Recycled Paint.
- D. Master Painters Institute, Inc.:
 - 1. MPI Architectural Painting Specification Manual.
 - 2. MPI #10 RC – Detailed Performance Standard for Latex, Recycled (Consolidated), Exterior Flat (G1) White and Tints.
 - 3. MPI #53 RC – Detailed Performance Standard for Latex, Recycled (Consolidated), Interior (MPI Glass Level 1) White and Tints.
- E. National Fire Protection Association:
 - 1. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials.
- F. SSPC: The Society for Protective Coatings:
 - 1. SSPC - Steel Structures Painting Manual.

1.3 DEFINITIONS

- A. Conform to ASTM D16 for interpretation of terms used in this section.

1.4 SUBMITTALS

- A. Division 01 – General Requirements: Submittal procedures.
- B. Samples:
 - 1. Submit two paper chip samples, 4 x 4 inch in size illustrating range of colors and textures available for each surface finishing product scheduled.
- C. Manufacturer's Installation Instructions: Submit special surface preparation procedures, and substrate conditions requiring special attention.

1.5 CLOSEOUT SUBMITTALS

- A. Division 01 – General Requirements: Closeout procedures.
- B. Operation and Maintenance Data: Submit data on cleaning, touch-up, and repair of painted and coated surfaces.

1.6 QUALITY ASSURANCE

- A. Manufacturer's Record Requirements:
 - 1. Manufacturer shall be required to retain samples of each batch of qualified products for a minimum of 2 years.
 - 2. Minimum sample size for each retained product is one quart.
 - 3. Quality control records of qualified products shall be retained for a minimum of 3 years.
 - 4. All records and samples must clearly indicate the product batch number, product identifier and date produced.
 - 5. The following quality control testing shall be performed and recorded for each batch of product;
 - a. Viscosity in Ku.
 - b. Fineness of Grind – Hegman.
 - c. Gloss @60 degrees.
 - d. Sheen @85 degrees.
 - e. Hiding power by contrast ratio method.
 - 6. A draw bar application of each batch using a draw bar with a 7 mil gap shall be produced, thoroughly dried and retained for each batch of product produced.
 - 7. A roller application demonstrating the foaming characteristics shall be prepared, thoroughly dried and retained for each batch of product produced.
- B. Surface Burning Characteristics:
 - 1. Fire Retardant Finishes: Maximum 25/450 flame spread/smoke developed index when tested in accordance with ASTM E84.

1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section.
- B. Applicator: Company specializing in performing work of this section and approved by manufacturer.

1.8 PRE-INSTALLATION MEETINGS

- A. Division 01 – General Requirements: Pre-installation meeting.
- B. Convene minimum one week prior to commencing work of this section.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Division 01 – General Requirements: Product storage and handling requirements.
- B. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.

- C. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.
- D. Paint Materials: Store at minimum ambient temperature of 45 degrees F and maximum of 90 degrees F, in ventilated area, and as required by manufacturer's instructions.

1.10 ENVIRONMENTAL REQUIREMENTS

- A. Division 01 – General Requirements.
- B. Do not apply materials when surface and ambient temperatures are outside temperature ranges required by paint product manufacturer.
- C. Do not apply exterior coatings during rain or snow when relative humidity is outside humidity ranges, or moisture content of surfaces exceed those required by paint product manufacturer.
- D. Minimum Application Temperatures for Latex Paints: 45 degrees F for interiors; 50 degrees F for exterior; unless required otherwise by manufacturer's instructions.
- E. Minimum Application Temperature for Varnish Finishes: 65 degrees F for interior or exterior, unless required otherwise by manufacturer's instructions.
- F. Provide lighting level of 80 ft candle measured mid-height at substrate surface.

1.11 SEQUENCING

- A. Division 01 – General Requirements: Work sequence.
- B. Sequence application to the following:
 - 1. Do not apply finish coats until paintable sealant is applied.
 - 2. Back prime wood trim before installation of trim.

1.12 WARRANTY

- A. Division 01 – General Requirements: Product warranties and product bonds.
- B. Furnish five year manufacturer warranty for paints and coatings.

PART 2 PRODUCTS

2.1 PAINTS AND COATINGS

- A. Recycled Interior and Exterior Paint:
 - 1. Paint shall be suitable for application by brush, roller and spray equipment. If

thinning is required, the manufacturer will display information about the recommended amounts in the directions for application.

2. Paint shall be capable of curing at temperatures between 50 degrees F and 104 degrees F and a relative humidity of 30 to 80 percent.

B. Hiding Power: A dried film of the un-tinted white paint and shall have a contrast ratio of 98 or higher. Colored paint shall comply with the requirements set out below:

<u>Reflectance</u>	<u>Contrast Ratio</u>
75 and Above	96
70-75	97
65-69	98
64 and below	99

C. Reflectance: Average reflectance of a dried film of the un-tinted white paint shall not be less than 92 percent.

D. Alkali Resistance: A dried film of the paint shall show no signs of lifting, wrinkling, disintegration or more than a slight color change.

E. Scrubbability: Dried film will withstand 1000 scrub cycles for interiors and 2500 scrub cycles for exterior, without showing any breakthrough of the film, only a slight difference in appearance between the scrubbed and un-scrubbed areas of the panel, when prepared and tested in accordance with ASTM D2486.

F. Package Stability: Paint shall not thicken, skin or show any coarse particles when stored at temperatures between 40 degrees F and 104 degrees F in un-opened containers for twelve months. After 12 months, the paint shall show no hard setting and shall be readily stirrable and shall meet the requirements for grind, dry tint and applicability.

G. Applicability and Appearance:

1. When applied by brush and roller the paint shall meet the following requirements;
 - a. Paint shall have suitable consistency for good brushing and rolling properties and shall be free of coarse particles and sagging.
 - b. There shall be no objectionable odor and paint shall have a suitable re-coating and dry time. There shall be no lifting, wrinkling, lack of uniformity or other film defects.
2. There shall be no difference in color or gloss between the brushed and rolled sections of the panel. There will be a minimum of foam developed during the roller application. If foam is evident there shall be no cratering or bubbles visible from a distance of 0.5 meters in the dry film.

3. The dried finish coat shall be uniform in color, appearance and sheen. There shall be no flashing or ghosting. There will be good flow and leveling properties indicated by the absence of brush marks or roller stipple in the dry film. The gray stripe shall only be slightly visible under the one coat area and shall not be visible under the two-coat area.
 4. Flexibility: The dried film, when prepared and tested in accordance with ASTM D522, Method B, shall show no cracking, peeling or loss of adhesion when subjected to the mandrel test, using a 1/4-inch mandrel.
 5. Sorting Protocol and Filtering: The collection and sorting protocol for consolidated post consumer recycled paint shall comply with the requirements of the Green Seal Environmental Standard for recycled latex paint GS-43
- H. Recycled Exterior Paint Criteria;
1. Biological Growth: The exposed panels shall attain a surface disfigurement rating of 8 or greater when exposed in a biological test chamber following the requirements of ASTM D3273 for 4 weeks and evaluated according to the requirements of ASTM D3274.
 2. Early Water Resistance: Paint shall show no evidence of washing off the panel, lifting or wrinkling, after a continuous 5 minute exposure to the spray.
 3. Accelerating Weathering: Paint when prepared in accordance with ASTM D358 and D4587 and exposed for 500 hours, shall show no blistering, chalking, checking, cracking, flaking or loss of adhesion. There shall be a minimum color change when the exposed panels are compared with the unexposed panel.
 4. Adhesion: The dried film, when tested in accordance with ASTM D3359, shall exhibit a minimum adhesion of 4B.
- I. Accessory Materials: Linseed oil, shellac, turpentine, paint thinners and other materials not specifically indicated but required to achieve finishes specified; commercial quality.
- J. Patching Materials: Latex filler.
- K. Fastener Head Cover Materials: Latex filler.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Division 01 – General Requirements: Coordination and project conditions.
- B. Verify surfaces and substrate conditions are ready to receive Work as instructed by product manufacturer.
- C. Examine surfaces scheduled to be finished prior to commencement of work. Report conditions capable of affecting proper application.

- D. Test shop applied primer for compatibility with subsequent cover materials.
- E. Measure moisture content of surfaces using electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:
 - 1. Plaster and Gypsum Wallboard: 12 percent.
 - 2. Masonry, Concrete, and Concrete Unit Masonry: 12 percent.
 - 3. Interior Wood: 15 percent, measured in accordance with ASTM D4442.

3.2 PREPARATION

- A. Surface Appurtenances: Remove or mask electrical plates, hardware, light fixture trim, escutcheons, and fittings prior to preparing surfaces or finishing.
- B. Surfaces: Correct defects and clean surfaces capable of affecting work of this section.
- C. Aluminum Surfaces Scheduled for Paint Finish: Remove surface contamination by steam or high pressure water. Remove oxidation with acid etch and solvent washing. Apply etching primer immediately following cleaning.
- D. Gypsum Board Surfaces: Fill minor defects with filler compound. Spot prime defects after repair.
- E. Galvanized Surfaces: Remove surface contamination and oils and wash with solvent. Apply coat of etching primer.
- F. Shop Primed Steel Surfaces: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces. Prime metal items including shop primed items.
- G. Interior Wood Items Scheduled to Receive Paint Finish: Wipe off dust and grit prior to priming. Seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks after primer has dried; sand between coats.
- H. Metal Doors Scheduled for Painting: Prime metal door top and bottom edge surfaces.

3.3 APPLICATION

- A. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.
- B. Apply each coat to uniform appearance. Apply each coat of paint slightly darker than preceding coat unless specified otherwise.
- C. Sand wood and metal surfaces lightly between coats to achieve required finish.

- D. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.
- E. Prime concealed surfaces of interior woodwork with primer paint.
- F. Finishing Mechanical And Electrical Equipment:
 - 1. Refer to Division 22, Section 23 05 53, and Section 26 05 53 for schedule of color coding and identification banding of equipment, duct work, piping, and conduit.
 - 2. Paint shop primed equipment.
 - 3. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.
 - 4. Paint both sides and edges of plywood backboards for electrical and telephone equipment before installing equipment.
 - 5. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

3.4 FIELD QUALITY CONTROL

- A. Division 01 – General Requirements: Field inspecting, testing, adjusting, and balancing.

3.5 CLEANING

- A. Division 01 – General Requirements: Final cleaning.
- B. Collect waste material which may constitute fire hazard, place in closed metal containers, and remove daily from site.

END OF SECTION

SECTION 09 96 00

HIGH-PERFORMANCE COATINGS

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes high performance coatings and special preparation of surfaces.
- B. Related Sections:
 - 1. Applicable provisions of Division 01 shall govern all work under this Section.
 - 2. Section 09 90 00 - Painting and Coating.

1.2 REFERENCES

- A. ASTM International:
 - 1. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
 - 2. ASTM E96 – Standard Test Methods for Water Vapor Transmission of Materials.
 - 3. ASTM D2240 - Standard Test Method for Rubber Property—Durometer Hardness.
- B. Federal Specification Unit:
 - 1. FS TT-C-555 - Coating, Textured (For Interior and Exterior Masonry Surfaces).
- C. SSPC: The Society for Protective Coatings:
 - 1. SSPC SP 2 - Hand Tool Cleaning.
 - 2. SSPC SP 3 - Power Tool Cleaning.
 - 3. SSPC SP 5 - White Metal Blast Cleaning.
 - 4. SSPC SP 6 - Commercial Blast Cleaning.
 - 5. SSPC SP 7 - Brush-Off Blast Cleaning.
 - 6. SSPC SP 10 - Near-White Blast Cleaning.

1.3 PERFORMANCE REQUIREMENTS

- A. Minimum Performance Criteria: Provide coating systems meeting the following, unless more stringent criteria are specified:
 - 1. Hardness: 70, when tested in accordance with ASTM D2240, Shore D.
 - 2. Lead Content: None.
 - 3. Water Vapor Transmission: 0.012 grams/hr/sq ft., when tested in accordance with E-96.

1.4 SUBMITTALS

- A. Division 01 - Submittal Procedures: Requirements for submittals.

- B. Product Data: Submit data indicating coating materials and performance ratings.
- C. Submit two samples 6 x 6 inch in size illustrating colors available for selection.
- D. Manufacturer's Installation Instructions: Submit special procedures and perimeter conditions requiring special attention.
- E. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

1.5 CLOSEOUT SUBMITTALS

- A. Division 01 - Execution Requirements: Closeout procedures.
- B. Operation and Maintenance Data: Submit maintenance and cleaning requirements for coatings and repair and patching techniques.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum five years experience.
- B. Applicator: Company specializing in performing Work of this section with minimum five years experience.

1.7 MOCKUP

- A. Division 01 - Quality Requirements: Mock-up requirements.
- B. Construct one mock-up, 5 feet long by 5 feet wide, illustrating coating, color, and surface sheen, for each specified coating.
- C. Locate where directed by Construction Manager.
- D. Incorporate accepted mockup as part of Work.

1.8 PRE-INSTALLATION MEETINGS

- A. Division 01 - Administrative Requirements: Pre-installation meeting.
- B. Convene minimum one week prior to commencing work of this section.

1.9 ENVIRONMENTAL REQUIREMENTS

- A. Division 01 - Product Requirements.
- B. Do not install materials when temperature is below 55 degrees F or above 90 degrees F.

- C. Maintain this temperature range, 24 hours before, during, and 72 hours after installation of coating.
- D. Provide lighting level of 80 ft candles measured mid-height at substrate surface.
- E. Restrict traffic from area where coating is being applied or is curing.

1.10 WARRANTY

- A. Division 01 – General Requirements: Product warranties and product bonds.
- B. Warranty: Include coverage for bond to substrate and degradation of chemical resistance.

1.11 EXTRA MATERIALS

- A. Division 01 - Execution and Closeout Requirements: Spare parts and maintenance products.
- B. Supply 1 gallon of each color of each type of coating specified, for Owner's maintenance use.
- C. Label each container with manufacturer's name, product number, color number, and room names and numbers where used.

PART 2 PRODUCTS

2.1 HIGH PERFORMANCE COATINGS

- A. Manufacturers:
 - 1. Carboline Company.
 - 2. Duron Inc.
 - 3. Tnemec Co., Inc.
 - 4. Substitutions: Division 01 - Product Requirements.

2.2 COMPONENTS

- A. Coatings - General: Furnish complete multi-coat systems formulated and recommended by manufacturer for applications indicated, in thicknesses indicated; number of coats specified does not include primer or filler coat.
 - 1. Lead content: None.
 - 2. Chromium content, as zinc chromate or strontium chromate: None.
 - 3. Maximum VOC content: As required by applicable regulations.
 - 4. Colors: Selected from manufacturer's standard colors.
- B. High-Build Epoxy Coatings:
 - 1. Type 1 Concrete Walls (HHW): High Build: Epoxy coating, two coats;
 - a. Percentages of solids by volume: 99 percent minimum.
 - b. Dry Film Thickness: 8 mils, each coat.
 - c. Product: Sanitile 755, solvent-free epoxy, manufactured by Carboline, Inc.,

- 10 mils minimum.
 - d. Primer: Sanitile 755, solvent-free epoxy, manufactured by Carboline, Inc., 10 mils thick minimum.
 - 2. Type 2 Concrete Masonry Unit (CMU) Walls (HHW): High Build;
 - a. Percentages of solids by volume: 59 percent minimum.
 - b. Dry Film Thickness: 5 mils, each coat.
 - c. Product: Sanitile 655, epoxy, manufactured by Carboline, Inc., 5 mils minimum.
 - d. Primer: Sanitile 600, epoxy block filler, 10 mils minimum.
- C. (Type 3) Epoxy Floor Coating: Two coats, two-part epoxy, non-skid finish.
 - 1. Percentage of solids by volume: 100 percent minimum.
 - 2. Dry film thickness, per coat: 25 mils, minimum.
 - 3. Comply with performance requirements specified above.
 - 4. Comply with performance requirements of MIL C-22750.
 - 5. Product: Sanitile 945SL manufactured by Carboline, Inc.
- D. Masonry Filler: Vehicle and resin compatible with topcoats, portland cement and sand, formulated for applied thickness of 30-40 mils; manufactured by Carboline, Inc.
- E. Primers: As recommended by coating manufacturer for specific substrate, unless otherwise specified.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Division 01 – General Requirements: Coordination and project conditions.
- B. Verify substrate surfaces are ready to receive work as instructed by coating manufacturer. Obtain and follow manufacturer's instructions for examination and testing of substrates.
- C. Cementitious Substrates: Do not begin application until substrate has cured 28 days minimum and measured moisture content is not greater than 16 percent.
- D. Masonry: Verify masonry joints are struck flush.

3.2 PREPARATION

- A. Clean surfaces of loose foreign matter.
- B. Substrate must be dry and free of wax, grease and oils.
- C. Concrete floors shall be cured for 28 days and have the following characteristics:
 - 1. Substrate Tensile Strength: Minimum 300 psi.
 - 2. pH in the range of 7 to 11.
 - 3. Surface must show open pores throughout and have a sandpaper texture.

- D. Remove finish hardware, fixture covers, and accessories and store.
- E. Protect adjacent surfaces and materials not receiving coating from overspray; mask when necessary to provide adequate protection. Repair damage.

3.3 INSTALLATION

- A. Apply primer to all surfaces, unless specifically not required by coating manufacturer.
- B. Concrete: Prior to priming, patch with masonry filler to produce smooth surface.
- C. Concrete Masonry Units: Apply masonry filler to thickness required to fill holes and produce smooth surface; minimum thickness of 30 mils.
- D. Apply coatings to thicknesses specified.
- E. Apply in uniform thickness coats, without runs, drips, pinholes, brush marks, or variations in color, texture, or finish. Finish edges, crevices, corners, and other changes in dimension with full coating thickness.

3.4 CLEANING

- A. Division 01 – General Requirements: Final cleaning.
- B. Collect waste material which may constitute fire hazard, place in closed metal containers, and remove daily from site.
- C. Clean surfaces immediately of overspray, splatter, and excess material.
- D. After coating has cured, clean and replace finish hardware, fixtures, and fittings previously removed.

3.5 SCHEDULE

- A. Colors: As selected from manufacturer's standard color range.
- B. CMU Walls in Breakroom, Product Area, Product Exchange, Corridor, and Solvent Bulking: Type 2 High-build epoxy, semi-gloss.
- C. Concrete Walls in Product Area, Product Exchange, and Solvent Bulking: Type 1 High-build epoxy, gloss.
- D. Concrete Floors: Type 3 epoxy floor coating, non-skid finish.

END OF SECTION

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SECTION 10 14 00
SIGNAGE

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes interior signs.
- B. Related Sections:
 - 1. Applicable provisions of Division 01 shall govern all work under this Section.

1.2 SUBMITTALS

- A. Division 01 – General Requirements: Submittal procedures.
- B. Shop Drawings: Indicate sign styles, lettering font, foreground and background colors, locations, overall dimensions of each sign.
- C. Samples: Submit two signs, full size in size illustrating type, style, letter font, and colors specified; method of attachment.
- D. Manufacturer's Installation Instructions: Submit installation template and attachment devices.

1.3 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three (3) years experience.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Division 01 – General Requirements: Product storage and handling requirements.
- B. Package signs, labeled in name groups.

1.5 ENVIRONMENTAL REQUIREMENTS

- A. Division 01 – General Requirements: Environmental conditions affecting products on site.
- B. Do not install signs when ambient temperature is lower than recommended by manufacturer.
- C. Maintain this minimum temperature during and after installation of signs.

PART 2 PRODUCTS

2.1 INTERIOR SIGNS

- A. Manufacturers:
 - 1. APCO Graphics.
 - 2. ASI Sign Systems.
 - 3. Daktronics, Inc.
 - 4. FFI Group, Inc.
 - 5. Mills Manufacturing.
 - 6. Unicor.
 - 7. Substitutions: Division 01 – General Requirements as approved by Architect.

2.2 COMPONENTS

- A. Engraved Signs: Laminated colored plastic; lettering engraved through face to expose core color:
 - 1. Face Color: Color as selected.
 - 2. Core Color: White.
 - 3. Total Thickness: 1/8 inch.
 - 4. Height: 2 inches.
 - 5. Edges: Square.
 - 6. Character Font: Helvetica.

2.3 ACCESSORIES

- A. Mounting Hardware: Chrome screws.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Division 01 – General Requirements: Verification of existing conditions before starting work.

3.2 INSTALLATION

- A. Install signs after doors and surfaces are finished, in locations as directed by Owner.
- B. Position sign 6 inches from strike side of door; on door surface, level.
- C. Locate sign on wall surface, level.

3.3 SCHEDULES

- A. Door Signs: Individual Helvetica letters, 1-inch high, white color, identifying name indicated below:
 - 1. Office.

2. Product Exchange (2 each)
 3. Employees Only (3 each)
 4. Keep Door Closed at All Times (8 each)
- B. Toilet Room Graphics: 6 inches high, unisex graphic image, black color, located on toilet room door.
- C. At Eye Wash Stations: Signage per applicable code.

END OF SECTION

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SECTION 10 28 00

TOILET, BATH, AND LAUNDRY ACCESSORIES

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes toilet accessories; shower accessories; and utility room accessories.
- B. Related Sections:
 - 1. Applicable provision of Division 01 shall govern all work under this Section.
 - 2. Section 04 05 03 – Masonry Mortaring and Grouting: Placement of concealed anchor devices.

1.2 REFERENCES

- A. ASTM International:
 - 1. ASTM A123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - 2. ASTM A153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 - 3. ASTM A269 - Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
 - 4. ASTM A653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - 5. ASTM A666 - Standard Specification for Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
- B. Federal Specification Unit:
 - 1. FS A-A-3002 - Mirrors, Glass.
- C. South Coast Air Quality Management District:
 - 1. SCAQMD Rule 1168 - Adhesive and Sealant Applications.

1.3 DESIGN REQUIREMENTS

- A. Design grab bars, shower seats, dressing room bench seats, and attachments to resist forces as required by applicable code.

1.4 SUBMITTALS

- A. Division 01 – General Requirements: Submittal procedures.
- B. Product Data: Submit data on accessories describing size, finish, details of function, attachment methods.

- C. Manufacturer's Installation Instructions: Submit special procedures, and conditions requiring special attention.

1.5 COORDINATION

- A. Division 01 – General Requirements: Coordination and project conditions.
- B. Coordinate the Work with placement of internal wall reinforcement to receive anchor attachments.

PART 2 PRODUCTS

2.1 TOILET AND BATH ACCESSORIES

- A. Manufacturers:
 - 1. American Specialties, Inc.
 - 2. Bobrick Washroom Accessories.
 - 3. Bradley Corp.
 - 4. Sloan Jansan.
 - 5. Substitutions: Division 01 – General Requirements.

2.2 COMPONENTS

- A. Accessories - General: Shop assembled, free of dents and scratches and packaged complete with anchors and fittings, steel anchor plates, adapters, and anchor components for installation.
 - 1. Grind welded joints smooth.
 - 2. Fabricate units made of metal sheet of seamless sheets, with flat surfaces.
- B. Keys: Furnish two (2) keys for each accessory to Owner.
- C. Adhesive: Two component epoxy type, waterproof.
 - 1. Interior Adhesives: Maximum volatile organic compound content in accordance with SCAQMD Rule 1168.
- D. Fasteners, Screws, and Bolts: Hot dip galvanized, tamper-proof.
- E. Expansion Shields: Fiber, lead, or rubber as recommended by accessory manufacturer for component and substrate.

2.3 TOILET ROOM ACCESSORIES

- A. Toilet Paper Dispenser: Double roll, surface mounted bracket type, chrome-plated zinc alloy brackets.
 - 1. Product: 522 manufactured by Bradley Corp.

- B. Towel Dispenser: Surface mounted, stainless steel; welded construction, door secured with full length stainless steel piano hinge and tumbler locks, keyed.
 - 1. Towel dispenser capacity: One standard core 8-inch or 9-inch wide x 800 feet long paper towel roll.
 - 2. Product: 2483 manufactured by Bradley Corp.
- C. Soap Dispenser: Foam soap dispenser, wall-mounted, battery-operated, touchless, with cartridge refill, hands free sensor.
 - 1. Minimum Capacity: 40 ounces.
 - 2. Product: SJS-1150 manufactured by Sloan Jansan.
- D. Mirrors: Stainless steel framed, 6 mm thick tempered glass mirror.
 - 1. Size: 18 x 30.
 - 2. Frame: Mitered and welded and ground corners, satin finish.
 - 3. Backing: Full-mirror sized, galvanized steel sheet and nonabsorptive filler material.
 - 4. Fixed Tilt Mirrors.
 - 5. Product: 740-1830 manufactured by Bradley Corp.
- E. Grab Bars: Stainless steel, 1-1/2 inches outside diameter, minimum 0.05 inch wall thickness, nonslip grasping surface finish, concealed flange mounting; 1-1/2 inches clearance between wall and inside of grab bar.
 - 1. Length and configuration: As indicated on Drawings.
 - 2. Product: 812 manufactured by Bradley Corp.
- F. Sanitary Napkin Disposal Unit: Stainless steel, surface-mounted, self-closing door, locking bottom panel with full-length stainless steel piano-type hinge, removable receptacle.
 - 1. Product: 4791-15 manufactured by Bradley Corp.

2.4 SHOWER ACCESSORIES

- A. Shower Curtain Rod: Stainless steel tube, 1-1/4 inch outside diameter, 18 gage stainless steel, satin-finished, with 3 inch outside diameter, minimum 22 gage satin-finished stainless steel escutcheon over glass polypropylene flanges, for concealed mounting.
 - 1. Product: #9539 manufactured by Bradley Corp.
- B. Shower Curtain: Nylon reinforced vinyl, 0.008 inch thick, matte finish, with antibacterial treatment, flame resistant and stain-resistant fabric.
- C. Folding Shower Seat: Wall-mounted surface; welded tubular seat frame, structural support members, hinges and mechanical fasteners of Type 304 stainless steel, rectangular-shaped, right-hand seat.
 - 1. Seat: Phenolic or polymeric composite one-piece seat.
 - 2. Product: 9557 manufactured by Bradley Corp.
- D. Wall-Mounted Soap Dish: Heavy duty, seamless stainless steel, surface-mounted with drain holes, without grab bar, satin finish; with mechanical fastening suitable for substrate:

1. Product: 921 manufactured by Bradley Corp.
- E. Towel Pin: Stainless steel, 5 inch extension from wall; rectangular-shaped bracket and backplate for concealed attachment, satin finish.
 1. Product: 9311 manufactured by Bradley Corp.
- F. Robe Hook: Heavy-duty stainless steel, double-prong, rectangular-shaped bracket and backplate for concealed attachment, satin finish.
 1. Product: 932 manufactured by Bradley Corp.

2.5 FACTORY FINISHING

- A. Stainless Steel: No. 4 satin brushed finish, unless otherwise noted.
- B. Shop Primed Ferrous Metals: Pretreat and clean, spray apply one coat primer and bake.
- C. Back paint components where contact is made with building finishes to prevent electrolysis.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Division 01 – General Requirements: Coordination and project conditions.
- B. Verify exact location of accessories for installation.
- C. Verify field measurements are as instructed by manufacturer.
- D. See Section 04 05 03 – Masonry Mortaring and Grouting for installation of reinforcing plates and concealed anchors in walls.

3.2 PREPARATION

- A. Deliver inserts and rough-in frames to site for timely installation.
- B. Provide templates and rough-in measurements as required.

3.3 EXISTING WORK

- A. Clean and repair existing toilet accessories which remain or are to be reinstalled.

3.4 INSTALLATION

- A. Install plumb and level, securely and rigidly anchored to substrate.
- B. Mounting Heights and Locations: As required by accessibility regulations.

END OF SECTION

SECTION 10 44 00

FIRE PROTECTION SPECIALTIES

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Fire extinguishers and brackets for wall mounting.
 - 2. Graphic Identification.
- B. Related Sections:
 - 1. Applicable provision of Division 01 shall govern all work under this Section.
 - 2. Section 06 10 53 - Miscellaneous Rough Carpentry: Wood blocking and shims.
 - 3. Section 09 90 00 - Painting and Coating: Field applied paint finish.

1.2 REFERENCES

- A. National Fire Protection Association:
 - 1. NFPA 10 - Standard for Portable Fire Extinguishers.
- B. Underwriters Laboratories Inc.:
 - 1. UL - Fire Protection Equipment Directory.

1.3 PERFORMANCE REQUIREMENTS

- A. Conform to NFPA 10 code.
- B. Provide extinguishers classified and labeled by Underwriters Laboratories, Inc. for purpose specified and indicated.

1.4 SUBMITTALS

- A. Division 01 – General Requirements: Submittal procedures.
- B. Product Data: Submit extinguisher operational features, color, finish and anchorage details.
- C. Manufacturer's Installation Instructions: Submit special criteria and wall opening coordination requirements.
- D. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

1.5 CLOSEOUT SUBMITTALS

- A. Division 01 – General Requirements: Closeout procedures.

- B. Operation and Maintenance Data: Submit test, refill or recharge schedules and re-certification requirements.

1.6 ENVIRONMENTAL REQUIREMENTS

- A. Division 01 – General Requirements: Environmental conditions affecting products on site.
- B. Do not install extinguishers when ambient temperatures are capable of freezing extinguisher ingredients.

PART 2 PRODUCTS

2.1 FIRE EXTINGUISHERS

- A. Manufacturers:
 - 1. Ansul Incorporated.
 - 2. JL Industries.
 - 3. Kidde Fire Extinguishers.
 - 4. Nystrom Products Co.
 - 5. Substitutions: Division 01 – General Requirements.
- B. Water Type: Stainless steel tank, pressurized, including hose and nozzle; size and classification as scheduled.
- C. Dry Chemical Type: Cast steel tank, with pressure gage; Class A, B, and C, Size 10.
- D. Carbon Dioxide Type: Stainless steel tank, with pressure gage; Class B and C.
- E. Dry Powder: Class D – Dry powder stored pressure extinguisher.
- F. Extinguisher Finish: Stainless steel, No. 4 finish.

2.2 ACCESSORIES

- A. Extinguisher Brackets: Formed steel, galvanized finish.
- B. Graphic Identification: Signage as required by Code.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Division 01 – General Requirements: Coordination and project conditions.
- B. Verify rough openings for cabinet are correctly sized and located.

3.2 INSTALLATION

- A. Install wall brackets, maximum 48 inches from finished floor to top of extinguisher handle.
- B. Secure rigidly in place.
- C. Place extinguishers on wall brackets.

END OF SECTION

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SECTION 11 13 13

LOADING DOCK BUMPERS

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes dock bumpers with attachment frame.
- B. Related Sections:
 - 1. Applicable provisions of Division 01 shall govern all work under this Section.
 - 2. Section 03 31 00 – Structural Concrete: Execution requirements for placement of bumper anchors into concrete loading dock.
 - 3. Section 13 34 19 – Metal Building Systems.

1.2 SUBMITTALS

- A. Division 01 – General Requirements: Submittal requirements.
- B. Product Data: Submit unit dimensions, method of anchorage, and details of construction.
- C. Manufacturer's Installation Instructions: Submit special installation requirements.

1.3 DOCK BUMPERS

- A. Manufacturers:
 - 1. Rite-Hite Corp. – Extra Thick Series.
 - 2. Other approved manufacturers:
 - a. Blue Giant USA Corp.
 - b. Kelley Dock Systems
 - 3. Substitutions: Division 01 – General Requirements.

1.4 COMPONENTS

- A. Bumpers: Fabric reinforced rubber pads, ozone resistant, laminated and compressed in position between 1/4-inch galvanized steel angle plates:
 - 1. Projection From Wall: 12 inches.
 - 2. Vertical Height: 12 inches.
 - 3. Length: 24 inches.
- B. Attachment Hardware: 3/4 - inch diameter “L” shaped anchor rods for casting into concrete.

PART 2 EXECUTION

2.1 EXAMINATION

- A. Division 01 – General Requirements: Coordination and project conditions.
- B. Verify anchor placement is acceptable.

2.2 PREPARATION

- A. Coordinate integral anchor placement by Section 03 31 00 – Structural Concrete and Section 13 34 19 – Metal Building Systems.

2.3 INSTALLATION

- A. Install dock bumpers.
- B. Set plumb and level.
- C. Secure angle end frames to concrete.
- D. Weld angle end frames to embedded anchors. Touch up weld with primer.

END OF SECTION

SECTION 11 13 19

LOADING DOCK LEVELERS

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes;
 - 1. Prefabricated steel leveler.
 - 2. Operating hardware.
- B. Related Sections:
 - 1. Applicable provision of Division 01 shall govern all work under this Section.
 - 2. Section 03 31 00 - Structural Concrete: Concrete pit.
 - 3. Section 11 13 13 – Loading Dock Bumpers.
 - 4. Division 26 – Electrical: Wiring connections.

1.2 REFERENCES

- A. ASTM International:
 - 1. ASTM A653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- B. National Electrical Manufacturers Association:
 - 1. NEMA MG 1 - Motors and Generators.
- C. Underwriters Laboratories Inc.:
 - 1. UL - Electrical Appliance and Utilization Equipment Directory.

1.3 SUBMITTALS

- A. Division 01 – General Requirements: Submittal requirements.
- B. Shop Drawings: Indicate required opening dimensions, tolerances of opening dimensions, and perimeter conditions.
- C. Product Data: Submit materials and finish, installation details, roughing-in measurements, and operation of unit.
- D. Manufacturer's Installation Instructions: Submit manufacturer's installation instructions.

1.4 CLOSEOUT SUBMITTALS

- A. Division 01 – General Requirements: Closeout procedures.

- B. Operation and Maintenance Data: Submit operating instructions, identify unit limitations. Submit unit maintenance information, lubrication cycles, spare parts manual.

1.5 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum five years documented experience, and with service facilities within 100 miles of project.
- B. Installer: Company specializing in performing Work of this section with minimum five years experience and approved by manufacturer.

PART 2 PRODUCTS

2.1 DOCK LEVELERS

- A. Manufacturers:
 - 1. Rite-Hite Corp.: Series RHH.
 - 2. Other approved manufacturers:
 - a. Blue Giant USA Corp.
 - b. Kelley Dock Systems.
 - 3. Substitutions: Division 01 – General Requirements.

2.2 COMPONENTS

- A. Dock Leveler:
 - 1. Operation: Hydraulic.
 - 2. Deck Width: 76-inch.
 - 3. Deck Length: 78-inch.
 - 4. Operating Range: 12 inches above dock level, 12 inches below dock level.
 - 5. Capacity: As determined by Manufacturer.
- B. Leveler: ANSI MH30.1, Test Load Specification with Proper Identification from a 3rd Party.
 - 1. Dock leveler shall meet ANSI MH30.1-2000 test load specifications with proper documentation from a third party.
 - 2. When leveler is in stored position, the leveler lip will provide an integral and automatically-positioned, impact-rated, solid barrier 5 inches above building floor to help prevent accidental falls from vacant dock positions. Unobstructed end loading shall be possible from below dock level. Overlapping platform barriers or pinch points are not acceptable.
 - 3. Levelers shall have ramp flex of 4 inches to compensate for unlevel trailer beds. Rear hinges shall be fixed and shall not rise above floor level.
- C. Pit Frame: Steel angle, 3 x 3 x 1/4 inch; welded corners, fitted with anchors for concrete embedment. Anchor placement shall be determined by Manufacturer.

- D. Attachment Hardware: Galvanized bolts and "L" shaped anchor rods for casting into concrete.

2.3 ELECTRICAL CHARACTERISTICS AND COMPONENTS

- A. Electrical Characteristics: In accordance with Division 26 – Electrical.
- B. Motors: NEMA MG 1.
- C. Controls: Reference Division 26 - Electrical.
- D. Disconnect Switch: Factory mount disconnect switch in control panel.

2.4 FACTORY FINISHING

- A. Leveler Platform: Hot dip galvanized to 1.25 oz/sq ft finish.
- B. Leveler Frame: Hot dip galvanized to 1.25 oz/sq ft finish.
- C. Pit Frame: Hot dip galvanized to 1.25 oz/sq ft finish.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Division 01 – General Requirements: Coordination and project conditions.
- B. Verify rough-in opening is acceptable.

3.2 PREPARATION

- A. Coordinate pit frame and integral anchor placement by Section 03 31 00 – Structural Concrete.

3.3 INSTALLATION

- A. Install dock leveler unit in prepared opening.
- B. Set square and level.
- C. Anchor unit securely, flush with dock. Weld back of leveling dock to pit frame. Touch-up weld with primer.

3.4 ADJUSTING

- A. Division 01 – General Requirements: Testing, adjusting, and balancing.
- B. Adjust installed unit or smooth and balanced operation.

3.5 DEMONSTRATION AND TRAINING

- A. Demonstrate operation and maintenance requirements to Owner's personnel.

END OF SECTION

SECTION 13 34 19

METAL BUILDING SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes:
1. Pre-engineered, shop fabricated structural steel building frame insulated.
 2. Metal wall and sloped roof system including;
 - a. Soffits.
 - b. Gutters and downspouts.
 - c. Roof mounted equipment curbs.
 - d. Exterior doors windows, overhead doors, and louvers.
 - e. Explosion control panels.
- B. Related Sections:
1. Applicable provisions of Division 01 shall govern all work under this Section.
 2. Section 03 31 00 – Structural Concrete: Execution requirements for placement of anchor bolts and base plates specified in this section in concrete.
 3. Section 07 90 00 - Joint Protection.
 4. Section 09 90 00 - Painting and Coating: Finish painting of inside surface of liner sheet as scheduled on Drawings.
 5. Division 21: Fire protection rough-in utilities.
 6. Division 22: Plumbing rough-in utilities.
 7. Division 23: HVAC rough-in utilities.
 8. Division 26 - Electrical: Electrical rough-in utilities.

1.2 REFERENCES

- A. American Institute of Steel Construction:
1. AISC S335 - Specification for Structural Steel Buildings Allowable Stress Design, and Plastic Design.
 2. AISC S342L - Load and Resistance Factor Design Specification for Structural Steel Buildings.
 3. AISC S344L - Metric Load and Resistance Factor Design Specification for Structural Steel Buildings.
- B. American Iron and Steel Institute (AISI):
1. Specification for the Design of Cold-Formed Steel Structural Members.
 2. Specification for the Design, Fabrication and Erection of Structural Steel for Buildings.

- C. ASTM International:
1. ASTM A36 - Standard Specification for Carbon Structural Steel.
 2. ASTM A123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 3. ASTM A153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 4. ASTM A307 - Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength.
 5. ASTM A325 - Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
 6. ASTM A500 - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
 7. ASTM A572 - Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel.
 8. ASTM A653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 9. ASTM A792 - Standard Specification for Steel Sheet, 55 Percent Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.
 10. ASTM A992 - Steel for Structural Shapes For Use in Building Framing.
 11. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.
 12. ASTM C991 - Standard Specification for Flexible Glass Fiber Insulation for Pre-Engineered Metal Buildings.
 13. ASTM C1107 - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).
 14. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
 15. ASTM E96 - Standard Test Methods for Water Vapor Transmission of Materials.
- D. American Welding Society:
1. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination.
 2. AWS D1.1 - Structural Welding Code - Steel.
- E. Glass Association of North America:
1. GANA - Sealant Manual.
 2. GANA - Glazing Manual.
 3. GANA - Laminated Glass Design Guide.
- F. Metal Building Manufacturers Association:
1. MBMA - Low Rise Building Systems Manual.
- G. National Fenestration Rating Council Incorporated:
1. NFRC 100 - Procedures for Determining Fenestration Product U-Factors.

2. NFRC 200 - Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence.
 3. NFRC 300 - Test Method for Determining the Solar Optical Properties of Glazing Materials and Systems.
- H. SSPC: The Society for Protective Coatings:
1. SSPC - Steel Structures Painting Manual.
 2. SSPC Paint 20 - Zinc-Rich Primers (Type I - Inorganic and Type II - Organic).
- I. Underwriters Laboratories Inc.:
1. UL - Building Materials Directory.
 2. UL 723 - Tests for Surface Burning Characteristics of Building Materials.
- J. U.S. Environmental Protection Agency:
1. ENERGY STAR - ENERGY STAR Voluntary Labeling Program.

1.3 SYSTEM DESCRIPTION

- A. Single span rigid frame.
- B. Bay Spacing: Reference Drawings.
- C. Primary Framing: Rigid frame of rafter beams and columns, canopy beams, braced end frames, end wall columns and wind bracing.
- D. Secondary Framing: Purlins, girts, eave struts, flange bracing, sill supports, clips, and other items detailed.
- E. Wall System: Preformed metal panels of vertical profile, with sub-girt framing/anchorage assembly, insulation, liner sheets and accessory components.
- F. Roof System: Preformed metal panels of upslope profile, with sub-girt framing/anchorage assembly, insulation, liner sheets and accessory components.
- G. Roof Slope: 1/2 – inch.

1.4 DESIGN REQUIREMENTS

- A. Thermal resistance of Installed Wall System:
 1. WTS: R-Value of 11.
 2. HHW: R-Value of 13.
- B. Thermal Resistance of Installed Roof System:
 1. WTS: R-Value of 10.
 2. HHW: R-Value of 19.

- C. Design members to withstand dead load, applicable snow load, vertical and horizontal seismic loads, and design loads due to pressure and suction of wind calculated in accordance with applicable code.
- D. Design members to support mechanical and electrical equipment and fire sprinkler system piping indicated.
- E. Maximum Allowable Vertical Deflection: 1/180 of span with imposed loads for exterior wall and roof system.
- F. Maximum Allowable Horizontal Deflection: 1/200 of height.
- G. Provide drainage to exterior for water entering or condensation occurring within wall or roof system.
- H. Permit movement of components without buckling, failure of joint seals, undue stress on fasteners or other detrimental effects, when subject to temperature range of 75 degrees F.
- I. Size and fabricate wall and roof systems free of distortion or defects detrimental to appearance or performance.

1.5 PERFORMANCE REQUIREMENTS

- A. Conform to applicable code for submission of design calculations and reviewed shop and erection drawings as required for acquiring permits.
- B. Cooperate with regulatory agency or authority and provide data as requested authority having jurisdiction.
- C. Provide components of each type from one manufacturer compatible with adjacent materials.
- D. Vapor Retarder Permeance: Maximum 1 perm when tested in accordance with ASTM E96, Procedure A.
- E. Thermal and Solar Optical Performance: Measured or calculated in accordance with the following:
 - 1. U-values: NFRC 100.
 - 2. Solar Heat Gain Coefficients: NFRC 200.
 - 3. Solar Optical Properties: NFRC 300.

1.6 SUBMITTALS

- A. Division 01 – General Requirements: Submittal procedures.
- B. Shop Drawings:
 - 1. Indicate assembly dimensions, locations of structural members, connections,

1.10 PRE-INSTALLATION MEETINGS

- A. Division 01 – General Requirements: Pre-installation meeting.
- B. Convene minimum one week prior to commencing work of this section.

1.11 WARRANTY

- A. Division 01 – General Requirements: Product warranties and product bonds.
- B. Furnish five year manufacturer warranty for pre-engineered building systems and components.
- C. Furnish five year warranty to include coverage for exterior pre-finished surfaces color coat against chipping, cracking or crazing, blistering, peeling, chalking, or fading. Include coverage for weather tightness of building enclosure elements after installation.

PART 2 PRODUCTS

2.1 PRE-ENGINEERED BUILDINGS

- A. Manufacturers:
 - 1. Butler Manufacturing Co.
 - 2. Lester Building Systems.
 - 3. Varco-Pruden Buildings.
 - 4. Foremost Buildings, Inc.
 - 5. Substitutions: Division 01 – General Requirements.

2.2 COMPONENTS - FRAMING

- A. Structural Steel Members: ASTM A36 or A572, Grade 50.
- B. Structural Tubing: ASTM A500, Grade B.
- C. Plate or Bar Stock: ASTM A36.
- D. Anchor Bolts: ASTM A307, unprimed.
- E. Bolts, Nuts, and Washers: ASTM A325.
- F. Welding Materials: AWS D1.1; type required for materials being welded.
- G. Primer: SSPC Paint 20, Red Oxide.
- H. Grout: ASTM C1107, Non-shrink type, premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents, capable of developing minimum compressive strength of 2400 psi in two days and 7000 psi in 28 days.

2.3 COMPONENTS - WALL AND ROOF SYSTEM

- A. Sheet Steel Stock: ASTM A653 galvanized to G90 designation.
- B. Sheet Steel Stock: ASTM A792 aluminum-zinc alloy Coating Designation AZ50.
- C. Insulation: Batt or roll glass fiber type, unfaced, paper-faced and faced with reinforced white vinyl, friction fit, 6 inches thick.
- D. Joint Seal Gaskets: Manufacturer's standard type.
- E. Fasteners: Manufacturer's standard type, galvanized, finish to match adjacent surfaces when exterior exposed.
- F. Bituminous Paint: Asphaltic type.
- G. Sealant: Manufacturer's standard type, non-staining, elastomeric, skinning.
- H. Roof Curbs: Insulated metal same as roofing, thickness indicated on shop drawings, designed for imposed equipment loads, anchor fasteners to equipment, counterflashed to metal roof system.
- I. Trim, Closure Pieces, Caps, Flashings, Facias and Infills: Same material, thickness and finish as exterior sheets; brake formed to required profiles.

2.4 COMPONENTS - METAL DOORS AND FRAMES

- A. Doors: Specified in Section 08 12 14 – Standard Steel Frames.
- B. Frames: Specified in Section 08 13 14 – Standard Steel Doors.

2.5 COMPONENTS - OVERHEAD DOORS

- A. Overhead Doors: Specified in Section 08 36 13 – Sectional Doors.
- B. Overhead Door Frame: Formed steel sections braced to building frame specified in Section 05 50 00 – Metal Fabrications.

2.6 COMPONENTS - WINDOWS

- A. Clear Uncoated Float Glass:
 - 1. Description: Annealed clear float glass meeting requirements of ASTM C1036, Type 1, Class 1, Quality q3.
 - 2. Minimum Glass Thickness: 1/4-inch.

- B. Heat-Strengthened Glass:
 - 1. Cut float glass materials to indicated sizes and provide cut-outs and holes, if indicated, before heat strengthening.
 - 2. Heat strengthen float glass materials in accordance with ASTM C1048, Kind HS.

- C. Low-Emissivity Coated Float Glass:
 - 1. Description: Annealed clear coated float glass meeting requirements of ASTM C 1036, Type 1, Class 1, Quality q3; with pyrolytic coating meeting the requirements of ASTM C1376, "Specification for Pyrolytic and Vacuum Deposition Coatings on Glass"
 - 2. Minimum Glass Thickness: 1/4-inch.

- D. Sealed Insulating Glass Units (Surface No. 3 Only):
 - 1. Fabricate units in accordance with ASTM E2190 Standard Specification for Insulating Glass Unit Performance and Evaluation.
 - 2. Insulating Glass Components:
 - a. Outer Pane:
 - 1) Glass Type: Clear Float (Surface 1 and 2).
 - 2) Glass Thickness: 1/4-inch.
 - 3) Heat Treating: Fully tempered.
 - b. Air Space: 1/2- inch wide, hermetically sealed, argon gas filled, dehydrated air space.
 - c. Inner Pane:
 - 1) Glass Type: Low E for Surface 3 and Clear Float for Surface 4.
 - 2) Glass Color: As selected.
 - 3) Glass Thickness: 1/4-inch.
 - 4) Heat Treating: Fully tempered.
 - 3. Provide unit edge seals meeting requirements of ASTM E 773, with aluminum spacers having mitered and corners, and silicone sealant for glass-to-spacer seals.

- E. Window Accessories:
 - 1. Setting Blocks: ASTM C 864, neoprene, 80 to 90 Shore A durometer hardness; length 4 inches, width of glazing rabbet space less 1/16 inch, height required for glazing method, pane weight, and pane area.
 - 2. Spacer Shims: ASTM C 864, neoprene, 50 to 60 Shore A durometer hardness; length 3 inches, one half height of glazing stop, thickness required for application, one face self-adhesive.
 - 3. Glazing Tape: Butyl compound tape with integral resilient tube spacer, 10 to 15 Shore A durometer hardness, black color, coiled on release paper; widths required for specified installation.
 - 4. Glazing Tape: Closed cell polyvinyl chloride foam, maximum water absorption by volume 2 percent, designed for 25 percent compression percent for air barrier and vapor retarder seal, black color, coiled on release paper over adhesive on two sides; widths required for specified installation.

5. Glazing Splines: ASTM C 864, resilient polyvinyl chloride, extruded shape to fit glazing channel retaining slot; black color.
 6. Glazing Gaskets: ASTM C 864, resilient polyvinyl chloride, extruded shape to fit glazing channel retaining slot; black color.
 7. Glazing Clips: Manufacturer's standard type.
 8. Sealants: Specified in Section 07 90 00 – Joint Protection.
- F. Interior Dry Method (Tape and Tape):
1. Apply glazing tape to permanent stops, allowing tape edge to project 1/16 inch above stop; butt-joint tape edges; seal joints with butyl sealant.
 2. Place setting blocks with edge blocks maximum 6 inches from glass edges and intermediate blocks at 1/4 points of glass panel length.
 3. Set glass unit on setting blocks; apply pressure against fixed stop for full contact.
- G. Exterior Dry Method (Tape and Gasket Spline):
1. Apply glazing tape or spline to glass; butt-joint tape edges; seal joints with butyl sealant.
 2. Place setting blocks with edge blocks maximum 6 inches from glass edges and intermediate blocks at 1/4 points of glass panel length.
 3. Set glass unit on setting blocks; apply pressure against fixed stop for full contact.
 4. Install removable stops without displacing glazing tape or spline; apply pressure for full continuous contact.
 5. Trim sight-exposed tape flush with stop.

2.7 FABRICATION - FRAMING

- A. Fabricate members in accordance with AISC Specification for plate, bar, tube, or rolled structural shapes.
- B. Anchor Bolts: Formed with bent shank, assembled with template for casting into concrete.
- C. Provide framing for door, window and mechanical openings.

2.8 FABRICATION - WALL AND ROOF SYSTEMS

- A. Siding: Minimum 24 gauge metal thickness, profile as selected, lapped edges fitted with continuous gaskets.
- B. Roofing: Minimum 24 gauge metal thickness, profile as selected, lapped edges fitted with continuous gaskets.
- C. Liner: Minimum 26 gauge metal thickness, profile as selected, lapped edges.
- D. Soffit Panels: Minimum 26 gauge inch metal thickness, profile as selected and perforated for ventilation.

- E. Girts and Purlins: Rolled formed structural shape to receive siding, roofing and liner sheet.
- F. Internal and External Corners: Same material thickness and finish as adjacent material, profile shop cut and factory mitered to required angles. Back brace mitered internal corners with 22 gauge thick sheet.
- G. Expansion Joints: Same material and finish as adjacent material where exposed, manufacturer's standard brake formed type, of profile to match siding system.
- H. Flashings, Closure Pieces, Fascia, Infills and Caps: Same material and finish as adjacent material, profile to match system.
- I. Fasteners: To maintain load requirements and weather tight installation, same finish as cladding, non-corrosive type.
- J. Ventilator: Sheet steel, galvanized, rotary design, size as indicated on Drawings.
- K. Wall Louvers: As specified in Division 23 – Heating, Ventilating and Air Conditioning.

2.9 FABRICATION - GUTTERS AND DOWNSPOUTS

- A. Fabricate of same material and finish as roofing metal.
- B. Form gutters and downspouts of profile and size indicated to collect and remove water. Fabricate with connection pieces.
- C. Form sections in maximum possible lengths. Hem exposed edges. Allow for expansion at joints.
- D. Fabricate support straps of same material and finish as roofing metal, color as selected.

2.10 FACTORY FINISHING

- A. Framing Members: Clean, prepare, and shop prime. Prime to SSPC Manual requirements.
- B. Galvanizing for Nuts, Bolts and Washers: ASTM A153.
- C. Interior Surfaces of Wall and Roof Components and Accessories: Precoated enamel on steel of modified silicone finish, color as selected from manufacturer's standard range.
- D. Exterior Surfaces of Wall and Roof Components and Accessories: Precoated enamel on steel of modified silicone or fluoropolymer finish, color as selected from manufacturer's standard range.
- E. Vapor Retarder at Interior Face of Insulation: Sheet vinyl, 6-inch thick, white.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Division 01 – General Requirements: Coordination and project conditions.
- B. Verify foundation, floor slab, mechanical and electrical utilities, and placed anchors are in correct position.

3.2 ERECTION - FRAMING

- A. Erect framing in accordance with AISC Specification.
- B. Provide for erection and wind loads.
- C. Provide temporary bracing to maintain structure plumb and in alignment until completion of erection and installation of permanent bracing.
- D. Locate braced bays as indicated on Drawings.
- E. Set column base plates with non-shrink grout to achieve full plate bearing.
- F. Do not field cut or alter structural members without approval of Architect/Engineer.
- G. After erection, prime welds, abrasions, and surfaces not shop primed.

3.3 ERECTION - WALL AND ROOFING SYSTEMS

- A. Exercise care when cutting prefinished material to ensure cuttings do not remain on finish surface.
- B. Fasten cladding system to structural supports, aligned level and plumb.
- C. Locate end laps over supports. End laps minimum 2 inches. Place side laps over bearing.
- D. Install expansion joints where indicated on Drawings.
- E. Use exposed fasteners.
- F. Install insulation and vapor retarder utilizing fastening for attachment.
- G. Install sealant and gaskets to prevent weather penetration.

3.4 ERECTION - GUTTER AND DOWNSPOUTS

- A. Rigidly support and secure components. Joint lengths with formed seams sealed watertight. Flash and seal gutters to downspouts.

- B. Apply bituminous paint on surfaces in contact with cementitious materials.
- C. Slope gutters minimum 1/8- inch/ft.
- D. Connect downspouts to storm sewer system.

3.5 ERECTION - ACCESSORIES

- A. Install door frame, door, overhead door, window and glass, and louvers.
- B. Seal wall and roof accessories watertight and weather tight with sealant in accordance with Section 07 90 00 – Joint Protection.

3.6 ERECTION TOLERANCES

- A. Division 01 – General Requirements: Tolerances.
- B. Framing Members: 1/4 - inch from level; 1/8 - inch from plumb.
- C. Siding and Roofing: 1/8 - inch from indicated position.

END OF SECTION

SECTION 21 05 00

BASIC FIRE SUPPRESSION MATERIALS AND METHODS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Pipe, fittings, valves, and connections for sprinkler standpipe and fire hose systems.
 2. References.
 3. Quality Assurance.
 4. Continuity of Existing Services.
 5. Protection of Finished Surfaces.
 6. Sleeves and Openings.
 7. Sealing and Firestopping.
 8. Equipment Furnished By Others.
 9. Provisions for Future.
 10. Submittals.
 11. Off Site Storage.
 12. Codes.
 13. Request and Certification for Payment.
 14. Certificates and Inspections.
 15. Operating and Maintenance Instructions.
 16. Training of Owner Personnel.
 17. Record Drawings.
 18. Qualifications.
 19. Pre-Installation Meetings
 20. Delivery, Storage, and Handling
 21. Warranty.
 22. Extra Materials.
- B. Related Sections:
1. Applicable provisions of Division 01 shall govern all work under this Section.
 2. Section 03 31 00 – Structural Concrete: Execution requirements for inserts and sleeves specified by this section.

1.2 REFERENCES

- A. American Society of Mechanical Engineers (ASME):
1. ASME B16.1 - Cast Iron Pipe Flanges and Flanged Fittings.
 2. ASME B16.11 - Forged Steel Fittings - Socket-Welding and Threaded.
 3. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings.
 4. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.

5. ASME B16.25 - Buttwelding Ends.
 6. ASME B16.3 - Malleable Iron Threaded Fittings.
 7. ASME B16.4 - Gray Iron Threaded Fittings.
 8. ASME B16.5 - Pipe Flanges and Flanged Fittings.
 9. ASME B16.9 - Factory-Made Wrought Steel Buttwelding Fittings.
 10. ASME B36.10M - Welded and Seamless Wrought Steel Pipe.
- B. American Society for Testing and Materials (ASTM International):
1. ASTM A47 - Standard Specification for Ferritic Malleable Iron Castings.
 2. ASTM A53 - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
 3. ASTM A135 - Standard Specification for Electric-Resistance-Welded Steel Pipe.
 4. ASTM A234 - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.
 5. ASTM A795 - Standard Specification for Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use.
 6. ASTM B247 - Standard Specification for Aluminum and Aluminum-Alloy Die Forgings, Hand Forgings, and Rolled Ring Forgings.
 7. ASTM B32 - Standard Specification for Solder Metal.
 8. ASTM B75 - Standard Specification for Seamless Copper Tube.
 9. ASTM B88 - Standard Specification for Seamless Copper Water Tube.
 10. ASTM B251 - Standard Specification for General Requirements for Wrought Seamless Copper and Copper-Alloy Tube.
 11. ASTM D3309 - Standard Specification for Polybutylene (PB) Plastic Hot- and Cold-Water Distribution Systems.
 12. ASTM F438 - Standard Specification for Socket-Type Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 40.
 13. ASTM F439 - Standard Specification for Socket-Type Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80.
 14. ASTM F442 - Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe (SDR-PR).
 15. ASTM F493 - Standard Specification for Solvent Cements for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe and Fittings.
- C. American Welding Society (AWS):
1. AWS A5.8 - Specification for Filler Metals for Brazing and Braze Welding.
 2. AWS D1.1 - Structural Welding Code - Steel.
- D. American Water Works Association (AWWA):
1. AWWA C110 - American National Standard for Ductile-Iron and Grey-Iron Fittings, 3 in. through 48 in. (75 mm through 1200 mm), for Water and Other Liquids.
 2. AWWA C111 - American National Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

3. AWWA C151 - American National Standard for Ductile-Iron Pipe, Centrifugally Cast, for Water.
- E. National Fire Protection Association (NFPA):
1. NFPA 13 - Installation of Sprinkler Systems.
 2. NFPA 14 - Standard for the Installation of Standpipe, Private Hydrants and Hose Systems.
 3. NFPA 24 - Installation of Private Fire Service Mains and Their Appurtenances.
- 1.3 QUALITY ASSURANCE
- A. Perform Work in accordance with NFPA 13.
 - B. Perform Work in accordance with state and local building codes.
- 1.4 CONTINUITY OF EXISTING SERVICES
- A. Do not interrupt or change existing services without prior written approval from Owner's Project Representative.
 - B. When interruption is required, coordinate scheduling of down-time with Owner to minimize disruption to his activities.
 - C. Unless specifically stated, all work involved in interrupting or changing existing services is to be done during normal working hours.
- 1.5 PROTECTION OF FINISHED SURFACES
- A. Division 01 - General Requirements: Protection of Finished Surfaces.
- 1.6 SLEEVES AND OPENINGS
- A. Division 01 - General Requirements: Sleeves and Openings.
- 1.7 SEALING AND FIRESTOPPING
- A. Sealing and firestopping of sleeves and related openings between piping and sleeve and structural opening shall be responsibility of Contractor whose work penetrates opening.
 - B. Contractor responsible shall provide individuals skilled in such work to do sealing and fireproofing.
- 1.8 SUBMITTALS
- A. Division 01- General Requirements: Submittal procedures.

- B. Shop Drawings: Indicate pipe materials used, jointing methods, supports, floor and wall penetration seals. Indicate installation, layout, weights, mounting and support details, and piping connections.
- C. Product Data: Submit manufacturer's catalogue information. Indicate valve data and ratings.
- D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.9 CLOSEOUT SUBMITTALS

- A. Division 01 – General Requirements: Closeout procedures.
- B. Project Record Documents: Record actual locations of components and tag numbering.
- C. Operation and Maintenance Data: Submit spare parts lists.

1.10 GOVERNING AGENCIES

- A. Comply with requirements of State and local fire codes.

1.11 CERTIFICATES AND INSPECTIONS

- A. Division 00 – General Conditions: Permits, Regulations, Utilities and Taxes.

1.12 OPERATING AND MAINTENANCE INSTRUCTIONS

- A. Division 01 - General Requirements: Operating and maintenance instructions.
- B. Assemble material in three-ring or post binders, using an index at front of each volume and tabs for each system or type of equipment.
- C. In addition to data indicated in the General Requirements, include the following information:
 1. Copies of all approved shop drawings.
 2. Manufacturer's wiring diagrams for electrically powered equipment.
 3. Records of tests performed to certify compliance with system requirements.
 4. Certificates of inspection by regulatory agencies.
 5. Parts lists for fixtures, equipment, valves and specialties.
 6. Manufacturers' installation, operation and maintenance recommendations for fixtures, equipment, valves and specialties.
 7. Valve schedules.
 8. Lubrication instructions, including parts list and frequency of lubrication.
 9. Warranties.
 10. Additional information as indicated in technical specification sections.

1.13 TRAINING OF OWNER PERSONNEL

- A. Instruct Owner personnel in proper operation and maintenance of systems and equipment provided as part of this project.
- B. Include not less than 1 hour of instruction, using Operation and Maintenance manuals during this instruction.
- C. Demonstrate startup, operation, and shutdown procedures for all equipment. All training to be during normal working hours. Videotape all instructions and provide Owner with copy.

1.14 RECORD DRAWINGS

- A. Division 01 - General Requirements: Record drawings.

1.15 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum five years experience, and with service facilities within 100 miles of Project.
- B. Installer: Company specializing in performing Work of this section with minimum five years experience.

1.16 PRE-INSTALLATION MEETINGS

- A. Division 01- General Requirements: Pre-installation meeting.
- B. Convene minimum one week prior to commencing work of this section.

1.17 DELIVERY, STORAGE, AND HANDLING

- A. Division 01 – General Requirements: Product storage and handling requirements.
- B. Deliver and store valves in shipping containers, with labeling in place.
- C. Furnish cast iron and steel valves with temporary protective coating.
- D. Furnish temporary end caps and closures on piping and fittings. Maintain in place until installation.

1.18 WARRANTY

- A. Division 01 – General Requirements: Product warranties and product bonds.
- B. Furnish five year manufacturer warranty for basic fire suppression materials and methods.

1.19 EXTRA MATERIALS

- A. Division 01 – General Requirements: Spare parts and maintenance products.
- B. Furnish two sets of valve stem packing for each size and type of valve installed.

PART 2 PRODUCTS

2.1 VALVES

- A. Manufacturers:
 - 1. Appollo.
 - 2. Hammond.
 - 3. Milwaukee.
 - 4. Substitutions: In accordance with Division 01 – General Requirements.
- B. Gate Valves:
 - 1. Up to and including 2 inches: Bronze body and trim, rising stem, hand wheel, solid wedge or disc, threaded ends.
 - 2. Over 2 inches: Iron body, bronze trim, rising stem pre-grooved for mounting tamper switch, hand wheel, OS&Y, solid bronze or cast iron wedge, flanged or grooved ends.
 - 3. Over 4 inches: Iron body, bronze trim, non-rising stem with bolted bonnet, solid bronze wedge, flanged ends, iron body indicator post assembly.
- C. Globe or Angle Valves:
 - 1. Up to and including 2 inches: Bronze body, bronze trim, rising stem and hand wheel, inside screw, renewable rubber disc, threaded ends, with back seating capacity packable under pressure.
 - 2. Over 2 inches: Iron body, bronze trim, rising stem, hand wheel, OS&Y, plug-type disc, flanged ends, renewable seat and disc.
- D. Ball Valves:
 - 1. Up to and including 2 inches: Bronze two piece body, brass, chrome plated bronze, or stainless steel ball, teflon seats and stuffing box ring, lever handle threaded ends with union.
 - 2. Over 2 inches: Cast steel body, chrome plated steel ball, teflon seat and stuffing box seals, lever handle or gear drive hand wheel for sizes 10 inches and over, flanged.
- E. Butterfly Valves:
 - 1. Bronze Body: Stainless steel disc, resilient replaceable seat, threaded or grooved ends, extended neck, hand wheel and gear drive and integral indicating device, and built-in tamper proof switch rated 10 amp at 115 volt AC.
 - 2. Cast or Ductile Iron Body: Cast or ductile iron, chrome or nickel plated ductile iron or aluminum bronze disc, resilient replaceable EPDM seat, wafer, lug, or grooved

ends. With extended neck, hand wheel and gear drive and integral indicating device, and external tamper switch rated 10 amp at 115 volt AC.

F. Check Valves:

1. Up to and including 2 inches: Bronze body and swing disc, rubber seat, threaded ends.
2. Over 2 inches: Iron body, bronze trim, swing check with rubber disc, renewable disc and seat, flanged ends.
3. 4 inches and Over: Iron body, bronze disc with stainless steel spring, resilient seal, threaded, wafer, or flanged ends.

G. Drain Valves:

1. Compression Stop: Bronze with hose thread nipple and cap.
2. Ball Valve: Brass with cap and chain, 3/4 inch hose thread.

2.2 BURIED PIPING

A. Steel Pipe: ASTM A53, Grade B, Schedule 40 galvanized, with ASME C105 polyethylene jacket, or double layer, half-lapped 10 mil polyethylene tape.

1. Steel Fittings: ASME B16.9, wrought steel, butt welded; with double layer, half-lapped 10 mil polyethylene tape.
2. Cast Iron Fittings: ASME B16.1, flanges and flanged fittings.
3. Joints: AWS D1.1, welded.
4. Casing: Polyurethane insulation with high density polyethylene jacket and heat shrink sleeves.

B. Copper Tubing: Type L annealed.

1. Fittings: ASME B16.18, cast copper alloy, or ASME B16.22, wrought copper and bronze, solder joint, pressure type.
2. Joints: ASTM B32, solder, Grade 95TA.
3. Casing: Polyurethane insulation with high density polyethylene jacket and heat shrink sleeves.

C. Cast Iron Pipe: AWWA C151.

1. Fittings: AWWA C110, standard thickness.
2. Joints: AWWA C111, rubber gasket.
3. Mechanical Couplings: Shaped composition sealing gasket, steel bolts, nuts, and washers.

2.3 ABOVE GROUND PIPING

A. Steel Pipe: ASTM A53, Grade B; Schedule 10 and 40 galvanized.

1. Steel Fittings: ASME B16.9, wrought steel, butt welded; ASME B16.25, butt weld ends; ASTM A234/A234M, wrought carbon steel and alloy steel; ASME B16.5, steel

- flanges and fittings; ASME B16.11, forged steel socket welded and threaded.
 - 2. Cast Iron Fittings: ASME B16.1, flanges and flanged fittings; ASME B16.4, threaded fittings.
 - 3. Malleable Iron Fittings: ASME B16.3, threaded fittings ASTM 47 ASTM 47M.
 - 4. Mechanical Grooved Couplings: Malleable iron housing clamps to engage and lock, "C" shaped elastomeric sealing gasket, steel bolts, nuts, and washers; galvanized for galvanized pipe.
 - 5. Mechanical Formed Fittings: Carbon-steel housing with integral pipe stop and O-ring pocked and O-ring uniformly compressed into permanent mechanical engagement onto pipe.
- B. Copper Tubing: ASTM B251; Type L, hard drawn.
- 1. Fittings: ASME B16.22, wrought copper and bronze, solder joint, pressure type.
 - 2. Joints: ASTM B32, solder, Grade 95TA.
- C. Copper Tubing: ASTM B88, Type L, hard drawn.
- 1. Fittings: ASME B16.22, wrought copper and bronze, grooved.
 - 2. Mechanical Grooved Couplings: Ductile iron housing with alkyd enamel paint coating clamps to engage and lock, "C" shaped elastomeric sealing gasket, steel bolts, nuts, and washers.
- D. CPVC Pipe: ASTM F442, SDR 13.5.
- 1. Fittings: ASTM F438 schedule 40, or ASTM F439 schedule 80, CPVC.
 - 2. Joints: ASTM F493, solvent weld.
- E. Polybutylene Pipe: ASTM D3309, SDR 11.
- 1. Fittings: ASTM D3309, Polybutylene.
 - 2. Joints: Fusion welds.
- F. Cast Iron Pipe: AWWA C151.
- 1. Fittings: AWWA C110, standard thickness.
 - 2. Joints: AWWA C111, rubber gasket.
 - 3. Mechanical Grooved Couplings: Malleable iron housing clamps to engage and lock, "C" shaped composition sealing gasket, steel bolts, nuts, and washers; galvanized for galvanized pipe.

2.4 PIPE HANGERS AND SUPPORTS

- A. Conform to NFPA 13.
- B. Hangers for Pipe Sizes 1/2 to 1-1/2 inch: Carbon steel, adjustable swivel, split ring.
- C. Hangers for Pipe Sizes 2 inch and Over: Carbon steel, adjustable, clevis.

- D. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
- E. Wall Support for Pipe Sizes to 3 inches: Cast iron hook.
- F. Wall Support for Pipe Sizes 4 inches and Over: Welded steel bracket and wrought steel clamp.
- G. Vertical Support: Steel riser clamp.
- H. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
- I. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

PART 3 EXECUTION

3.1 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and foreign material, from inside and outside, before assembly.
- C. Prepare piping connections to equipment with flanges or unions.

3.2 INSTALLATION

- A. Install piping in accordance with NFPA 13 for sprinkler systems and NFPA 24 for service mains.
- B. Route piping in orderly manner, plumb and parallel to building structure. Maintain gradient.
- C. Install piping to conserve building space, to not interfere with use of space and other work.
- D. Group piping whenever practical at common elevations.
- E. Install pipe sleeve at piping penetrations through footings partitions, walls, and floors. Seal pipe and sleeve penetrations to maintain fire resistance equivalent to fire separation.
- F. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- G. Pipe Hangers and Supports:
 - 1. Install in accordance with NFPA 13.
 - 2. Install hangers to with minimum 1/2 inch space between finished covering and adjacent work.
 - 3. Place hangers within 12 inches of each horizontal elbow.

4. Use hangers with 1-1/2 inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
 5. Support vertical piping at every floor. Support riser piping independently of connected horizontal piping.
 6. Where installing several pipes in parallel and at same elevation, provide multiple or trapeze hangers.
 7. Install copper plated hangers and supports for copper piping.
 8. Prime coat exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.
- H. Slope piping and arrange systems to drain at low points. Install eccentric reducers to maintain top of pipe level.
- I. Prepare pipe, fittings, supports, and accessories for finish painting. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding. Refer to Section 09 90 00.
- J. Do not penetrate building structural members unless indicated.
- K. Where more than one piping system material is specified, install compatible system components and joints. Install flanges, union, and couplings at locations requiring servicing.
- L. Die cut threaded joints with full cut standard taper pipe threads with red lead and linseed oil or other non-toxic joint compound applied to male threads only.
- M. Install valves with stems upright or horizontal, not inverted. Remove protective coatings after installation.
- N. Install gate valves for shut-off or isolating service.
- O. Install drain valves at main shut-off valves, low points of piping and apparatus.
- P. Where inserts are omitted, drill through concrete slab from below and install through-bolt with recessed square steel plate and nut flush with top of slab.

3.3 INTERFACE WITH OTHER PRODUCTS

- A. Inserts:
1. Install inserts for placement in concrete forms.
 2. Install inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
 3. Install hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.
 4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.

3.4 CLEANING

- A. Division 01 – General Requirements: Final cleaning.
- B. Clean entire system after other construction is complete.

END OF SECTION

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SECTION 21 13 00
SPRINKLER SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Wet-pipe sprinkler system.
 - 2. Dry-pipe sprinkler system.
 - 3. System design, installation, and certification.
 - 4. Fire department connections.

- B. Related Sections:
 - 1. Applicable provisions of Division 01 shall govern all work under this Section.
 - 2. Division 31 – Earthwork.
 - 3. Section 21 05 00 – Basic Fire Suppression Materials and Methods.
 - 4. Section 22 05 00 – Basic Plumbing Materials and Methods: Identification for Plumbing Piping and Equipment.
 - 5. Division 26 - Electrical: Electrical characteristics and wiring connections.

1.2 REFERENCES

- A. Factory Mutual (FM):
 - 1. FM - Factory Mutual Approval Guide.

- B. Intertek Testing Services (Warnock Hersey) (WH):
 - 1. Warnock Hersey - Certification Listings.

- C. National Fire Protection Association (NFPA):
 - 1. NFPA 13 - Standard for the Installation of Sprinkler Systems.
 - 2. NFPA 13R - Standard for the Installation of Sprinkler Systems in Residential Occupancies up to and Including Four Stories in Height.
 - 3. NFPA 15 - Water Spray Fixed Systems for Fire Protection.
 - 4. NFPA 70 - National Electrical Code.

- D. Underwriter's Laboratories, Inc. (UL):
 - 1. UL - Fire Resistance Directory.
 - 2. UL 199 - Automatic Sprinklers.

1.3 SYSTEM DESCRIPTION

- A. System to provide coverage for entire building.

- B. Provide system to NFPA 13 ordinary hazard, Group 2, ordinary hazard, Group 3, extra hazard

occupancy requirements.

- C. Determine volume and pressure of incoming water supply from water flow test data. If not available assume 1,000 gpm at 50 psig. Revise design when test data available prior to submittals.
- D. Interface system with building control system.
- E. Provide fire department connections where indicated.

1.4 SUBMITTALS FOR REVIEW

- A. Section 21 05 00 - Basic Fire Suppression Materials and Methods: Procedures for submittals.
- B. Product Data: Provide data on sprinklers, valves, and specialties, including manufacturers catalog information. Submit performance ratings, rough-in details, weights, support requirements, and piping connections.
- C. Shop Drawings:
 - 1. Submit preliminary layout of finished ceiling areas indicating only sprinkler locations coordinated with ceiling installation.
 - 2. Indicate hydraulic calculations, detailed pipe layout, hangers and supports, sprinklers, components and accessories. Indicate system controls.
- D. Submit shop drawings, product data, hydraulic calculations to Owner's insurance underwriter for approval. Submit proof of approval to Architect/Engineer.
- E. Samples: Submit two of each style of sprinkler specified.

1.5 SUBMITTALS AT PROJECT CLOSEOUT

- A. Section 21 05 00 - Basic Fire Suppression Materials and Methods: Procedures for submittals.
- B. Project Record Documents: Record actual locations of sprinklers and deviations of piping from drawings. Indicate drain and test locations.
- C. Manufacturer's Certificate: Certify that system has been tested and meets or exceeds code requirements.
- D. Operation and Maintenance Data: Include components of system, servicing requirements, record drawings, inspection data, replacement part numbers and availability, and location and numbers of service depot.
- E. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.6 QUALITY ASSURANCE

- A. Perform Work in accordance with NFPA 13. Maintain one copy on site.
- B. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum five years experience.
- C. Installer Qualifications: Company specializing in performing the work of this section with minimum five years experience.
- D. Design system under direct supervision of a Professional Engineer experienced in design of this Work and licensed in the State of Wisconsin.

1.7 REGULATORY REQUIREMENTS

- A. Conform to UL, FM.
- B. Perform Work in accordance with NFPA 13.
- C. Equipment and Components: Bear UL, FM label or marking identification.
- D. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

1.8 MOCKUP

- A. Section 21 05 00 - Basic Fire Suppression Materials and Methods: Requirements for mockup.
- B. Provide components for installation in mockup.
- C. Mockup may remain as part of the Work.

1.9 PRE-INSTALLATION MEETING

- A. Section 21 05 00 - Basic Fire Suppression Materials and Methods: Pre-installation meeting.
- B. Convene one week before starting work of this section.

1.10 DELIVERY, STORAGE, AND PROTECTION

- A. Section 21 05 00 - Basic Fire Suppression Materials and Methods: Transport, handle, store, and protect products.
- B. Store products in shipping containers and maintain in place until installation. Provide temporary inlet and outlet caps. Maintain caps in place until installation.

1.11 EXTRA MATERIALS

- A. Section 21 05 00 - Basic Fire Suppression Materials and Methods.
- B. Provide extra sprinklers under provisions of NFPA 13.
- C. Provide suitable wrenches for each sprinkler type.
- D. Provide metal storage cabinet located adjacent to alarm valve.

PART 2 PRODUCTS

2.1 SPRINKLERS

- A. Exposed Area Type:
 - 1. Manufacturers:
 - a. Reliable Model FIFR.
 - b. Substitutions: In accordance with Section 21 05 00 - Basic Fire Suppression Materials and Methods.
 - 2. Type: Standard upright type.
 - 3. Finish: Brass.
 - 4. Fusible Link: Glass bulb type temperature rated for specific area hazard.
- B. Dry Sprinklers:
 - 1. Manufacturers:
 - a. Reliable Model DH56.
 - b. Substitutions: In accordance with Section 21 05 00 - Basic Fire Suppression Materials and Methods.
 - 2. Type: Standard.
 - 3. Finish: Brass.
 - 4. Escutcheon Plate Finish: Brass.
 - 5. Fusible Link: Glass bulb type temperature rated for specific area hazard.
- C. Guards: Finish to match sprinkler finish.

2.2 PIPING SPECIALTIES

- A. Dry Pipe Sprinkler Alarm Valve: Check type valve with divided seat ring, rubber faced clapper to automatically actuate water motor alarm and electric alarm, with accelerator; with test and drain valve.
- B. Electric Alarm: Electrically operated red enameled gong with pressure alarm switch.
- C. Water Flow Switch: Vane type switch for mounting horizontal or vertical, with two contacts; rated 10 amp at 125 volt AC and 2.5 amp at 24 volt DC.

- D. Fire Department Connections:
 - 1. Type: Flush mounted wall type with brass finish.
 - 2. Outlets: Two way with thread size to suit fire department hardware; threaded dust cap and chain of matching material and finish.
 - 3. Drain: 3/4 inch automatic drip, outside.
 - 4. Label: "Sprinkler - Fire Department Connection".
- E. Supervisory Switches: As manufactured by System Sensor Model OSY2.

2.3 PRESSURE MAINTENANCE PUMP

- A. Manufacturers:
 - 1. Gast.
 - 2. Substitutions: In accordance with Section 21 05 00 - Basic Fire Suppression Materials and Methods.
- B. Type: Close coupled motor and positive displacement pump unit.
- C. Construction: Bronze with stainless steel shafts, carbon bearings.
- D. Performance: 10-13 psi differential pressure.
- E. Motor: Open drip proof, permanently lubricated.
- F. Electrical Characteristics:
 - 1. 1-1/2 hp.
 - 2. 208-230 volts, single phase, 60 Hz.
- G. Accessories: Include flexible hose connections, inlet strainer, relief valve, steel mounting plate.
- H. Operation: Automatic with pressure switch actuation.

2.4 AIR COMPRESSOR

- A. Manufacturers:
 - 1. Gast.
 - 2. Substitutions: In accordance with Section 21 05 00 - Basic Fire Suppression Materials and Methods.
- B. Compressor: Single unit, electric motor driven, motor, motor starter, safety valves, check valves, air maintenance device incorporating electric pressure switch and unloader valve.
- C. Electrical Characteristics:
 - 1. 1-1/2 hp.
 - 2. 208/230 volts, single phase, 60 Hz.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install in accordance with NFPA 13.
- B. Install equipment in accordance with manufacturer's instructions.
- C. Install buried shut-off valves in valve box. Provide post indicator.
- D. Provide approved double check valve, backflow preventer assembly at sprinkler system water source connection.
- E. Locate fire department connection with sufficient clearance from walls, obstructions, or adjacent siamese connectors to allow full swing of fire department wrench handle.
- F. Locate outside alarm gong on building wall as indicated.
- G. Place pipe runs to minimize obstruction to other work.
- H. Place piping in concealed spaces above finished ceilings.
- I. Center sprinklers in one direction only in ceiling tile with location in other direction variable, dependent upon spacing and coordination with ceiling elements.
- J. Apply masking tape or paper cover to ensure concealed sprinklers, cover plates, and sprinkler escutcheons do not receive field paint finish. Remove after painting. Replace painted sprinklers.
- K. Install air compressor on vibration isolators. Refer to Section 23 05 48.
- L. Flush entire piping system of foreign matter.
- M. Hydrostatically test entire system.
- N. Require test be witnessed by Fire Marshall or authority having jurisdiction and Owner's insurance underwriter and Architect/Engineer.

3.2 INTERFACE WITH OTHER PRODUCTS

- A. Ensure required devices are installed and connected as required to fire alarm system.

3.3 SCHEDULE

- A. Reference drawings for schedules.

END OF SECTION

SECTION 21 13 16

DRY-PIPE FIRE SUPPRESSION SPRINKLERS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Dry-pipe sprinkler system, system design, installation, and certification.
- B. Related Sections:
 - 1. Applicable provisions of Division 01 shall govern all work under this Section.
 - 2. Section 21 05 00 – Basic Fire Suppression Materials and Methods.
 - 3. Section 22 05 00 – Basic Plumbing Materials and Methods: Product requirements for Valve and piping identification for placement by this section.
 - 4. Section 26 05 03 – Wiring Connections: Execution requirements for electric connections to equipment specified by this section.

1.2 REFERENCES

- A. National Fire Protection Association (NFPA):
 - 1. NFPA 13 - Installation of Sprinkler Systems.

1.3 SYSTEM DESCRIPTION

- A. System to provide coverage for entire building.
- B. Provide hydraulically designed system to NFPA 13 ordinary hazard, Group 2 and extra hazard occupancy requirements.
- C. Determine volume and pressure of incoming water supply from water flow test data. When not available assume 1,000 gpm at 50 psig. Revise design when test data becomes available prior to submittals.
- D. Interface system with building fire and smoke alarm system.
- E. Provide fire department connections as indicated on Drawings.

1.4 SUBMITTALS

- A. Section 21 05 00 – Basic Fire Suppression Materials and Methods: Submittal procedures.
- B. Shop Drawings: Indicate layout of finished ceiling areas indicating sprinkler locations coordinated with ceiling installation. Indicate detailed pipe layout, hangers and supports, sprinklers, components and accessories. Indicate system controls.

- C. Product Data: Submit data on sprinklers, valves, pumps, compressors and specialties, including manufacturers catalog information. Submit performance ratings, rough-in details, weights, support requirements, and piping connections.
- D. Samples: Submit two of each style of sprinkler specified.
- E. Design Data: Submit design calculations.
- F. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.5 CLOSEOUT SUBMITTALS

- A. Section 21 05 00 – Basic Fire Suppression Materials and Methods: Closeout procedures.
- B. Project Record Documents: Record actual locations of sprinklers and deviations of piping from drawings. Indicate drain and test locations.
- C. Operation and Maintenance Data: Submit components of system, servicing requirements, record drawings, inspection data, replacement part numbers and availability, and location and numbers of service depot.

1.6 QUALITY ASSURANCE

- A. Perform Work in accordance with NFPA 13.
- B. Perform Work in accordance with state and local building codes.
- C. Maintain one copy of each document on site.

1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum five years experience.
- B. Installer: Company specializing in performing Work of this section with minimum five years experience.
- C. Design system under direct supervision of Professional Engineer experienced in design of this Work and licensed in State of Wisconsin.

1.8 PRE-INSTALLATION MEETINGS

- A. Section 21 05 00 – Basic Fire Suppression Materials and Methods: Pre-installation meeting.
- B. Convene minimum one week prior to commencing work of this section.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Section 21 05 00 – Basic Fire Suppression Materials and Methods: Product storage and handling requirements.
- B. Store products in shipping containers until installation.
- C. Furnish temporary end caps and closures on piping and fittings. Maintain in place until installation.

1.10 WARRANTY

- A. Section 21 05 00 – Basic Fire Suppression Materials and Methods: Product warranties and product bonds.
- B. Furnish 1 year manufacturer warranty for air compressor and pump.

1.11 EXTRA MATERIALS

- A. Section 21 05 00 – Basic Fire Suppression Materials and Methods: Spare parts and maintenance products.
- B. Furnish extra sprinklers under provisions of NFPA 13.
- C. Furnish suitable wrenches for each sprinkler type.
- D. Furnish metal storage cabinet adjacent to alarm valve.

PART 2 PRODUCTS

2.1 SPRINKLERS

- A. Manufacturers:
 - 1. Reliable Sprinkler Corp. Model FIFR.
 - 2. Substitutions: In accordance with Section 21 05 00 – Basic Fire Suppression Materials and Methods.
- B. Exposed Area Type:
 - 1. Type: Standard upright type.
 - 2. Finish: Brass.
 - 3. Fusible Link: Glass bulb type temperature rated for specific area hazard.
- C. Side wall Type:
 - 1. Type: Standard horizontal side wall type with matching push on escutcheon plate.
 - 2. Finish: Brass.
 - 3. Escutcheon Plate Finish: Chrome plated.

4. Fusible Link: Glass bulb type temperature rated for specific area hazard.

D. Guards: Finish to match sprinkler finish.

2.2 PRESSURE MAINTENANCE PUMP

A. Manufacturers:

1. Gast Model 7LDE-46S-M750X.
2. Substitutions: In accordance with Section 21 05 00 – Basic Fire Suppression Materials and Methods.

B. Type: Close coupled motor and positive displacement pump unit.

C. Construction: Bronze with stainless steel shafts, carbon bearings.

D. Performance: 10-13 psi differential pressure.

E. Motor: Open drip proof, permanently lubricated.

F. Accessories: Include flexible hose connections, inlet strainer, relief valve and steel mounting plate.

G. Operation: Automatic with pressure switch actuation.

2.3 PIPING SPECIALTIES

A. Dry Pipe Sprinkler Alarm Valve: Check type valve with divided seat ring, rubber faced clapper to automatically actuate water motor alarm with accelerator; with test and drain.

B. Water Motor Alarm: Hydraulically operated impeller type alarm with aluminum alloy red enameled gong and motor housing, nylon bearings, and inlet strainer.

C. Water Flow Switch: Vane type switch for mounting horizontal or vertical, with two contacts; rated 10 amp at 125 volt AC and 2.5 amp at 24 volt DC.

D. Fire Department Connections:

1. Type: Flush mounted wall type with brass finish.
2. Outlets: Two way with thread size to suit fire department hardware; threaded dust cap and chain of matching material and finish.
3. Drain: 3/4 inch automatic drip, outside.
4. Label: "Sprinkler - Fire Department Connection"

2.4 AIR COMPRESSOR

A. Manufacturers:

1. Gast Model 7LDE-46T-M750X (30 gallon tank).
 2. Substitutions: In accordance with Section 21 05 00 – Basic Fire Suppression Materials and Methods.
- B. Compressor: Single unit, electric motor driven, motor, motor starter, safety valves, check valves, air maintenance device incorporating electric pressure switch and unloading valve.

2.5 ELECTRICAL CHARACTERISTICS AND COMPONENTS

- A. Division 26 - Wiring Connections: Requirements for electrical characteristics.
1. 1-1/2 hp 20 rated load amperes.
 2. 208/230 volts, single phase, 60 Hz.
 3. 30 amperes maximum circuit breaker size.
 4. 20 minimum circuit ampacity.
- B. Division 21 – Common Motor Requirements for Fire-Suppression Equipment: Requirements for motors.
- C. Controls: Supervisory switches, Water Level Supervisory Switches, Tank Temperature Supervisory Switches, Room Temperature Supervisory Switches.
- D. Disconnect Switch: Factory mount in control panel on equipment.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install in accordance with NFPA 13.
- B. Install buried shut-off valves in valve box. Install with post indicator.
- C. Install approved double check valve assembly at sprinkler system water source connection.
- D. Locate fire department connection with sufficient clearance from walls, obstructions, or adjacent Siamese connectors to allow full swing of fire department wrench handle.
- E. Install outside alarm-gong on building wall as indicated on Drawings.
- F. Install piping to minimize obstruction with other work.
- G. Install piping in concealed spaces above finished ceilings.
- H. Center sprinklers in one direction only in ceiling tile with location in other direction variable, dependent upon spacing and coordination with ceiling elements.
- I. Install air compressor on vibration isolators. Refer to Division 23.

- J. Hydrostatically test entire system.
- K. Require test be witnessed by Fire Marshall, Authority having jurisdiction or Owner's insurance underwriter and Architect/Engineer.

3.2 INTERFACE WITH OTHER PRODUCTS

- A. Verify devices are installed and connected to fire alarm system.

3.3 CLEANING

- A. Section 21 05 00 – Basic Fire Suppression Materials and Methods: Final cleaning.
- B. Flush entire piping system of foreign matter.

3.4 PROTECTION OF INSTALLED CONSTRUCTION

- A. Section 21 05 00 – Basic Fire Suppression Materials and Methods: Protecting installed construction.
- B. Apply masking tape or paper cover to sprinklers, cover plates, and sprinkler escutcheons not receiving field painted finish. Remove after painting. Replace painted sprinklers with new.

3.5 SCHEDULES

SYSTEM HAZARD AREAS

<u>Location</u>	<u>System Type/Hazard</u>
Offices	Light Hazard
Warehouse	Ordinary Hazard, Group 2

END OF SECTION

SECTION 22 05 00

BASIC PLUMBING MATERIALS AND METHODS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes
 - 1. Reference Standards.
 - 2. Quality Assurance.
 - 3. Continuity of Existing Services.
 - 4. Protection of Finished Surfaces.
 - 5. Sleeves and Openings.
 - 6. Sealing and Firestopping.
 - 7. Equipment Furnished By Others.
 - 8. Provisions for Future.
 - 9. Submittals.
 - 10. Off Site Storage.
 - 11. Codes.
 - 12. Request and Certification for Payment.
 - 13. Certificates and Inspections.
 - 14. Operating and Maintenance Instructions.
 - 15. Training of Owner Personnel.
 - 16. Record Drawings.
 - 17. Access Panels and Doors.
 - 18. Identification.
 - 19. Sealing and Firestopping.
 - 20. Bedding and Backfill.
 - 21. Demolition.
 - 22. Excavation and Backfill.
 - 23. Sheeting, Shoring and Bracing.
 - 24. Dewatering.
 - 25. Rock Excavation.
 - 26. Surface Repair.
 - 27. Concrete Work.
 - 28. Cutting and Patching.
 - 29. Building Access.
 - 30. Equipment Access.
 - 31. Coordination.
 - 32. Identification.
 - 33. Lubrication.
 - 34. Sleeves.
 - 35. Sealing and Firestopping.

- B. Related Sections
 - 1. Applicable provisions of Division 01 shall govern all work under this Section.
 - 2. This section applies to all Division 22 specification sections related to plumbing.

1.2 REFERENCES

- A. American Concrete Institute (ACI)
 - 1. ACI 614 - Recommended Practice for Measuring, Mixing and Placing of Concrete
- B. ASTM International
 - 1. ASTM D1557 - Test Method for Moisture-Density Relations of Soils
 - 2. ASTM D2000 – Standard Classification System for Rubber Products in Automotive Applications.
 - 3. ASTM E84 - Test Method for Surface Burning Characteristics of Building Materials
 - 4. ASTM E814 - Test Method for Fire Tests of Through-Penetration Fire Stops
- C. State of Wisconsin Department of Transportation
 - 1. Standard Specifications for Highway and Structure Construction, Current Edition, including latest supplements. (WISDOT).
- D. Underwriters Laboratories, Inc. (UL)
 - 1. UL1479 - Fire Tests of Through-Penetration Firestops.
 - 2. UL723 - Surface Burning Characteristics of Building Materials.

1.3 REFERENCE STANDARDS

- A. Abbreviations of standards organizations referenced in this and other sections are as follows:
 - 1. ABMA: American Boiler Manufacturers Association.
 - 2. ACPA: American Concrete Pipe Association.
 - 3. AGA: American Gas Association.
 - 4. AMCA: Air Movement and Control Association.
 - 5. ANSI: American National Standards Institute.
 - 6. ARI: Air Conditioning and Refrigeration Institute.
 - 7. ASME: American Society of Mechanical Engineers.
 - 8. ASPE: American society of Plumbing Engineers.
 - 9. ASSE: American Society of Sanitary Engineering.
 - 10. ASTM: American Society for Testing and Materials.
 - 11. AWWA: American Water Works Association.
 - 12. AWS: American Welding Society.
 - 13. CISPI: Cast Iron Soil Pipe Institute.
 - 14. CGA: Compressed Gas Association.
 - 15. CS: Commercial Standards, Products Standards Sections, Office of Engineering Standards Service, NBS.
 - 16. EPA: Environmental Protection Agency.

17. FS: Federal Specifications, Superintendent of Documents, U.S. Government Printing Office.
18. GAMA: Gas Appliance Manufacturers Association.
19. IAPMO: International Association of Plumbing & Mechanical Officials.
20. IEEE: Institute of Electrical and Electronics Engineers.
21. ISA: Instrument Society of America.
22. MCA: Mechanical Contractors Association.
23. MICA: Midwest Insulation Contractors Association.
24. MSS: Manufacturer's Standardization Society of the Valve & Fitting Industry, Inc.
25. NBS: National Bureau of Standards.
26. NEC: National Electric Code.
27. NEMA: National Electrical Manufacturers Association.
28. NFPA: National Fire Protection Association.
29. NSF: National Sanitation Foundation.
30. PDI: Plumbing and Drainage Institute.
31. SMACNA: Sheet Metal and Air Conditioning Contractors' National Association. Inc.
32. STI: Steel Tank Institute.
33. UL: Underwriters Laboratories Inc.

1.4 QUALITY ASSURANCE

- A. Substitution of Materials: In accordance with Division 01.
- B. Products and materials used are to be new, undamaged, clean and in good condition.
- C. Existing products and materials are not to be reused unless specifically indicated.
- D. Where equipment or accessories are used which differ in arrangement, configuration, dimensions, ratings, or engineering parameters from those indicated on the contract documents, Contractor is responsible for all costs involved in integrating equipment or accessories into system and for obtaining intended performance from system into which these items are placed.

1.5 PROTECTION OF FINISHED SURFACES

- A. Division 01 - General Requirements: Protection of Finished Surfaces.

1.6 SLEEVES AND OPENINGS

- A. Division 01 - General Requirements: Sleeves and Openings.

1.7 SEALING AND FIRESTOPPING

- A. Sealing and firestopping of sleeves and related openings between piping and sleeve and structural opening shall be responsibility of Contractor whose work penetrates opening.

- B. Contractor responsible shall provide individuals skilled in such work to do sealing and fireproofing.

1.8 GOVERNING AGENCIES

- A. Comply with requirements of State and local plumbing codes.

1.9 CERTIFICATES AND INSPECTIONS

- A. Division 00 – General Conditions: Permits, Regulations, Utilities and Taxes.

1.10 SUBMITTALS

- A. Division 01 - Submittal Procedures: Requirements for submittals.
- B. Shop Drawing submittals are to be bound, labeled, contain Project Manual cover page and a material index list page showing item designation, manufacturer and additional items supplied with installation.
- C. Submit for all equipment and systems as indicated in respective specification sections, marking each submittal with that specification section number.
- D. Mark general catalog sheets and drawings to indicate specific items being submitted and proper identification of equipment by name and number, as indicated in contract documents. Include wiring diagrams of electrically powered equipment.
- E. Firestopping System Submittals:
 - 1. Contractor shall submit product data for each firestop system.
 - 2. Submittals shall include product characteristics, performance and limitation criteria, test data, MSDS sheets, installation details and procedures for each method of installation applicable to this project.
 - 3. For non-standard conditions where no UL tested system exists, submit manufacturer's drawings for UL system with known performance for which an engineering judgment can be based upon.

1.11 OPERATING AND MAINTENANCE INSTRUCTIONS

- A. Refer to Division 01 - General Requirements, Operating and Maintenance Instructions.
- B. Assemble material in three-ring or post binders, using an index at front of each volume and tabs for each system or type of equipment.
- C. In addition to data indicated in the General Requirements, include the following information:
 - 1. Copies of all approved shop drawings.
 - 2. Manufacturer's wiring diagrams for electrically powered equipment.
 - 3. Records of tests performed to certify compliance with system requirements.

4. Certificates of inspection by regulatory agencies.
5. Parts lists for fixtures, equipment, valves and specialties.
6. Manufacturers' installation, operation and maintenance recommendations for fixtures, equipment, valves and specialties.
7. Valve schedules.
8. Lubrication instructions, including parts list and frequency of lubrication.
9. Warranties.
10. Additional information as indicated in technical specification sections.

1.12 TRAINING OF OWNER PERSONNEL

- A. Instruct Owner personnel in proper operation and maintenance of systems and equipment provided as part of this project.
- B. Include not less than 2 hours of instruction, using Operation and Maintenance manuals during this instruction.
- C. Demonstrate startup, operation, and shutdown procedures for all equipment. All training to be during normal working hours. Videotape all instructions and provide Owner with copy.

1.13 RECORD DRAWINGS

- A. Refer to Division 01 - General Requirements: Record Drawings.

PART 2 PRODUCTS

2.1 ACCESS PANELS AND DOORS

- A. Lay-in Ceilings:
 1. Removable lay-in ceiling tiles in 24-inch by 24-inch configuration provided under Division 09 are sufficient; no additional access provisions are required unless specifically indicated.
- B. Plaster Walls and Ceilings:
 1. Provide minimum 16-gauge frame with not less than a 20-gauge hinged door panel, prime coated steel for general applications, stainless steel for use in toilets, showers, and similar wet areas, concealed hinges, screwdriver operated cam latch for general applications, key lock for use in public or secured areas, UL listed for use in fire rated partitions if required by application.
 2. Provide largest size access opening possible, consistent with space and item needing service; minimum size is 12-inch x 12-inch.

2.2 IDENTIFICATION

- A. Stencils: Provide not less than one-inch high letters and numbers for marking pipe and equipment.
- B. Engraved Name Plates: Provide white letters on a black background, 1/16-inch thick plastic laminate, beveled edges, screw mounting.
 - 1. Manufacturers:
 - a. Setonply Style 2060 by Seton Name Plate Company.
 - b. Emedolite Style EIP by EMED Company.
 - c. W. H. Brady.
 - d. Or approved equal.
- C. Snap-Around Pipe Markers: Provide one-piece, preformed, vinyl construction, snap-around or strap-around pipe markers with applicable labeling and flow direction arrows, 3/4-inch minimum size for lettering. Provide nylon ties on each end of pipe markers.
 - 1. Manufacturers:
 - a. Seton Setmark.
 - b. Or approved equal.
- D. Valve Tags: Provide round brass tags with 1/2-inch numbers, 1/4-inch system identification abbreviation, 1-1/4-inch minimum diameter, with brass jack chains, brass "S" hooks or one-piece nylon ties around valve stem.
 - 1. Manufacturers:
 - a. EMED Company.
 - b. Seton Name Plate Company.
 - c. W. H. Brady.
 - d. Or approved equal.

2.3 **BEDDING, COVER AND BACKFILL**

- A. Place and compact bedding and cover 12 inches above top of pipe, compacted to 95 percent modified proctor.
- B. Bedding, cover and backfill shall meet the following gradations:

<u>Gradation for Bedding Sand</u>		<u>Gradation for Crushed Stone Chip Bedding</u>	
<u>Sieve Size</u>	<u>% Passing (by Wt)</u>	<u>Sieve Size</u>	<u>% Passing (by Wt)</u>
1 inch	100	1/2 inch	100
No. 16	45 - 80	No. 4	75 - 100
No. 200	2 - 10	No. 100	10 - 25

- C. Backfill above bedding and cover material in lawn areas shall be thoroughly compacted to density equal to adjacent soil and excavated material shall be free of large rocks, perishable, and frozen materials.

- D. Backfill above bedding and cover material under existing and future utilities, paving, sidewalks, curbs, roads, and buildings shall be approved aggregate materials such as sand, gravel, or crushed stone and shall be compacted to 95 percent modified proctor.
- E. Backfill material shall be free of large rocks, organic, perishable, and frozen materials.

2.4 SEALING AND FIRESTOPPING

A. FIRESTOPPING SYSTEMS:

- 1. Manufacturers:
 - a. 3M
 - b. Hilti
 - c. Rectorseal
 - d. STI/SpecSeal
 - e. Tremco
 - f. Substitutions: In accordance with Division 01.
- 2. Firestopping systems shall be provided by same manufacturer.
- 3. Fire stop systems shall be UL listed, and tested by an independent testing laboratory and approved by authorities having jurisdiction.
- 4. Use product that has rating not less than rating of wall or floor being penetrated.
- 5. Reference architectural drawings for identification of fire and smoke rated walls and floors.
- 6. Use firestop putty, caulk sealant, intumescent wrapstrips, intumescent firestop collars, firestop blocks, firestop mortar or combination of these products to provide UL listed system for each application required for this project.
- 7. Provide mineral wool backing where specified in firestopping manufacturer's application detail.

B. NON-RATED PENETRATIONS:

- 1. In exterior wall openings below grade, use modular mechanical type seal consisting of interlocking synthetic rubber links shaped to continuously fill annular space between uninsulated pipe and cored opening or water-stop type wall sleeve.
- 2. Operating bolts of mechanical type seal shall be accessible from interior of building.
- 3. At pipe penetrations of non-rated interior partitions, floors and exterior walls, use polyurethane caulk in annular space between pipe insulation and sleeve.
- 4. For non-rated drywall, plaster, or wood partitions where sleeve is not required use polyurethane caulk in annular space between pipe insulation and wall material

PART 3 EXECUTION

3.1 EXCAVATION AND BACKFILL

- A. Perform excavation and backfill work necessary to accomplish indicated plumbing systems installation.

- B. Excavate to bottom of pipe and structure bedding, provide minimum of 4 inches in stable soils, 6 inches in rock or wet trenches, and 8 inches in unstable soil. Prepare bottoms of excavations to true, level surface.
- C. At no time place excavated materials where materials will impede surface drainage unless such drainage is being safely rerouted away from excavation.
- D. Verify locations of any water, drainage, gas, sewer, electric, telephone, or steam lines which may be encountered during excavation.
- E. Underpin and support all lines. Cut off service connections encountered which are to be removed at limits of excavation and cap.
- F. Elevations shown on Drawings are subject to such revisions as may be necessary to fit field conditions.
- G. No adjustment in compensation will be made for adjustments up to two (2) feet above or below grades indicated on Drawings.
- H. Bed pipe up to 12 inches above top of pipe. Take care during bedding, compaction and backfill not to disturb or damage piping.
- I. Mechanically compact bedding and backfill to prevent settlement.
- J. Initial loose backfill lift to not exceed 24 inches, compacted to 95 percent modified proctor density in accordance with ASTM D1557.
- K. Subsequent loose lifts under pavements, curbs, walks, and structures are not to exceed 12 inches and be compacted to 95 percent modified proctor density.
- L. In all other areas where construction above excavation is not anticipated within 2 years, mechanically compact backfill in lifts not exceeding 24 inches to 95 percent modified proctor density.
- M. Place compaction equipment over each lift of material so that compaction equipment contacts all areas of surface of lift.
- N. Excavate whatever materials are encountered as required to place pipe, manholes, and other work at elevations shown.
- O. Remove debris and rubbish from excavations before placing bedding and backfill material.
- P. Leave existing base materials between area disturbed by removal work and sawcut line undisturbed by sawcutting, pavement removal, or pavement replacement processes.

- Q. Strip topsoil from area to be excavated, free from subsoil and debris, and store for later respreading.
- R. Remove surplus excavated materials from site.
- S. Provide and maintain all fencing, barricades, signs, warning lights, and/or other equipment necessary to keep all excavation pits and trenches and entire subgrade area safe under all circumstances and at all times. No excavation shall be left unattended without adequate protection.
- T. Install lines passing under foundations with minimum of 1-1/2-inch clearance to concrete and insure there is no disturbance of bearing soil.

3.2 SHEETING, SHORING AND BRACING

- A. Provide shoring, sheet piling, and bracing in conformance with State and local codes to prevent earth from caving or washing into excavation.
- B. Shore and underpin to properly support adjacent or adjoining structures.
- C. Abandon in place shoring, sheet piling, and underpinning below top of pipe, or, if approved in advance by Engineer/Architect Engineer Owner's Representative Construction Manager.

3.3 DEWATERING

- A. Provide, operate and maintain pumps and other equipment necessary to drain and keep all excavation pits, trenches and entire subgrade area free from water under all circumstances.
- B. Obtain general permit from authorities having jurisdiction for discharge of construction dewatering effluent. Obtain well permit from authorities having jurisdiction for dewatering wells discharging more than 70 GPM. Comply with permit requirements.

3.4 CUTTING AND PATCHING

- A. Division 01 - General Requirements: Cutting and Patching.

3.5 BUILDING ACCESS

- A. Arrange for necessary openings in building to allow for admittance or removal of all apparatus.
- B. When building access was not previously arranged and must be provided by this Contractor, restore any opening to its original condition after apparatus has been brought into building.

3.6 EQUIPMENT ACCESS

- A. Install piping, conduit, and accessories to permit access to equipment for maintenance. Coordinate exact location of wall and ceiling access panels and doors with General Contractor, making sure that access is available for all equipment and specialties.
- B. Where access is required in plaster walls or ceilings, furnish access doors to General Contractor.

3.7 COORDINATION

- A. Coordinate work with other contractors prior to installation. Any work that is not coordinated and that interferes with other contractor's work shall be removed or relocated at installing contractor's expense.
- B. Verify that devices are compatible for type of construction and surfaces on which they will be used.

3.8 IDENTIFICATION

- A. Identify equipment in mechanical equipment rooms by stenciling equipment number and service with one coat of black enamel against light background or white enamel against dark background. Use primer where necessary for proper paint adhesion.
- B. Where stenciling is not appropriate for equipment identification, engraved name plates shall be used.
- C. Identify interior piping not less than once every 30 feet, not less than once in each room, adjacent to each access door or panel, and on both side of partition where accessible piping passes through walls or floors.
- D. Place flow directional arrows at each pipe identification location. Use one coat of black enamel against light background or white enamel against a dark background.
- E. Identify exterior buried piping for entire length with underground warning tape except for sewer piping which is routed in straight lines between manholes or cleanouts.
- F. Place tape 12 inches below finished grade along entire length of pipe.
- G. Extend tape to surface at building entrances, meters, hydrants, and valves.
- H. Where existing underground warning tape is broken during excavation, replace with new tape identifying appropriate service and securely spliced to ends of existing tape.
- I. Identify valves with brass tags bearing system identification and valve sequence number.
- J. Valve tags are not required at terminal device unless valves are greater than ten feet from device, located in another room, or not visible from device.

- K. Provide typewritten valve schedule and pipe identification schedule indicating valve number and equipment or areas supplied by each valve and symbols used for pipe identification.
- L. Locate schedules in mechanical room and in each Operating and Maintenance manual. Schedule in mechanical room to be framed under clear plastic.

3.9 LUBRICATION

- A. Lubricate bearings with lubricant as recommended by manufacturer before equipment is operated for any reason.
- B. Once equipment has been operated, maintain lubrication in accordance with manufacturer's instructions until Owner accepts work.
- C. Maintain log of lubricants used and frequency of lubrication; include this information in Operation and Maintenance Manuals at completion of project.

3.10 SLEEVES

- A. Provide galvanized sheet metal sleeves for pipe penetrations through interior and exterior walls to provide backing for sealant or firestopping.
- B. Patch wall around sleeve to match adjacent wall construction and finish.
- C. Grout area around sleeve in masonry construction.
- D. In finished spaces where pipe penetration through wall is exposed to view, sheet metal sleeve shall be installed flush with face of wall.
- E. In existing poured concrete walls where penetration is core drilled, pipe sleeve is not required.
- F. Pipe sleeves are not required in interior non-rated drywall, plaster, or wood partitions and sleeves are not required in existing poured concrete walls where penetrations are core drilled.
- G. Pipe sleeves in new poured concrete construction shall be schedule 40 steel pipe, sized to allow insulated pipe to run through sleeve, cast in place.
- H. In piping floor penetrations, fire rated and non-fire rated, top of sleeve shall extend one-inch above adjacent finished floor.
- I. In existing floor penetrations, core drill sleeve opening large enough to insert schedule 40 sleeve and grout area around sleeve with hydraulic setting, non-shrink grout.
- J. If pipe penetrating sleeve is supported by pipe clamp resting on sleeve, weld collar or struts to sleeve that will transfer weight to existing floor structure.

- K. For floor penetrations through existing floors in mechanical and wet locations listed below, core drill opening and provide “Link Seal” as manufactured by Thunderline Corporation. “Link Seal” shall consist of ASTM D2000 EPDM rubber compound interlocking links, Devlin pressure plates, and corrosion resistant fastener to prevent water from entering penetration or core drill sleeve openings large enough to insert schedule 40 sleeve and grout area around sleeve with hydraulic setting non-shrink grout and cement.
- L. For pipe penetrations through existing floors in food service areas, core drill sleeve opening large enough to insert Schedule 40 sleeve and grout area around sleeve with hydraulic setting non-shrink grout/cement.
- M. Size sleeve to allow insulated pipe to pass through sleeve and paint sleeve.
- N. Pipe sleeves are not required in cored floor pipe penetrations through existing floors that are not located in mechanical rooms, food service areas, or wet locations listed above.

3.11 SEALING AND FIRESTOPPING

A. FIRE AND SMOKE RATED PENETRATIONS:

1. Install approved product in accordance with manufacturer's instructions where pipe penetrates fire/smoke rated surface.
2. When pipe is insulated, use product which maintains integrity of insulation and vapor barrier.
3. Where firestop mortar is used to infill large fire-rated floor openings that could be required to support weight, provide permanent structural forming.
4. Firestop mortar alone is not adequate to support substantial weight.

B. NON-RATED PARTITIONS:

1. In exterior wall openings below grade, assemble rubber links of mechanical seal to proper size for pipe and tighten in place, in accordance with manufacturer's instructions.
2. At interior partitions and exterior walls, pipe penetrations are required to be sealed.
3. Apply sealant to both sides of penetration in such a manner that annular space between pipe sleeve or cored opening and pipe or insulation is completely blocked.

END OF SECTION

SECTION 22 05 13

MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes
 - 1. Single and three phase motors.
- B. Related Sections
 - 1. Applicable provisions of Division 01 shall govern all work under this Section.
 - 2. Section 21 13 00 – Sprinkler Systems.
 - 3. Section 21 13 16 – Dry Pipe Fire Suppression Sprinklers.
 - 4. Section 22 30 00 - Plumbing Equipment: Equipment requiring motors.
 - 5. Section 22 42 00 - Plumbing Fixtures.
 - 6. Division 26 - Electrical - Electrical for power wiring, starters, and other electrical devices.

1.2 REFERENCES

- A. American Bearing Manufacturers Association (ABMA)
 - 1. ABMA 9 - Load Ratings and Fatigue Life for Ball Bearings
- B. Institute of electrical and Electronic Engineers (IEEE)
 - 1. IEEE 112 - Test Procedure for Polyphase Induction Motors and Generators.
- C. National electrical Manufacturers Association (NEMA)
 - 1. NEMA MG-1 - Motors and Generators.
- D. National Fire Protection Association (NFPA)
 - 1. NFPA 70 - National Electrical Code.

1.3 SUBMITTALS

- A. Division 01 - Submittal Procedures: Requirements for submittals.
- B. Submit with equipment which motor drives the following motor information: motor manufacturer, voltage, phase, hertz, rpm, full load efficiency, full load power factor, service factor, NEMA design designation, insulation class, and frame type.
- C. Submit manufacturer's instructions in manuals with specific equipment to which they apply.

1.4 ELECTRICAL COORDINATION

- A. Starters, disconnects, relays, wire, conduit, pushbuttons, pilot lights, and other devices required for control of motors or electrical equipment are provided by Contractor, except as specifically noted elsewhere in this division of specifications.
- B. Should any discrepancy in size, horsepower rating, electrical characteristics or means of control be made to any motor or other electrical equipment after contracts are awarded, Contractor is to immediately notify Engineer/Architect and Construction Manager of such discrepancy.
- C. Costs involved in any changes required due to equipment substitutions initiated by Contractor shall be responsibility of Contractor.

1.5 PRODUCT CRITERIA

- A. Motors to conform to all applicable requirements of NEMA, IEEE, and NEC standards and shall be listed by U.L. for service specified.
- B. Select motors for conditions in which they will be required to perform; i.e., general purpose, splash-proof, explosion-proof, standard duty, high torque, or any other special type as required by equipment or motor manufacturer's recommendations.
- C. Furnish motors for starting in accordance with utility requirements and compatible with starters as specified.

PART 2 PRODUCTS

2.1 GENERAL

- A. Work shall conform to requirements of Division 26 - Electrical.
- B. Power wiring shall be provided by Electrical Contractor. Control wiring shall be provided by the Plumbing Contractor.
- C. Plumbing Contractor shall provide wiring diagrams for use by the Electrical Contractor.

2.2 MOTORS

- A. Motors smaller than 1/2 HP shall be NEMA standard motors rated for 120 volts, AC, single phase, 60 Hz.
- B. Motors shall be capacitor start and capacitor run type and shall have internal overload protection.
- C. Motors 1/2 HP and larger shall be NEMA standard motors rated for specified voltage, AC, three phase and 60 Hz.

- D. Motors shall be Design B, squirrel cage, open drip-proof construction with standard T frame, ball bearings, Class B insulation, single winding, continuous duty rated and 1.15 service factor, unless noted otherwise.
- E. Minimum power factor for motors one HP and larger is 85 percent at rated capacity. Capacitors for power factor correction are not acceptable.
- F. Provide devices for motor overload protection unless integral with equipment.
- G. Devices shall be sized according to actual measured current draw with motor operating under normal load conditions.
- H. Provide temporary protective devices where installation is not complete.

2.3 MOTOR STARTERS

- A. Motor starters shall be provided by Plumbing Contractor.
- B. Provide a combination starter for each motor.
- C. Starter shall conform to Allen-Bradley Company Bulletin 512, consisting of a Bulletin 509 full voltage starter and non-fusible disconnect switch mounted in a NEMA Type 1 general purpose enclosure.
- D. Starter shall be equipped as standard with block type overload relays and external reset buttons.
- E. Starter shall be equipped as standard with a transformer to provide a 120V, 60 Hz, secondary control circuit.
- F. Provide a three position Hand-Off-Auto selector switch for field installation in the enclosure flange: Allen-Bradley Catalog No. 1481-N51A or 1481-N51B.

2.4 THREE PHASE, SINGLE SPEED MOTORS

- A. Use NEMA rated three phase, 60 hertz motors for all motors 1/2-HP and larger unless specifically indicated.
- B. Use NEMA general purpose, continuous duty, Design B, normal starting torque, T-frame or U-frame motors with Class B or better insulation unless manufacturer of equipment on which motor is being used has different requirements.
- C. Use open drip-proof motors unless totally enclosed fan-cooled, totally enclosed non-ventilated, explosion-proof, or encapsulated motors are specified in equipment sections.
- D. Use grease lubricated anti-friction ball bearings with housings equipped with plugged/capped

provision for re-lubrication, rated for minimum ABMA 9, L-10 life of 20,000 hours.

- E. Calculate bearing load with NEMA minimum V-belt pulley with belt center line at end of NEMA standard shaft extension. Stamp bearing sizes on nameplate.
- F. Open drip-proof motors to have a 1.15 service factor. Other motor types may have minimum 1.0 service factors.
- G. Motors 1-HP and larger, except specially wound motors and inline pump motors 56 frame and smaller, to be high efficiency design with full load efficiencies which meet or exceed values listed below when tested in accordance with NEMA MG 1.

2.5 MOTORS USED ON VARIABLE FREQUENCY DRIVES

- A. Motors must be suitable for use with drive specified, including but not limited to motor cooling.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Mount motors on a rigid base designed to accept a motor, using shims if required under each mounting foot to get a secure installation.
- B. When motor will be flexible coupled to driven device, mount coupling to shafts in accordance with coupling manufacturer's recommendations.
- C. Using a dial indicator, check angular misalignment of two shafts; adjust motor position as necessary so that angular misalignment of shafts does not exceed 0.002 inches per inch diameter of coupling hub. Again using dial indicator, check shaft for run-out to assure concentricity of shafts; adjust as necessary so that run-out does not exceed 0.002 inch.
- D. When motor will be connected to driven device by means of a belt drive, mount sheaves on appropriate shafts in accordance with manufacturer's instructions.
- E. Use a straight edge to check alignment of sheaves; reposition sheaves as necessary so that straight edge contacts both sheave faces squarely.
- F. After sheaves are aligned, loosen adjustable motor base so that belt(s) can be added and tighten base so that belt tension is in accordance with drive manufacturer's recommendations.
- G. Frequently re-check belt tension and adjust if necessary during first day of operation and again after several days.
- H. Verify proper rotation of each three-phase motor as it is being wired or before motor is energized for any reason.

- I. Lubricate all motors requiring lubrication. Record lubrication material used and frequency of use. Include this in maintenance manuals.

END OF SECTION

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SECTION 22 05 14

PLUMBING SPECIALTIES

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes
 - 1. Floor drains.
 - 2. Roof drains.
 - 3. Cleanouts.
 - 4. Backflow preventers
 - 5. Water hammer arrestors.
 - 6. Miscellaneous plumbing specialties.

- B. Related Sections
 - 1. Applicable provisions of Division 01 shall govern all work under this Section.
 - 2. Section 22 05 23 - Valves for Plumbing Piping.
 - 3. Section 22 11 00 - Facility Water Distribution.
 - 4. Section 22 13 00 - Facility Sanitary Sewerage.
 - 5. Section 22 14 00 - Facility Storm Drainage.
 - 6. Section 22 15 13 - General Service Compressed-Air Piping.

1.2 REFERENCES

- A. American Society of Mechanical Engineers (ASME)
 - 1. ASME A112.14.1 - Backwater Valves
 - 2. ASME A112.21.1M - Floor Drains.
 - 3. ASME A112.21.2M - Roof Drains.

- B. American Society of Safety Engineers (ASSE)
 - 1. ASSE 1001 - Pipe Applied Atmospheric Type Vacuum Breakers.
 - 2. ASSE 1010 - Water Hammer Arrestors.
 - 3. ASSE 1011 - Hose Connection Vacuum Breakers.
 - 4. ASSE 1012 - Backflow Preventers with Intermediate Atmospheric Vent.
 - 5. ASSE 1013 - Reduced Pressure Principle Backflow Preventers.
 - 6. ASSE 1018 - Trap Seal Primer Valves.
 - 7. ASSE 1019 - Wall Hydrants, Frost Proof Automatic Draining, Anti-Backflow Type.

- C. ASTM International
 - 1. ASTM A48 – Specification for Gray Iron Castings.
 - 2. ASTM A443 - Specification for Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets.

3. ASTM A478 - Specification for Precast Reinforced Concrete Manhole Sections.
4. ASTM C923 - Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals.
5. ASTM C990 - Specification for Joints for Concrete Pipe, Manholes and Precast Box Sections Using Preformed Flexible Joint Sealants.

- D. Plumbing and Drainage Institute (PDI)
1. PDI-WH-201 - Water Hammer Arrestors.

1.3 SUBMITTALS

- A. Division 01 - Submittal Procedures: Requirements for submittals.
- B. Shop Drawings: Include data concerning dimensions, capacities, materials of construction, ratings, certifications, weights, and manufacturer's performance limitations.
- C. Submit manufacturer's installation requirements.

1.4 QUALITY ASSURANCE

- A. Plumbing products requiring approval by State and local authorities must be approved at time of shop drawing submission.

PART 2 PRODUCTS

2.1 FLOOR DRAINS

- A. Manufacturers:
1. Josam Company.
 2. Jay R. Smith Manufacturing Company.
 3. Tyler Pipe/Wade Division.
 4. Watts Water Technologies.
 5. Zurn Plumbing Products.
 6. Or approved equal.
- B. Refer to Plumbing Drain and Cleanout Schedule on Drawings.

2.2 HUB DRAINS

- A. Manufacturers:
1. Josam Company.
 2. Jay R. Smith Manufacturing Company.
 3. Tyler Pipe/Wade Division.
 4. Watts Water Technologies.
 5. Zurn Plumbing Products.

6. Or approved equal.

B. Refer to Plumbing Drain and Cleanout Schedule on Drawings.

2.3 ROOF DRAINS

A. Manufacturers:

1. Josam Company.
2. Jay R. Smith Manufacturing Company.
3. Tyler Pipe/Wade Division.
4. Watts Water Technologies.
5. Zurn Plumbing Products.
6. Or approved equal.

B. Refer to Plumbing Drain and Cleanout Schedule on Drawings.

2.4 TRENCH DRAINS

A. Manufacturers:

1. ACO Polymer Products.
2. Josam Company.
3. Jay R. Smith Manufacturing Company.
4. Watts Water Technologies.
5. Zurn Plumbing Products.
6. Or approved equal.

B. Refer to Plumbing Drain and Cleanout Schedule on Drawings.

2.5 CLEANOUTS

A. Manufacturers:

1. Josam Company.
2. Jay R. Smith Manufacturing Company.
3. Tyler Pipe/Wade Division.
4. Watts Water Technologies.
5. Zurn Plumbing Products.
6. Or approved equal.

B. Refer to Plumbing Drain and Cleanout Schedule on Drawings.

2.6 WATER HAMMER ARRESTORS

A. Manufacturers:

1. PPP Industries.
2. Sioux Chief Manufacturing Company.

3. Tyler Pipe/Wade Division.
 4. Watts Water Technologies.
 5. Or approved equal.
- B. ASSE 1010; sized in accordance with PDI WH-201, precharged piston type constructed of hard drawn Type K copper, threaded brass adapter, brass piston with o-ring seals, FDA approved silicone lubricant, suitable for operation in temperature range 35 to 150 degrees F, maximum 250 psig working pressure, 1500 psig surge pressure. Watts series 15.

2.7 BACKFLOW PREVENTERS

- A. Manufacturers:
1. Conbraco Industries, Inc.
 2. Chicago Faucet.
 3. Febco Division - Watts Water Technologies.
 4. Wilkins – A Zurn Company.
 5. NIBCO, Inc.
 6. Or approved equal.
- B. Backflow preventers shall be manufactured by. Refer to Plumbing Equipment Schedule.
- C. Vacuum Breakers
1. For use in finished areas with concealed piping, brass construction, chromium plated, Chicago Faucet No. 892-G.
 2. For exposed piping in unfinished areas, brass construction, Watts Series 288A.
 3. Hose thread inlet and outlet, non-removable hose connection, vacuum breaker for use on service sink faucets, Chicago Faucet No. E27.
- D. Continuous Pressure Type
1. Bronze construction, stainless steel internal parts, primary and secondary checks with vent chamber, ASSE 1012, Watts No. 9D.
 2. Satin chrome finish for finished areas, Watts Regulator No. 9DSC.
- E. Double Check Assembly
1. Sizes 3/4 inch through 3 inches: Bronze body, replaceable seats, ball valve shutoffs, strainer, union connections, ball valve test ports, ASSE 1015, Watts Series 007.
 2. Sizes 4 inches and larger: Cast iron body, epoxy coated bronze seats, ball valve test ports, ASSE 1015, Watts Series 709. Include butterfly shutoff valves, EPDM encapsulated disk, NIBCO FC-27 series.
- F. Reduced Pressure Zone Type (RPBP)
1. Sizes 3/4 inch through 3 inches: Bronze body, replaceable seats, ball valve type shutoffs, strainer, union connections, ball valve test ports, ASSE 1013, Watts 009.

2. 4 inches and larger: Cast iron body, bronze check seats, stainless steel relief seat, ball valve test ports, ASSE 1013, Watts Series 909. Include butterfly shutoff valves, EPDM encapsulated disk, NIBCO FC-27 series.

2.8 HOSE BIBBS

- A. Manufacturers:
 1. Josam Company.
 2. Jay R. Smith Manufacturing Company.
 3. Tyler Pipe/Wade Division.
 4. Watts Water Technologies.
 5. Woodford Manufacturing Company.
 6. Zurn Plumbing Products.
 7. Or approved equal.

2.9 YARD HYDRANTS

- A. Manufacturers:
 1. Woodford Manufacturing Company.
 2. Or approved equal.
- B. Freeze-proof/Pollution-proof post-type, with below-ground reservoir yard hydrant with locking handle, 1-inch inlet, 3/4-inch hose thread, ASSE 1052 backflow preventer outlet, 1-1/4-inch galvanized steel casing pipe, schedule 80 PVC pipe reservoir, teflon packing, flow-finder flow plunger. Woodford Model S3-BFP or S4-BFP.

2.10 TRAP PRIMER VALVES

- A. Manufacturers:
 1. Ancon - Watts Water Technologies.
 2. PPP Industries.
 3. Jay R. Smith Manufacturing Company.
 4. Tyler Pipe/Wade Division.
 5. Or approved equal.
- B. Bronze body, O-ring seals, integral threaded outlet vacuum breaker, adjustable, in conformance with ANSI/ASSE 1018. PPP model P-1/P-2.

2.11 VENT FLASHINGS

- A. Manufacturers:
 1. SEMCO – A Gibraltar Company.
 2. Oatey.
 3. Or an approved equal.

- B. Formed 3 lb./sq. ft. lead flashing with minimum base size of 15-inch x 17-inch.
- C. Single Ply Membrane Roofs: Flashing boot of material compatible with roofing membrane with base flange for adhering to membrane and stainless steel drawband for securing to vent pipe.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Coordinate location and setting of plumbing specialties with adjacent construction. Install in accordance with manufacturers recommendations.
- B. Set floor drains, roof drains, trench drains, and cleanouts level and plumb adjusted to finished floor elevation, roof elevation or finished wall location. Locate where serviceable. Allow minimum of 18-inch clearance around cleanouts for rodding.
- C. Lubricate threaded cleanout plugs with graphite and oil, teflon tape, or waterproof grease. Install trap primer connections where indicated. Provide deep seal traps on floor drains.
- D. Test and adjust valve for proper operation. Allow minimum 18-inch clearance for servicing.
- E. Install water hammer arrestors where indicated and at quick closing valve installations.
- F. Install backflow preventers in accordance with State and local code requirements maintaining minimum clearance distances for servicing and testing.
- G. Provide indirect waste piping with air gap installation from relief opening to above hub drain or floor drain.
- H. Where backflow preventers requiring governing agency registration are installed, provide initial registration, testing and report filing required by governing agency. List name and address of building that backflow preventer installations occur in.
- I. Mount exterior hose bibbs recessed in exterior wall construction with valve plug extended beyond interior side of building insulation. Slope to drain to exterior.
- J. Install bibbs so discharge is 18 inches minimum above finished grade. Set wall box in grout or caulk and fill exterior wall penetration with insulation.
- K. Mount hose bibbs securely fastened to wall where indicated. Provide water hammer arrestor in line to hose bibb.

END OF SECTION

SECTION 22 05 15

PLUMBING PIPING SPECIALTIES

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes
 - 1. Plumbing piping specialties for all piping systems.
- B. Related Sections
 - 1. Applicable provisions of Division 01 shall govern all work under this Section.
 - 2. Section 22 05 23 - Valves for Plumbing Piping.
 - 3. Section 22 07 00 - Plumbing Insulation.
 - 4. Section 22 11 00 - Facility Water Distribution.
 - 5. Section 22 13 00 - Facility Sanitary Sewerage.
 - 6. Section 22 14 00 - Facility Storm Drainage.
 - 7. Section 22 15 13 - General Service Compressed-Air Piping.
 - 8. Section 22 30 00 - Plumbing Equipment.

1.2 REFERENCE

- A. ASTM International:
 - 1. ASTM A126 – Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
 - 2. ASTM B30 – Specification for Copper Alloys in Ingot Form.
 - 3. ASTM B62 – Specification for Composition Bronze or Ounce Metal Castings.
 - 4. ASTM B650 - Specification for Electrodeposited Engineering Chromium Coatings on Ferrous Substrates.

1.3 SUBMITTALS

- A. Division 01 - Submittal Procedures: Requirements for submittals.
- B. Required for all items in this section. Include materials of construction, dimensional data, ratings/capacities/ranges, approvals, test data, pressure drop data where appropriate, and identification as referenced in this section and on Drawings.
- C. Submit manufacturer's installation requirements.

1.4 DESIGN CRITERIA

- A. Piping specialties shall be rated for highest pressures and temperatures in respective system in accordance with ANSI B30, but not less than 125 psig, unless specifically indicated

otherwise.

PART 2 PRODUCTS

2.1 THERMOMETERS

- A. Manufacturers:
 - 1. Ashcroft.
 - 2. Marsh.
 - 3. Taylor.
 - 4. H. O. Trerice.
 - 5. Ametek/U. S. Gauge.
 - 6. Weiss.
 - 7. Wika.
 - 8. Weksler.
 - 9. Or Approved Equal.

- B. Stem Type: Cast aluminum case, 9-inch scale, clear acrylic window, adjustable angle brass stem with stem of sufficient length so end of stem is near middle of pipe without reducing thickness of any insulation, red indicating fluid, black lettering against white background, with scale ranges as follows:
 - 1. Service: Hot Water.
 - 2. Scale Range: 30 – 180 degrees F.
 - 3. Increment: 2 degrees F.

2.2 THERMOMETER SOCKETS

- A. Brass with threaded connections suitable for thermometer stems and temperature control sensing elements in pipeline. Furnish with extension necks for insulated piping systems.

2.3 TEST WELLS

- A. Similar to thermometer sockets except with brass cap that threads into inside of test well to prevent dirt from accumulating. Secure cap to body with short chain. Furnish with extension necks, where appropriate, to accommodate pipeline insulation.

2.4 TEST PLUGS

- A. Brass threaded pressure and temperature test plug with neoprene self-closing valve, valve retainer, brass threaded cap, rated for 150 psi and 0-200 degrees F.

2.5 PRESSURE GAUGES

- A. Manufacturers:
 - 1. Ametek/U. S. Gauge.

2. Ashcroft.
 3. Or Approved Equal.
- B. Cast aluminum case of not less than 4.5 inches in diameter, double strength glass window, black lettering on white background, phosphor bronze bourdon tube with bronze bushings, recalibration from front of dial, 99 percent accuracy over middle half of scale, 98.5 percent accuracy over remainder of scale, with scale range as follows:

Service	Hot Water	Cold Water	Compressed Air
Scale Range, psig	0-100	0-100	0-200
Increment, psig	1	1	2

- C. Pressure Snubbers: Bronze construction, 300 psig working pressure, 1/4-inch size.
- D. Gauge Valves: Use ball valves as specified in Section 22 05 23 - General-Duty Valves for Plumbing Piping.

2.6 STRAINERS

- A. Manufacturers:
1. Armstrong.
 2. Illinois.
 3. Keckley.
 4. Metraflex.
 5. Mueller Steam.
 6. Sarco.
 7. Watts.
 8. Or Approved Equal.
- B. Y type; cast bronze body, ASTM B62; 20 mesh stainless steel screens; bolted or threaded screen retainer tapped for blowoff valve; sweat, threaded or flanged body rated at not less than 150 psi WOG.
- C. Y type; cast iron body, ASTM A126; 20 mesh stainless steel screens; bolted or threaded screen retainer tapped for blowoff valve; threaded or flanged ends; rated at not less than 150 psi WOG.

PART 3 EXECUTION

3.1 THERMOMETERS

- A. Stem Type: Install in piping systems as indicated on Drawings or details using separable socket in each location.

3.2 THERMOMETER SOCKETS

- A. Install at each point where thermometer or temperature control-sensing element is located in pipeline.

3.3 TEST WELLS

- A. Install in piping systems as indicated on Drawings or details wherever provisions are needed for inserting thermometer at later date.

3.4 TEST PLUGS

- A. Install in piping systems as indicated on Drawings or details wherever provisions are needed for short-term measurement of pressure or temperature.

3.5 PRESSURE GAUGES

- A. Install in locations where indicated on Drawings or details, with scale range appropriate to system operating pressures.
- B. Pressure Snubbers: Install in gauge piping for all gauges used on water services.
- C. Gauge Valves: Install at each gauge location as close to main as possible and at each location where gauge tapping is indicated.

3.6 STRAINERS

- A. Install all strainers where indicated allowing sufficient space for screens to be removed. Install ball valve in tapped screen retainer.

END OF SECTION

SECTION 22 05 23

VALVES FOR PLUMBING PIPING

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes
 - 1. Waste System Valves.
 - 2. Compressed Air Systems.
 - 3. Specialty Valves and Valve Accessories.
- B. Related Sections
 - 1. Applicable provisions of Division 01 shall govern all work under this Section.
 - 2. Section 22 05 14 - Plumbing Specialties.
 - 3. Section 22 30 00 - Plumbing Equipment.

1.2 REFERENCES

- A. American National Standards Institute (ANSI)
 - 1. ANSI Z21.22 - Relief Valves and Automatic Gas Shutoff Devices for Hot Water Supply Systems.
- B. American Society of Safety Engineers (ASSE)
 - 1. ASSE 1003 - Water Pressure Reducing Valves for Domestic Water Supply Systems.
- C. American Water Works Association (AWWA)
 - 1. AWWA C504 – Rubber-Seated Butterfly Valves.
 - 2. AWWA C509 – Resilient-Seated Gate Valves for Water Supply Service.
 - 3. AWWA C550 – Protective Epoxy Interior Coatings for Valves and Hydrants.
 - 4. AWWA C800 - Underground Service Line Valves and Fittings.
- D. ASTM International
 - 1. ASTM D4101 - Specification for Polypropylene Injection and Extrusion Materials

1.3 SUBMITTALS

- A. Division 01 - Submittal Procedures: Requirements for submittals.
- B. Submit schedule of all valves indicating type of service, dimensions, materials of construction, and pressure/temperature ratings for all valves to be used on project. Temperature ratings specified are for continuous operation.

1.4 DESIGN CRITERIA

- A. Where valve types are specified for individual plumbing services, each valve type shall be of same approved manufacturer unless prior written approval is obtained from Engineer/Architect.
- B. Valves to be line size unless specifically noted otherwise.

PART 2 PRODUCTS

2.1 WATER SYSTEM VALVES

- A. Water system valves shall be rated at not less than 125 psig water working pressure at 240 degrees F unless noted otherwise.
- B. Ball Valves: 3-Inch and smaller: Two or three piece bronze body; sweat ends, chrome plated bronze full port ball; glass filled teflon seat; teflon packing and threaded packing nut; blowout-proof stem; 600 psig WOG. Provide valve stem extensions for valves installed in all piping with insulation.
 - 1. Manufacturers:
 - a. Apollo 70-200.
 - b. Hammond 8511.
 - c. Milwaukee BA150.
 - d. NIBCO S580-70.
 - e. Watts B-6001.
 - f. Or approved equal.
- C. Butterfly Valves:
 - 1. 2-1/2-Inch and Larger: Cast or ductile iron body; stainless steel shaft; bronze, copper or teflon bushings; EPDM resilient seat; EPDM seals; bronze, aluminum-bronze, EPDM encapsulated ductile iron or stainless steel disc. 200 psig WOG through 12-inch, 150 psig WOG through 24-inch. Valve assembly to be bubble tight to 175 psig with no downstream flange/pipe attached. Use tapped lug type valves with stud bolts or cap screws, or grooved end connection valves, permitting removal of downstream piping while using valve for system shutoff.
 - 2. Manufacturers:
 - a. Centerline LT Series.
 - b. DeZurik 632.
 - c. Hammond 6200 Series.
 - d. Milwaukee M or C Series.
 - e. NIBCO LD2000/LC2860.
 - f. Victaulic 300/608/700/709.
 - g. Watts BF-03.
 - h. Or approved equal.

3. Provide 10 position locking lever handle actuators for valves 6-inch and smaller. Provide worm gear operators with external position indication for valves 8-inch and larger.
- D. Swing Check Valves: 3-Inch and Smaller: Bronze body, sweat ends, Y-pattern, regrindable bronze seat, renewable bronze disc, Class 125, suitable for installation in horizontal or vertical line with flow upward.
1. Manufacturers:
 - a. Crane 1342.
 - b. Hammond IB941.
 - c. NIBCO S413B.
 - d. Watts CVYS.
 - e. Or approved equal.
- E. Swing Check Valves: 4-Inch and Larger: Cast iron body, flanged ends, bronze trim, bolted cap, renewable bronze seat and disc, Class 125, non-asbestos gasket, suitable for installation in a horizontal or vertical line with flow upward.
1. Manufacturers:
 - a. Crane 373.
 - b. Hammond IR1124.
 - c. Milwaukee F2974.
 - d. NIBCO F918B.
 - e. Watts Series 411.
 - f. Or approved equal.
- F. Spring Loaded Check Valves: 2-Inch and Smaller: Bronze body, sweat or threaded ends, bronze trim, stainless steel spring, stainless steel center guide pin, Class 125, teflon seat unless only bronze available.
1. Manufacturers:
 - a. ConBraCo 61 Series.
 - b. Mueller 203BP.
 - c. NIBCO S480Y.
 - d. Val-Matic S1400 Series.
 - e. Or approved equal.
- G. Spring Loaded Check Valves: 2-1/2-Inch and Larger: Cast or ductile iron body, wafer or globe type, bronze trim, bronze or EPDM seat, stainless steel spring, stainless steel stem if stem is required, Class 125.
1. Manufacturers:
 - a. APCO 300 or 600 Series.
 - b. Centerline CLC with Full-Body Option.
 - c. Hammond IR9354.
 - d. Milwaukee 1800 Series.
 - e. Mueller Steam 101AP or 105AP.

- f. NIBCO W910 or F910.
 - g. Val-Matic 1400 or 1800 or 8000 Series.
 - h. Or approved equal.

- H. Stop and Waste Valves: 1-Inch and Smaller: Bronze body, sweat or threaded ends, 400 psi WOG, stainless steel ball and stem, full port ball valve, with threaded drain cap.
 - 1. Manufacturers:
 - a. Watts B-6300/6301 SS Series.
 - b. Apollo.
 - c. Hammond.
 - d. Milwaukee.
 - e. NIBCO.
 - f. Or approved equal.

- I. Balance Valves: 2-Inch and Smaller: Two or three piece bronze body ball valve, sweat or threaded ends, chrome plated brass full port ball, glass filled teflon seat, threaded packing nut, with adjustable memory stop position indicator and extended handle stem, suitable for 400 psig water working pressure at 240 degrees F.
 - 1. Manufacturers:
 - a. Watts B-6000/B-6001 BS.
 - b. Apollo.
 - c. Grinnell.
 - d. Hammond.
 - e. Milwaukee.
 - f. NIBCO.
 - g. Or approved equal.

- J. Drain Valves: 3/4-inch ball valve with integral threaded hose adapter, sweat or threaded inlet connections, with threaded cap and chain on hose threads.
 - 1. Manufacturers:
 - a. Watts B-6000-CC/B-6001-CC Series.
 - b. Or approved equal.

2.2 SPECIALTY VALVES AND VALVE ACCESSORIES

- A. Gauge Valves: Use 1/4-inch ball valves. Needle valves and gauge cocks will not be accepted.

- B. Water Pressure Reducing Valves: Bronze body, diaphragm operated, with an integral thermal expansion bypass valve, inlet union, stainless steel strainer, renewable monel or stainless steel seat, and adjustable reduced pressure range, 300 psig at 160 degrees F. Pre-set for scheduled pressure.
 - 1. Manufacturers:
 - a. A. W. Cash.
 - b. Conbraco.

- c. Watts.
 - d. Wilkins.
 - e. Or approved equal.
- C. Safety Relief Valves: Bronze body, temperature and pressure actuated, stainless steel stem and spring, thermostat with non-metallic coating, test lever, suitable for 125 psig water working pressure at 240 degrees F, sized for full BTUH input and operating pressure of equipment, with valve capacity on metal label. For equipment less than or equal to 200,000 BTUH input, provide AGA, UL, or ASME listed and labeled valve. Provide ASME listed and labeled valve for larger equipment.
- 1. Manufacturers:
 - a. Bell & Gossett.
 - b. A. W. Cash.
 - c. Conbraco.
 - d. Watts.
 - e. Wilkins.
 - f. Or approved equal.
 - 2. Size temperature and pressure relief valve per AGA rating for BTUH input.

PART 3 EXECUTION

3.1 GENERAL

- A. Properly align piping before installation of valves.
- B. Install and test valves in strict accordance with valve manufacturer's installation recommendations.
- C. Do not support weight of piping system on valve ends.
- D. Mount valves in locations allowing access for operation, servicing, and replacement.
- E. Provide valve handle extensions for all valves installed in insulated piping.
- F. Install valves with stem in upright or horizontal position. Install butterfly valves with stem in horizontal position.
- G. Valves installed with stems down will not be accepted.
- H. Prior to flushing of piping systems, place valves in full-open position.

3.2 SHUT-OFF VALVES

- A. Install shut-off valves at each piece of equipment, at each branch take-off from mains for isolation or repair, as indicated on Drawings.

3.3 BALANCING VALVES

- A. Install where indicated on Drawings and details for balancing of flow in pumped hot water recirculation piping systems.
- B. Upon project completion, adjust each valve and set position stop.
- C. Balance system to minimum flow in return piping branches needed to maintain even supply water temperature throughout building.

3.4 DRAIN VALVES

- A. Provide drain valves for complete drainage of all systems.
- B. Locations of drain valves include low points of piping systems, downstream of riser isolation valves, equipment locations specified or detailed, other locations required for drainage of systems and as indicated on Drawings.

3.5 SPRING LOADED CHECK VALVES

- A. Install spring loaded check valve in each circulating pump discharge line, each clear water sump pump discharge line, and as indicated on Drawings.

3.6 SWING CHECK VALVES

- A. Install swing check valves in re-circulation branch lines and as indicated on Drawings.
- B. Provide weighted swing check valves at sanitary sump pump discharges.

3.7 PRESSURE REDUCING VALVES

- A. Provide ball valve and strainer at inlet and ball valve at outlet. Install pressure gauges to indicate inlet and outlet pressure at each pressure-reducing valve.

3.8 SAFETY RELIEF VALVES

- A. Install relief valves on pressure vessels and as indicated on Drawings.
- B. Inlet and outlet piping connecting to valves must be same size as valve connections or larger.
- C. Pipe discharge to drain where indicated or to floor.

3.9 COMPRESSED AIR VALVES

- A. Install shut-off valves at each piece of equipment, base of drip legs, and as indicated on Drawings.

- B. Install safety exhaust shut-off valves at terminal equipment designed for frequent removal.
- C. Install pressure-reducing valves at filter stations and as indicated on Drawings.
- D. Mount in readily accessible location for gauge and maintenance access.

END OF SECTION

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SECTION 22 05 29

HANGERS AND SUPPORTS FOR PLUMBING

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes
 - 1. Supports of plumbing equipment and materials.
 - 2. Piping system anchors.
- B. Related Sections
 - 1. Applicable provisions of Division 01 shall govern all work under this Section.
 - 2. Division 03: Formwork and cast-in-place concrete for equipment pads.
 - 3. Section 22 07 00 - Plumbing Insulation: Insulation protection at support devices.

1.2 REFERENCES

- A. ASTM International
 - 1. ASTM A123 – Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - 2. ASTM B633 – Specification for Electrodeposited Coatings of Zinc on Iron and Steel.
 - 3. ASTM B695 - Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel.
- B. Manufacturers Standardization Society (MSS)
 - 1. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, and Manufacture.
 - 2. MSS SP-69 - Pipe Hangers and Supports - Selection and Application.

1.3 QUALITY ASSURANCE

- A. Substitution of Materials: In accordance with Division 01.

1.4 DESCRIPTION

- A. Provide supporting devices as required for installation of mechanical equipment and materials.
- B. Supports and installation procedures shall conform to latest requirements of ANSI Code for building piping.
- C. Do not hang any mechanical item directly from a metal deck or run piping so it rests on bottom chord of any truss or joist.

- D. Fasteners depending on soft lead for holding power or requiring powder actuation shall not be accepted.
- E. Support apparatus and material under conditions of operation, variations in installed and operating weight of equipment and piping, to prevent excess stress, and allow for proper expansion and contraction.
- F. Protect insulation at all hanger points.

1.5 SUBMITTALS

- A. Division 01 - Submittal Procedures: Requirements for submittals.
- B. Submit manufacturer's installation instructions.

1.6 DESIGN CRITERIA

- A. Materials and application of pipe hangers and supports shall be in accordance with MSS Standard Practice SP-58 and SP-69 unless noted otherwise.
- B. Piping connected to pumps, compressors, or other rotating or reciprocating equipment is to have vibration isolation supports for distance of one hundred pipe diameters or three supports away from equipment, whichever is greater.
- C. Standard pipe hangers and supports as specified in this section are required beyond 100 pipe diameter divided by 3 for support distance.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturers: Anvil, B-Line, Pate, Piping Technology, Roof Products & Systems, or approved equal.

2.2 STRUCTURAL SUPPORTS

- A. Provide supporting steel required for installation of mechanical equipment and materials, including angles, channels, and beams, to suspended or floor supported tanks and equipment.
- B. Supporting steel not be specifically indicated on Drawings, shall be used as required by governing code.

2.3 PIPE HANGERS AND SUPPORTS

- A. Hangers for Pipe Sizes 1/2-Inch through 2-Inch:
 - 1. Carbon steel, adjustable swivel ring. B-Line B3170NF, Anvil 69 or 70.

2. Carbon steel, adjustable clevis, standard. B-Line B3100, Anvil 260.
- B. Hangers for Pipe Sizes 2-Inch and Larger:
1. Carbon steel, adjustable clevis, standard. B-Line B3100, Anvil 260.
- C. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
- D. Wall Support:
1. Carbon steel welded bracket with hanger. B-Line 3068 Series, Anvil 194 Series.
 2. Perforated, epoxy painted finish, 16-12 gauge minimum, steel channels securely anchored to wall structure, with interlocking, split-type, bolt secured, galvanized pipe and tubing clamps.
 3. B-Line type S channel with B-2000 series clamps or Anvil type PS 200 H with PS 1200 clamps.
 4. When copper piping is being supported, provide flexible elastomeric and thermoplastic isolation cushion material to completely encircle piping and avoid contact with channel or clamp, equal to B-Line B1999 Vibra Cushion or provide manufacturers clamp and cushion assemblies, B-Line BVT series, Anvil PS 1400 series.
- E. Vertical Support: Carbon steel riser clamp. B-Line B3373, Anvil 261 for above floor use.
- F. Floor Support: Carbon steel pipe saddle, stand and bolted floor flange, B-Line B3088T/B3093.
- G. Copper Pipe Supports: Supports, fasteners and clamps directly connected to copper piping shall be copper plated or polyvinyl chloride coated. Where steel channels are used, provide isolation collar between supports, clamps, fasteners and copper piping.

2.4 PIPE HANGER RODS

- A. Steel Hanger Rods: Threaded both ends, threaded one end, or continuous threaded, complete with adjusting and lock nuts.
- B. Size rods for individual hangers and trapeze support as indicated in following schedule, total weight of equipment, including valves, fittings, pipe, pipe content, and insulation, are not to exceed limits indicated in following schedule.

Maximum Load (Lbs.) (650°F Maximum Temp.)	Rod Diameter (inches)
610	3/8
1130	1/2
1810	5/8
2710	3/4
3770	7/8

4960 1
8000 1-1/4

2.5 BEAM CLAMPS

- A. MSS SP-69 Types 19 & 23 malleable black iron clamp for attachment to beam flange to 0.62 inches thick with retaining ring and threaded rod of 3/8, 1/2, and 5/8 inch diameter. Furnish with hardened steel cup point set screw. B-Line B3036L/B3034, Anvil 86/92.
- B. MSS SP-69 Type 28 or Type 29 forged steel jaw type clamp with tie rod to lock clamp in place, suitable for rod sizes to 1-1/2 inch diameter. B-Line B3054, Anvil 228.

2.6 CONCRETE INSERTS

- A. Poured In Place:
 - 1. MSS SP-69 Type 18 wedge type to be constructed of a black carbon steel body with removable malleable iron nut that accepts threaded rod to 7/8-inch diameter. Wedge design to allow insert to be held by concrete in compression to maximize load carrying capacity. B-Line B2505, Anvil 281.
 - 2. MSS SP-69 Type 18 universal type to be constructed of black malleable iron body with removable malleable iron nut that accepts threaded rod to 7/8-inch diameter. B-Line B3014N, Anvil 282.
- B. Drilled Fasteners: Carbon steel expansion anchors, vibration resistant, with ASTM B633 zinc plating. Use drill bit of same manufacturer as anchor. Hilti, Rawl, or Redhead.

2.7 CONTINUOUS CONCRETE INSERT CHANNELS

- A. Steel inserts with industry standard pre-galvanized finish, nominally 1-5/8-inch wide by 1-3/8 inch deep by length to suit application, designed to be nailed to concrete forms and provide linear slot for attaching other support devices.
- B. Installed channels to provide load rating of 2000 pounds per foot in concrete.
- C. Manufacturer's standard brackets, inserts, and accessories designed to be used with channel inserts may be used.
- D. Select insert length to accommodate all pipe in area.

2.8 ANCHORS

- A. Use welding steel shapes, plates, and bars to secure piping to structure.

2.9 EQUIPMENT STANDS

- A. Use structural steel members welded to and supported by pipe supports.

- B. Clean, prime and coat with three coat rust inhibiting alkyd paint or one coat epoxy mastic.
- C. Where exposed to weather, treat with corrosive atmosphere coatings.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Size, apply and install supports and anchors in compliance with manufacturer's recommendations.
- B. Install supports to provide for free expansion of piping system.
- C. Support piping from structure using concrete inserts, beam clamps, ceiling plates, wall brackets, or floor stands.
- D. Fasten ceiling plates and wall brackets securely to structure and test to demonstrate adequacy of fastening.
- E. Coordinate hanger and support installation to properly group piping of all trades.
- F. Where piping can be conveniently grouped to allow use of trapeze type supports, use standard structural shapes or continuous insert channels for supporting steel.
- G. Where continuous insert channels are used, pipe supporting devices made specifically for use with channels may be substituted for specified supporting devices provided that similar types are used and all data is submitted for prior approval.
- H. Size and install hangers and supports, except for riser clamps, for installation on exterior of piping insulation.
- I. Where vapor barrier is not required, hangers may be installed either on exterior of pipe insulation or directly on piping.
- J. Perform welding in accordance with standards of American Welding Society.

3.2 HANGER AND SUPPORT SPACING

- A. Install hangers to provide minimum 1/2-inch space between finished covering and adjacent work.
- B. Place hanger within 12 inches of each horizontal elbow, valve, strainer, or similar piping specialty item.
- C. Use hangers with 1-1/2-inch minimum vertical adjustment.

- D. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
- E. Support riser piping independently of connected horizontal piping.
- F. Adjust hangers to obtain slope specified in piping section of these specifications.
- G. Space hangers for pipe as follows:

Pipe Material	Pipe Size	Maximum Horizontal Spacing	Maximum Vertical Spacing
Cast Iron	2" and larger	5'-0"	15'-0"
Copper	1/2" through 3/4"	5'-0"	10'-0"
Copper	1" through 1-1/4"	6'-0"	10'-0"
Copper	1-1/2" through 2-1/2"	8'-0"	10'-0"
Copper	3"	10'-0"	10'-0"
Copper	4" and larger	12'-0"	10'-0"
Ductile Iron	All	10'-0"	20'-0"
Steel	1/2" through 1-1/4"	7'-0"	15'-0"
Steel	1-1/2" through 6"	10'-0"	15'-0"
Steel	8" through 12"	14'-0"	20'-0"
Steel	14" and over	20'-0"	20'-0"
Plastic	Drain and Vent	4'-0"	10'-0"
Plastic	1" or less	32"	4'-0"
Plastic	1-1/4" and over	4'-0"	6'-0"

3.3 RISER CLAMPS

- A. Support vertical piping with clamps secured to piping and resting on building structure or secured to building structure below at each floor.

3.4 CONCRETE INSERTS AND CONTINUOUS INSERT CHANNELS

- A. Select size based on manufacturer's stated load capacity and weight of material that will be supported.
- B. Locate continuous insert channels on 6'-0" maximum centers and 2'-0" from corners.
- C. Furnish inserts to Contractor for placement in concrete formwork.
- D. Use inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
- E. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inch size.
- F. Where concrete slabs form finished ceiling, provide inserts that are flush with slab surface.

3.5 ANCHORS

- A. Install where indicated on Drawings and details.
- B. Where not specifically indicated, install anchors at ends of principal pipe runs and at intermediate points in pipe runs between expansion loops.
- C. Make provisions for preset of anchors as required accommodating both expansion and contraction of piping.

END OF SECTION

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SECTION 22 07 00

PLUMBING INSULATION

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes
 - 1. Insulation for plumbing piping and equipment.
- B. Related Sections
 - 1. Applicable provisions of Division 01 shall govern all work under this Section.
 - 2. Section 22 05 00 – Basic Plumbing Materials and Methods.
 - 3. Section 22 05 29 - Hangers and Supports for Plumbing Piping and Equipment.
 - 4. Section 22 11 00 - Facility Water Distribution.
 - 5. Section 22 13 00 - Facility Sanitary Sewerage.
 - 6. Section 22 14 00 - Facility Storm Drainage.
 - 7. Section 22 15 13 - General Service Compressed-Air Piping.
 - 8. Section 22 30 00 - Plumbing Equipment.

1.2 REFERENCES

- A. ASTM International
 - 1. ASTM C534 - Specification for Preformed Flexible Elastomeric Thermal Insulation.
 - 2. ASTM C1136 - Specification for Flexible Low Permeance Vapor Retarders for Thermal Insulation.
 - 3. ASTM C1427 - Specification for Extruded Preformed Flexible Cellular Polyolefin Thermal Insulation in Sheet and Tubular Form.
 - 4. ASTM E84 - Test Method for Surface Burning Characteristics of Building Materials.
- B. Midwest Insulation Contractors Association (MICA)
 - 1. National Commercial & Industrial Insulation Standards.
- C. National Fire Protection Association (NFPA)
 - 1. NFPA 255 - Method of Test of Surface Burning Characteristics of Building Materials.
- D. Underwriters Laboratories, Inc.
 - 1. UL 723 - Surface Burning Characteristics of Building Materials.

1.3 QUALITY ASSURANCE

- A. Substitution of Materials: In accordance with Division 01.

- B. Label all insulating products delivered to construction site with manufacturer's name and description of materials.

1.4 DESCRIPTION

- A. Furnish and install all insulating materials and accessories as specified or as required for a complete installation. The following types of insulation are specified in this section:
 - 1. Pipe Insulation.
 - 2. Equipment Insulation.
- B. Install insulation in accordance with current edition of MICA Standards and manufacturer's installation instructions. Exceptions to these standards will only be accepted where specifically modified in these specifications, or where prior written approval has been obtained from Engineer/Architect.

1.5 DEFINITIONS

- A. Concealed: shafts, furred spaces, space above finished ceilings, utility tunnels and crawl spaces. All other areas, including walk-through tunnels, shall be considered as exposed.

1.6 SUBMITTALS

- A. Division 01 - Submittal Procedures: Requirements for submittals.
- B. Submit schedule of insulating materials to be used on project, including adhesives, fastening methods, fitting materials along with material safety data sheets and intended use of each material. Include manufacturer's technical data sheets indicating density, thermal characteristics, jacket type, and manufacturer's installation instructions.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Materials or accessories containing asbestos shall not be allowed.
- B. Use composite insulation systems (insulation, jackets, sealants, mastics, and adhesives) that have flame spread rating of 25 or less and smoke developed rating of 50 or less, with the following exceptions:
 - 1. Insulation not located in an air plenum may have a flame spread rating not over 25 and smoke developed rating no higher than 150.

2.2 INSULATION AND JACKETS

- A. Manufacturers:
 - 1. Armstrong.
 - 2. Certainteed.

3. Manson.
 4. Childers.
 5. Dow.
 6. Extol.
 7. Halstead.
 8. H.B. Fuller.
 9. Imcoa.
 10. Knauf.
 11. Owens-Corning.
 12. Pittsburgh Corning.
 13. Rubatex.
 14. Johns Manville.
 15. Or approved equal.
- B. Insulating materials shall be fire retardant, moisture and mildew resistant, and vermin proof. Insulation shall be suitable to receive jackets, adhesives and coatings as indicated.
- C. Rigid Fiberglass Insulation:
1. Minimum nominal density of 3 lbs. per cu. ft., and thermal conductivity of not more than 0.23 at 75 degrees F, minimum compressive strength of 25 PSF at 10 percent deformation, rated for service to 450 degrees F.
 2. White kraft reinforced foil vapor barrier all service jacket, factory applied to insulation with self-sealing pressure sensitive adhesive lap, maximum permeance of 0.02 perms and minimum beach puncture resistance of 50 units.
- D. Semi-Rigid Fiberglass Insulation:
1. Minimum nominal density of 3 lbs. per cu. ft., thermal conductivity of not more than 0.28 at 75 degrees F, minimum compressive strength of 125 PSF at 10 percent deformation, rated for service to 450 degrees F. Insulation fibers perpendicular to jacket and scored for wrapping cylindrical surfaces.
 2. White kraft reinforced foil vapor barrier all service jacket, factory applied to insulation with maximum permeance of 0.02 perms and minimum beach puncture resistance of 50 units.
- E. Elastomeric Insulation:
1. Flexible closed cell, minimum nominal density of 5.5 lbs. per cu. ft., thermal conductivity of not more than 0.27 at 75 degrees F, minimum compressive strength of 4.5 psi at 25 percent deformation, maximum water vapor transmission of 0.17 perm inch, maximum water absorption of 6 percent by weight, rated for service range of -20 degrees F to 220 degrees F on piping and 180 degrees F where adhered to equipment.
- F. Polyolefin Insulation (ASTM C1427):
1. Flexible closed cell, minimum nominal density of 1.5 lbs. per cu. ft., thermal

conductivity of not more than 0.24 at 75 degrees F, minimum compressive strength of 5 psi at 25 percent deformation, maximum water vapor transmission of 0.0 perm inch, maximum water absorption of 0 percent by weight and volume, rated for service range of -165 degrees F to 210 degrees F.

G. Extruded Polystyrene Insulation (ASTM C578):

1. Rigid closed cell, minimum nominal density of 2.2 lbs. per cu. ft., thermal conductivity of not more than 0.2 at 75 degrees F, minimum compressive strength of 35 psi, maximum water vapor transmission of 1.1 perm inch, maximum water absorption of 0.1 percent by volume, rated for service range of -290 degrees F to 165 degrees F.

H. Urethane Insulation:

1. ASTM C591, rigid closed cell polyisocyanurate, minimum nominal density of 1.8 lbs. per cu. ft., thermal conductivity of not more than 0.19 at 75 degrees F aged 180 days, minimum compressive strength of 19 psi parallel and 10 psi perpendicular, maximum water vapor transmission of 4 perm inch, maximum water absorption of 0.2 percent by volume, rated for service range of -290 degrees F to 300 degrees F.

I. Fireproofing Insulation:

1. Mineral fiber with nominal density of 8 lbs. per cu. ft., flame spread index of 15, ASTM E84, NFPA 225, and UL 723, fuel contribution index of 0, and smoke developed index of 0, thermal conductivity of not more than 0.23 at 75 degrees F.
2. Jacket material shall be same as jacket for adjacent insulation.

J. PVC Fitting Covers and Jackets:

1. White PVC film, gloss finish one side, semi-gloss other side, FS LP-535D, Composition A, Type II, Grade GU. Ultraviolet inhibited indoor/outdoor grade to be used where exposed to high humidity, ultraviolet radiation, in kitchens or food processing areas or installed outdoors. Jacket thickness to be 0.02-inch.

K. Metal Jackets:

1. 0.016 inch thick aluminum, ASTM B209, or 0.010 inch thick stainless steel, ASTM A240, with safety edge.

2.3 INSULATION INSERTS AND PIPE SHIELDS

A. Manufacturers: B-Line, Pipe Shields, Value Engineered Products

- B. Insert and shield to be minimum 180 degree coverage on bottom of supported piping and full 360 degree coverage on clamped piping.

- C. Contractor may propose shop and site fabricated inserts and shields. Contractor shall submit schedule of materials, thicknesses, gauges and lengths for each pipe size to demonstrate equivalency to pre-engineered pre-manufactured product described above.

- D. For low temperature systems, extruded polystyrene may be substituted for calcium silicate provided insert and shield length and gauge are increased to compensate for lower insulation compressive strength.
- E. Precompressed 20 lbs. density molded fiberglass blocks, Hamfab or approved equal, of same thickness as adjacent insulation may be substituted for calcium silicate inserts with one 1-inch x 6-inch block for piping through 2-1/2 inches and three 1-inch x 6-inch blocks for piping through 4 inches. Submit shield schedule to demonstrate equivalency to pre-engineered/pre-manufactured product described above.
- F. Wood blocks shall not be allowed.

2.4 ACCESSORIES

- A. All products shall be compatible with surfaces and materials on which they are applied, and be suitable for use at operating temperatures of systems to which they are applied.
- B. Adhesives, sealants, and protective finishes shall be as recommended by insulation manufacturer for applications specified.
- C. Insulation bands to be 3/4-inch wide, constructed of aluminum or stainless steel. Minimum thickness to be 0.015 inch for aluminum and 0.010 inch for stainless steel.
- D. Tack fasteners to be stainless steel ring grooved shank tacks.
- E. Staples to be clinch style.
- F. Insulating cement to be ASTM C195, hydraulic setting mineral wool.
- G. Finishing cement to be ASTM C449.
- H. Minimum untreated weight of fibrous glass or canvas fabric reinforcing shall be 6 oz./sq. yd.
- I. Bedding compounds to be non-shrinking and permanently flexible.
- J. Vapor barrier coatings to be non-flammable, fire resistant, polymeric resin.
- K. Fungicidal water base coating (Foster 40-20 or equal) to be compatible with vapor barrier coating.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install insulation, jackets and accessories in accordance with manufacturer's instructions and under ambient temperatures and conditions recommended by manufacturer. Surfaces to be

insulated must be clean and dry.

- B. Do not insulate systems or equipment specified to be pressure tested or inspected, until testing, inspection, and any necessary repairs have been successfully completed.
- C. Install insulation with smooth and even surfaces. Poorly fitted joints or use of filler in voids will not be accepted. Cover and seal exposed fiberglass insulation when insulation is terminated, no raw fiberglass insulation is allowed. Provide neat and coated terminations at all nameplates, uninsulated fittings, or at other locations where insulation terminates. Install with longitudinal joints facing wall or ceiling.
- D. Install fabric reinforcing without wrinkles. Overlap seams a minimum of 2 inches.
- E. Use full-length material (as delivered from manufacturer) wherever possible. Scrap piecing of insulation or pieces cut undersize and stretched to fit will not be accepted.
- F. Install insulation continuous through sleeves and openings. Maintain vapor barriers continuous through all penetrations.
- G. Provide a complete vapor barrier for insulation on the following systems:
 - 1. Cold water (potable and non-potable).
 - 2. Storm water.
 - 3. Equipment piping with surface temperature below 65 degrees F.

3.2 PIPING, VALVE, AND FITTING INSULATION

- A. General:
 - 1. Install insulation with butt joints and longitudinal seams closed tightly. Provide minimum 2-inch lap on jacket seams and 2-inch tape on butt joints, firmly cemented with lap adhesive. Additionally secure with staples along seams and butt joints. Coat staples with vapor barrier mastic on systems requiring vapor barrier.
 - 2. Water supply piping insulation shall be continuous throughout building and installed adjacent to and within building walls to a point directly behind fixture that is being supplied.
 - 3. Install insulation continuous through pipe hangers and supports with hangers and supports on exterior of insulation. Where vapor barrier is not required, attach hangers and supports directly to piping with insulation completely covering hanger or support and jacket sealed at support rod penetration. Where riser clamps are required to attach directly to piping requiring vapor barrier, extend insulation and vapor barrier jacketing/coating around riser clamp.
- B. Insulation Inserts and Pipe Shields:
 - 1. Provide insulation inserts and pipe shields at all hanger and support locations. Inserts may be omitted on 3/4-inch and smaller copper piping provided 12 inches long 22 gauge pipe shields are used.

C. Fittings and Valves:

1. Fittings, valves, unions, flanges, couplings and specialties may be insulated with factory molded or built up insulation of same thickness as adjoining insulation. Cover insulation with fabric reinforcing and mastic or where temperatures do not exceed 150 degrees, PVC fitting covers. Secure PVC fitting covers with tack fasteners and 1-1/2-inch band of mastic over ends, throat, seams or penetrations. On systems requiring vapor barrier, use vapor barrier mastic.

D. Elastomeric and Polyolefin:

1. Where practical, slip insulation on piping during pipe installation when pipe ends are open. Miter cut fittings allowing sufficient length to prevent stretching. Completely seal seams and joints for vapor tight installation. For elastomeric insulation, apply full bed of adhesive to both surfaces. For polyolefin, seal factory pre-glued seams with roller and field seams and joints with full bed of hot melt polyolefin glue to both surfaces.

E. Pipe Insulation Schedule:

1. Provide insulation on new and existing remodeled piping as indicated in the following schedule:

Service	Insulation Types	Insulation Thickness by Pipe Size				
		1" and smaller	1-1/4" to 2"	2-1/2" to 4"	5" to 6"	8" and larger
Hot Water Supply	Rigid Fiberglass	1"	1"	1.5"	1.5"	1.5"
Hot Water Circulating	Rigid Fiberglass	1"	1"	1.5"		
Cold Water	Rigid Fiberglass	0.5"	0.5"	1"	1"	1"
Tempered Water	Rigid Fiberglass	0.5"	0.5"	1"		
Non-Potable Cold Water	Rigid Fiberglass *	0.5"	0.5"	1"		
Non-Potable Hot Water	Rigid Fiberglass *	1"	1"	1.5"		
All Horizontal Storm Piping and 4'-0" of vertical Piping thereafter, & Roof Drain bodies	Rigid Fiberglass	0.5"	0.5"	0.5"	0.5"	0.5"
Clearwater Waste	Rigid Fiberglass *	0.5"	0.5"	0.5"	0.5"	0.5"

* = Elastomeric & Phenolic types are acceptable.

- F. Following piping and fittings shall not be insulated:
 1. Chrome plated exposed supplies and stops, except where specifically noted.
 2. Water hammer arrestors.
 3. Piping unions and flanges for systems not requiring vapor barrier.

3.3 EQUIPMENT INSULATION

- A. Do not insulate over equipment access manholes, fittings, nameplates or ASME stamps. Bevel and seal insulation at these locations.
- B. Semi-Rigid Fiberglass:
 1. Apply insulation to equipment shells using weld pins, bonding adhesive, banded and wired in place.
 2. Fill joints, seams and depressions with insulating cement to smooth, even surface.
 3. Cover with reinforcing fabric and 2 coats of mastic.
 4. Use vapor barrier mastic on systems requiring vapor barrier.
- C. Elastomeric/Polyolefin:
 1. Apply full cover coat of adhesive to surface to be insulated, insulation and edge butt joints.
 2. Place insulation with edge joints firmly butted pressing to surface for full adhesion.
 3. Seal seams and joints vapor tight.
- D. Equipment Insulation Schedule:
 1. Provide equipment insulation as follows:

Equipment	Insulation Type	Thickness	Remarks
Storage Tanks	Semi-Rigid Fiberglass	2"	
Water Meter	Elastomeric	1/2"	Sheet type. Fabricate for ease of removal and replacement when service is required.
Water Softener	Elastomeric	1/2"	Sheet type. Fabricate for ease of removal and replacement when service is required.
Water Filters	Elastomeric	1/2"	Sheet type, pipe size type or combination of both. Fabricate for ease of removal and replacement when testing and servicing is required.

R.P.B.P.

Elastomeric

1/2"

Sheet type, pipe size type or combination of both. Fabricate for ease of removal and replacement when testing and servicing is required.

END OF SECTION

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SECTION 22 11 00

FACILITY WATER DISTRIBUTION

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes
 - 1. Potable water pipe and pipe fittings:
- B. Related Sections
 - 1. Applicable provisions of Division 01 shall govern all work under this Section.
 - 2. Section 22 05 14 - Plumbing Specialties.
 - 3. Section 22 05 29 - Hangers and Supports for Plumbing.

1.2 REFERENCES

- A. American Society of Mechanical Engineers (ASME)
 - 1. ASME B16.3 - Malleable Iron Threaded Fittings.
 - 2. ASME B16.4 - Cast Iron Threaded Fittings.
 - 3. ASME B16.5 - Pipe Flanges and Flanged Fittings.
 - 4. ASME B16.11 - Forged Fittings, Socket-Welding and Threaded.
 - 5. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings.
 - 6. ASME B16.22 - Wrought Copper and Wrought Copper Alloy Solder Joint Pressure Fittings.
 - 7. ASME B16.26 - Cast Copper Alloy Fittings for Flared Copper Tubes.
 - 8. ASME B16.29 - Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings – DWV.
- B. ASTM International
 - 1. ASTM A53 – Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless.
 - 2. ASTM A105 - Specification for Forgings, Carbon Steel, for Piping Components.
 - 3. ASTM A126 - Specification for Gray Cast Iron Castings for Valves, Flanges, and Pipe Fittings.
 - 4. ASTM A234 - Specification for Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures.
 - 5. ASTM B32 - Specification for Solder Metal.
 - 6. ASTM B88 - Specification for Seamless Copper Water Tube.
 - 7. ASTM B280 - Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.
 - 8. ASTM B813 - Specification for Liquid and Paste Fluxes for Soldering Applications of Copper and Copper Alloy Tube.
 - 9. ASTM D1785 - Specification for Poly Vinyl Chloride (PVC) Plastic Pipe.

10. ASTM D2241 - Specification for Poly Vinyl Chloride (PVC) Pressure-Rated Pipe (SDR Series).
 11. ASTM D2464 - Specification for Threaded Poly Vinyl Chloride (PVC) Plastic Pipe Fittings, Schedule 80.
 12. ASTM D2466 - Specification for Poly Vinyl Chloride (PVC) Plastic Pipe Fittings, Schedule 40.
 13. ASTM D2513 - Specification for Thermoplastic Gas Pressure Pipe, Tubing, and Fittings.
 14. ASTM D2564 - Specification for Solvent Cements for Poly Vinyl Chloride (PVC) Plastic Pipe and Fittings.
 15. ASTM D2657 –Practice for Heat Fusion Joining of Polyolefin Pipe and Fittings.
 16. ASTM D2774 - Practice for Underground Installation of Thermoplastic Pressure Piping.
 17. ASTM D2855 – Practice for Making Solvent Cemented Joints with Poly Vinyl Chloride (PVC) Pipe and Fittings.
 18. ASTM D3139 - Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.
 19. ASTM D3222 - Specification for Unmodified Poly Vinylidene Fluoride (PVDF) Molding Extrusion and Coating Materials.
 20. ASTM D4101 - Specification for Propylene Plastic Injection and Extrusion Materials.
 21. ASTM F437 - Specification for Threaded Chlorinated Poly Vinyl Chloride (CPVC) Plastic Pipe Fittings, Schedule 80.
 22. ASTM F438 - Specification for Socket Type Chlorinated Poly Vinyl Chloride (CPVC) Plastic Pipe Fittings, Schedule 40.
 23. ASTM F441 - Specification for Chlorinated Poly Vinyl Chloride (CPVC Plastic Pipe, Schedules 40 and 80.
 24. ASTM F493 - Specification for Solvent Cements for Chlorinated Poly Vinyl Chloride (CPVC) Plastic Pipe and Fittings.
 25. ASTM F656 - Specification for Primers for Use in Solvent Cement Joints of Poly Vinyl Chloride (PVC) Plastic Pipe and Fittings.
- C. American Welding Society (AWS)
1. AWS A5.8 - Brazing Filler Metal
- D. American Water Works Association (AWWA)
1. AWWA C104 - Cement Mortar Lining for Ductile Iron Pipe and Fittings for Water.
 2. AWWA C105 - Polyethylene Encasement for Ductile Iron Piping for Water.
 3. AWWA C110 - Ductile Iron and Gray Iron Fittings, 3 In. Through 48 In., for Water and Other Liquids.
 4. AWWA C111 - Rubber Gasket Joints for Ductile Iron and Gray Iron Pressure Pipe and Fittings.
 5. AWWA C151 - Ductile Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds for Water or Other Liquids.

6. AWWA C153 - Ductile Iron Compact Fittings, 3 In. Through 48 In., for Water and Other Liquids.
7. AWWA C600 - Installation of Ductile Iron Water Mains and Their Appurtenances.
8. AWWA C651 - Disinfecting Water Mains.

1.3 SUBMITTALS

- A. Division 01 - Submittal Procedures: Requirements for submittals.
- B. Schedule from Contractor indicating ASTM or AWWA specification number of pipe being proposed along with its type and grade if known at time of submittal, and sufficient information to indicate type and rating of fittings for each service.
- C. Statement from manufacturer on his letterhead that pipe furnished meets ASTM OR AWWA specification contained in this section.

1.4 QUALITY ASSURANCE

- A. Substitution of Materials: In accordance with Division 01.
- B. Order all copper, cast iron, steel, PVC and polyethylene pipe with each length marked with name or trademark of manufacturer and type of pipe; with each shipping unit marked with purchase order number, metal or alloy designation, temper, size, and name of supplier.
- C. Any installed material not meeting specification requirements must be replaced with material that meets these specifications without additional cost to Owner.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Promptly inspect shipments to insure that material is undamaged and complies with specifications.
- B. Cover pipe to prevent corrosion or deterioration while allowing sufficient ventilation to avoid condensation. Do not store materials directly on grade. Protect pipe, tube, and fitting ends so they are not damaged. Where end caps are provided or specified, take precautions so caps remain in place. Protect fittings, flanges, and unions by storage inside or by durable, waterproof, above ground packaging.
- C. Offsite storage agreements will not relieve Contractor from using proper storage techniques.
- D. Storage and protection methods must allow inspection to verify products.

1.6 DESIGN CRITERIA

- A. Use only new material, free of defects, rust and scale, and meeting latest revision of ASTM or AWWA specifications as listed in this specification.

- B. Construct all piping for highest pressures and temperatures in respective system.
- C. Non-metallic piping will be acceptable only for services indicated. It will not be acceptable in ventilation plenum spaces, including plenum ceilings.
- D. Weld fittings or mechanical grooved fittings shall only use long radius elbows having a centerline radius of 1.5 pipe diameters.
- E. Where ASTM A53 type F pipe is specified, grade A, type E or S, or grade B, type E or S may be substituted at Contractor's option. Where grade or type is not specified, Contractor may choose from those commercially available.
- F. Where ASTM B88, Type L, H58 drawn temper copper tubing is specified, ASTM B88, Type K, H58 drawn temper copper tubing may be substituted at Contractor's option.

PART 2 PRODUCTS

2.1 DOMESTIC WATER

- A. Above Ground:
 1. Type L copper water tube, H58 drawn temper, ASTM B88; wrought copper pressure fittings, ASME B16.22; lead free, less than 0.2 percent solder, ASTM B32; flux, ASTM B813; copper phosphorous brazing alloy, AWS A5.8 BCuP.
 2. Wrought copper ANSI B16.22 or cast bronze. ANSI B16.18 fittings, copper tube dimensioned grooved ends, joined with mechanical couplings, synthetic rubber gasket seals, Victaulic style 606.
 3. Copper press fittings, ASTM B16.18 or ASTM B16.22, EPDM O-ring by Viega.
 4. Galvanized steel, Schedule 40, Grade A, ASTM A53; with cast iron threaded fittings, Class 125, ASME B16.4; forged steel threaded fittings, ASME 16.11; mechanical cut groove couplings and fittings; galvanize coat all fittings, ASTM A123.
- B. Below Ground 2-1/2-Inch and Smaller: Type K copper water tube, O50 (annealed) temper, ASTM B88; with cast copper pressure fittings, ASME B16.18; wrought copper pressure fittings, ASME B16.22; lead free, less than 0.2 percent solder, ASTM B32; flux, ASTM B813; or cast copper flared pressure fittings, ASME B16.26.
- C. Below Ground 3-Inch and Larger: Ductile iron pipe, mechanical or push on joint, thickness Class 52, AWWA C151; with standard thickness cement mortar lining, AWWA C104; ductile iron or gray iron mechanical joint cement mortar lined fittings, Class 250, AWWA C110; ductile iron mechanical joint compact fittings, Class 350, AWWA C153; rubber gasket joints with non-toxic gasket lubricant, AWWA C111.
 1. Provide 8-mil tube or sheet polyethylene encasement of iron pipe and pipe fittings, AWWA C105.
 2. PVC Pressure Pipe: DR 18, Class 150, AWWA C900 and C905; with integral bell and elastomeric gaskets, ASTM D3139. Fittings and fitting polyethylene encasement

to be same as noted above for ductile iron.

- D. Thrust Restraint for Underground Piping: Asphaltic or epoxy coated ductile iron follower gland mechanical joint restraint with gripping wedge restraints and torque limiting twist-off nuts around pipe circumference, low alloy steel T-bolts and UL listing or Factory Mutual approval. For PVC pipe joint bells, use epoxy or primer coated ductile iron bell and serrated ring restraints or gripping wedge restraints and torque limiting twist-off nuts around pipe circumference with low alloy steel tie bolts. Restraint to have minimum pressure rating and safety factor equal to or greater than pressure rating and safety factor of pipe and be designed specifically for pipe material applied to.

2.2 DIELECTRIC UNIONS AND FLANGES

- A. Watts Regulator Company, Lochinvar, Wilkins or EPCO Sales, Inc., dielectric unions 2-inch and smaller; dielectric flanges larger than 2-inch; with iron female pipe thread to copper solder joint or brass female pipe thread end connections, non-asbestos gaskets, having a pressure rating of not less than 175 psig at 180 degrees.

2.3 UNIONS AND FLANGES

- A. Unions, flanges, and gasket materials to have a pressure rating of not less than 150 psig at 180 degrees. Gasket material for flanges and flanged fittings shall be teflon type. Treated paper gaskets are not acceptable.
- B. 2-Inch and Smaller Steel: ASTM A197/ASME B16.3 malleable iron unions with brass seats. Use black malleable iron on black steel piping and galvanized malleable iron on galvanized steel piping.
- C. 2-Inch and Smaller Copper: ASME B16.18 cast bronze union coupling or ASME B15.24 Class 150 cast bronze flanges.
- D. 2-1/2-Inch and Larger Steel: ASTM A181 or A105, grade 1 hot forged steel flanges of threaded, welding neck, or slip-on pattern on black steel and threaded only on galvanized steel. Use raised face flanges ASME B16.5 for mating with other raised face flanges or equipment with flat ring or full face gaskets. Use ASME B16.1 flat face flanges with full face teflon gaskets for mating with other flat face flanges on equipment. Gaskets shall be teflon type.
- E. 2-1/2-Inch and Larger Copper: ASME B15.24 Class 150 cast bronze flanges with full face teflon gaskets.

2.4 MECHANICAL GROOVED PIPE CONNECTIONS

- A. Mechanical grooved pipe couplings and fittings, ASTM F1476, as manufactured by Victaulic, Gruvlok, or Gustin-Bacon may be used with cut groove galvanized steel pipe, cut groove

ductile iron pipe or roll groove copper pipe where noted. Mechanical grooved components and assemblies to be rated for minimum 250 psi working pressure.

- B. All mechanical grooved pipe material including gaskets, couplings, fittings, and flange adapters to be from same manufacturer.
- C. Couplings to be malleable iron, ASTM A47, or ductile iron ASTM A536, with painted finish. Reducing couplings are not acceptable.
- D. Fittings used on galvanized steel pipe to be malleable iron, ASTM A47, or ductile iron A536, with galvanized finish, ASTM A153. Fittings used on ductile iron pipe to be cement mortar lined ductile iron with coal tar coating, ASTM A536; conforming to requirements of AWWA C110/C153 and AWWA C606. Fittings used on copper pipe to be copper.
- E. Gaskets to be EPDM, ASTM D2000. Gaskets for hot water systems and dry pipe systems to be flush seal design. Heat-treated carbon steel oval neck track bolts and nuts, ASTM A183, with zinc electroplated finish ASTM B633.

PART 3 EXECUTION

3.1 GENERAL

- A. Install pipe and fittings in accordance with reference standards, manufacturer's recommendations and recognized industry practices.

3.2 PREPARATION

- A. Cut pipe ends square. Ream ends of piping to remove burrs. Clean scale and dirt from interior and exterior of each section of pipe and fitting prior to assembly.

3.3 ERECTION

- A. Install piping parallel to building walls and ceilings and at heights not obstructing any portion of a window, doorway, stairway, or passageway.
- B. Where interferences develop in field, offset or reroute piping as required to clear such interferences.
- C. Coordinate locations of plumbing piping with piping, ductwork, conduit and equipment of other trades to allow sufficient clearances.
- D. In all cases, consult drawings for exact location of pipe spaces, ceiling heights, door and window openings, or other architectural details before installing piping.
- E. Where copper or steel piping is embedded in masonry or concrete, provide protective sleeve covering of elastomeric pipe insulation.

- F. Maintain piping in clean condition internally during construction.
- G. Provide clearance for installation of insulation, access to valves and piping specialties.
- H. Provide anchors, expansion joints, swing joints and/or expansion loops so that piping may expand and contract without damage to itself, equipment, or building.
- I. Do not route piping through transformer vaults or above transformers, panelboards, or switchboards, including required service space for this equipment, unless piping is serving this equipment
- J. Install all valves and piping specialties, including items furnished by others, as specified or detailed. Provide access to valves and specialties for maintenance.
- K. Make connections to all equipment, fixtures and systems installed by others where same requires piping services indicated in this section.

3.4 PIPE JOINTS

- A. Copper Pipe Joints: Comply with following installation requirements.
 1. Remove slivers and burrs remaining from cutting operation by reaming and filing both pipe surfaces.
 2. Clean fitting and tube with metal brush, emery cloth or sandpaper.
 3. Remove residue from cleaning operation, apply flux and assemble joint to socket stop.
 4. Apply flame to fitting until solder melts when placed at joint.
 5. Remove flame and feed solder into joint until full penetration of cup and ring of solder appears.
 6. Wipe excess solder and flux from joint.
- B. Threaded Pipe Joints: Comply with following installation requirements.
 1. Use thread lubricant or teflon tape when making joints; no hard setting pipe thread cement or caulking will be allowed.
- C. Mechanical Hubless Pipe Connections: Comply with following installation requirements.
 1. Place gasket on end of one pipe or fitting and clamp assembly on end of other pipe or fitting.
 2. Firmly seat pipe or fitting ends against integrally molded shoulder inside neoprene gasket.
 3. Slide clamp assembly into position over gasket.
 4. Tighten fasteners to manufacturers recommended torque.
- D. Mechanical Joint Pipe Connections: Comply with following installation requirements.
 1. Comply with AWWA C600 and C605 installation requirements.
 2. Clean pipe end and socket.

3. Clean and lubricate pipe end, socket and gasket with soapy water or gasket lubricant.
 4. Place gland and gasket, properly oriented, on pipe end.
 5. Insert pipe end fully into socket and press gasket evenly into recess keeping joint straight.
 6. Press gland evenly against gasket, insert bolts and hand tighten nuts.
 7. Make joint deflection prior to tightening bolts.
 8. Evenly tighten bolts in sequence to recommended torque.
- E. Push-On Gasketed Pipe Connections: Comply with following installation requirements.
1. Clean pipe end, bell, gasket seat and gasket of dirt or debris.
 2. Coat end of pipe and gasket with gasket lubricant.
 3. Insure pipe is supported off-ground so lubricant does not pick up dirt.
 4. Push spigot end into gasket bell with levered pipe joining tool recommended by pipe manufacturer.
 5. Large diameter exterior mains may be joined by pushing end of pipe section with backhoe against wood blocking over pipe end.
 6. Insert to fully seated position or to reference mark on pipe.
- F. Mechanical Grooved Pipe Connections: Comply with following installation requirements.
1. Use pipe factory grooved in accordance with coupling manufacturer's specifications or field grooved pipe in accordance with same specifications using specially designed tools specially designed for application.
 2. Lubricate pipe and coupling gasket, align pipe, and secure joint in accordance with coupling manufacturer's specifications.

3.5 DOMESTIC WATER

- A. Maintain piping system in clean condition during installation.
- B. Remove dirt and debris from assembly of piping as work progresses.
- C. Cap open pipe ends where left unattended or subject to contamination.
- D. Install exterior water piping below predicted frost level in accordance with authority having jurisdiction, but in no case less than 6-foot bury depth to top of pipe.
- E. Maintain minimum of 8-foot horizontal distance between 2-1/2-inch and larger water piping and sanitary sewer piping.
- F. Maintain minimum of 30-inch horizontal and 12-inch vertical distance, water on top, between 2-inch and smaller water piping and sanitary sewer piping.
- G. Where water piping crosses a sanitary sewer, provide minimum 18-inch vertical clearance and waterproof PVC water pipe sleeve (reference sanitary sewer materials) sealed at both ends for distance of 10 feet from sewer in both directions.

- H. Provide thrust restraints for 3-inch and larger exterior water piping joints, hydrants, caps, plugs, fittings and bends of 22-1/2 degrees or more.
- I. Field apply continuous anti-corrosion coating to rodded restraint components.
- J. Protect mechanical joints, nuts and bolts from concrete cover.
- K. Cover with 8-mil sheet or tube polyethylene material sleeve.
- L. Install interior water piping with drain valves where indicated and at low points of system to allow complete drainage.
- M. Install shutoff valves where indicated and at base of risers to allow isolation of portions of system for repair. Do not install water piping within exterior walls.
- N. Prior to use, isolate and fill system with potable water. Allow to stand 24 hours.
- O. Flush each outlet proceeding from service entrance to furthest outlet for minimum of one minute and until water appears clear.
- P. Fill system with a solution of water and chlorine containing at least 50 parts per million of chlorine and allow to stand for 24 hours. Alternately, solution containing at least 200 parts per million of chlorine may be used and allowed to stand for 3 hours.
- Q. Flush system with potable water until chlorine concentration is no higher than source water level.
- R. Wait 24 hours after final flushing. Take samples of water for lab testing.
- S. Number and location of samples shall be representative of system size and configuration and are subject to approval by Engineer/Architect.
- T. Test shall show absence of coliform bacteria. If test fails, repeat disinfection and testing procedures until no coliform bacteria are detected. Submit test report indicating date and time of test along with test results.

3.6 UNDERGROUND PIPE WRAP

- A. Use for steel piping encased in concrete or underground which is not in a conduit.
- B. Remove dirt and other foreign material from exterior of pipe.
- C. Apply primer as recommended by manufacturer.
- D. Use a spiral wrap process for applying tape to pipe.

- E. Repair any breaks in tape coating caused by installation process.

3.7 DIELECTRIC UNIONS AND FLANGES

- A. Install dielectric unions or flanges at each point where a copper-to-steel pipe connection is required in domestic water systems.

3.8 UNIONS AND FLANGES

- A. Install a union or flange at each connection to each piece of equipment and at other items which may require removal for maintenance, repair, or replacement.
- B. Where a valve is located at a piece of equipment, locate flange or union connection on equipment side of valve. Concealed unions or flanges are not acceptable.

3.9 PIPING SYSTEM LEAK TESTS

- A. Isolate or remove components from system which are not rated for test pressure.
- B. Test piping in sections or entire system as required by sequence of construction.
- C. Do not insulate or conceal pipe until it has been successfully tested.
- D. If required for additional pressure load under test, provide temporary restraints at fittings or expansion joints.
- E. Backfill underground water mains prior to testing with exception of thrust restrained valves which may be exposed to isolate potential leaks.
- F. For hydrostatic tests, use clean water and remove all air from piping being tested by means of air vents or loosening of flanges/unions. Measure and record test pressure at high point in system.
- G. Inspect system for leaks. Where leaks occur, repair area with new materials and repeat test. Caulking will not be acceptable.
- H. Testing with air will not be allowed.

System	Medium	Test Pressure	Test Duration
*Below Ground Domestic Water	Water	200 psig	2 hour
Above Ground Domestic Water	Water	150 psig	4 hour
Above Ground Non-potable Water	Water	150 psig	4 hour
Below Ground Non-potable Water	Water	200 psig	2 hour

* Leakage on exterior mains 3-inch and larger may not exceed leakage calculated as follows:

GPH Allowable Leakage = (Feet of Pipe) (Inches Dia. of Pipe) (Test Pressure)² = 133,200

- I. Below Ground Domestic Water test pressure of 200 psig is required by NFPA 24 for private fire service mains. Small diameter piping not serving hydrants or buildings with fire protection systems may be tested at 150 psig.

END OF SECTION

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SECTION 22 13 00

FACILITY SANITARY SEWERAGE

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes
 - 1. Sanitary sewer pipe and pipe fittings.
- B. Related Sections
 - 1. Applicable provisions of Division 01 shall govern all work under this Section.
 - 2. Section 22 05 14 - Plumbing Specialties.
 - 3. Section 22 05 29 - Hangers and Supports for Plumbing.

1.2 REFERENCES

- A. American Society of Mechanical Engineers (ASME)
 - 1. ASME B16.3 - Malleable Iron Threaded Fittings.
 - 2. ASME B16.4 - Cast Iron Threaded Fittings.
 - 3. ASME B16.5 - Pipe Flanges and Flanged Fittings.
 - 4. ASME B16.22 - Wrought Copper and Wrought Copper Alloy Solder Joint Pressure Fittings.
 - 5. ASME B16.29 - Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings – DWV.
- B. ASTM International
 - 1. ASTM A53 – Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless.
 - 2. ASTM A74 - Specification for Cast Iron Soil Pipe and Fittings.
 - 3. ASTM A105 - Specification for Forgings, Carbon Steel, for Piping Components.
 - 4. ASTM A126 - Specification for Gray Cast Iron Castings for Valves, Flanges, and Pipe Fittings.
 - 5. ASTM A234 - Specification for Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures.
 - 6. ASTM A861 - Specification for High Silicon Iron Pipe and Fittings.
 - 7. ASTM A888 - Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications.
 - 8. ASTM B32 - Specification for Solder Metal.
 - 9. ASTM B306 - Specification for Copper Drainage Tube (DWV).
 - 10. ASTM B813 - Specification for Liquid and Paste Fluxes for Soldering Applications of Copper and Copper Alloy Tube.
 - 11. ASTM C76 - Specification for Reinforced Concrete Culvert, Storm Drain and Sanitary Pipe.

12. ASTM C564 - Standard Specifications for Rubber Gaskets for Cast Iron Soil Pipe and Fittings.
13. ASTM C1540 - Standard Specifications for Heavy Duty Shielded Couplings Joining Hubless Cast Iron Soil Pipe and Fittings.
14. ASTM D1785 - Specification for Poly Vinyl Chloride (PVC) Plastic Pipe.
15. ASTM D2241 - Specification for Poly Vinyl Chloride (PVC) Pressure-Rated Pipe (SDR Series).
16. ASTM D2466 - Specification for Poly Vinyl Chloride (PVC) Plastic Pipe Fittings, Schedule 40.
17. ASTM D2564 - Specification for Solvent Cements for Poly Vinyl Chloride (PVC) Plastic Pipe and Fittings.
18. ASTM D2665 - Specification for Poly Vinyl Chloride (PVC) Plastic Drain, Waste and Vent Pipe and Fittings.
19. ASTM D2729 - Specification for Poly Vinyl Chloride (PVC) Sewer Pipe and Fittings.
20. ASTM D2774 - Practice for Underground Installation of Thermoplastic Pressure Piping.
21. ASTM D2855 – Practice for Making Solvent Cemented Joints with Poly Vinyl Chloride (PVC) Pipe and Fittings.
22. ASTM D3034 - Specification for Type PSM Poly Vinyl Chloride (PVC) Sewer Pipe and Fittings.
23. ASTM D3139 - Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.
24. ASTM D3212 - Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.
25. ASTM D3222 - Specification for Unmodified Poly Vinylidene Fluoride (PVDF) Molding Extrusion and Coating Materials.
26. ASTM D3311 - Specification for Drain, Waste and Vent (DWV) Plastic Fitting Patterns.

C. American Welding Society (AWS)

1. AWS A5.8 - Brazing Filler Metal.

D. Cast Iron Soil Pipe Institute (CISPI)

1. CISPI 301 - Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste and Vent Piping Applications.
2. CISPI 310 - Couplings For Use In Connection With Hubless Cast Iron Soil Pipe And Fittings For Sanitary And Storm Drain, Waste And Vent Piping Applications.

1.3 SUBMITTALS

- A. Division 01 - Submittal Procedures: Requirements for submittals.

- B. Schedule from Contractor indicating ASTM or CISPI specification number of pipe being proposed along with its type and grade if known at time of submittal, and sufficient information to indicate type and rating of fittings for each service.
- C. Statement from manufacturer on his letterhead that pipe furnished meets ASTM or CISPI specification contained in this section.

1.4 QUALITY ASSURANCE

- A. Substitution of Materials: In accordance with Division 01.
- B. Order copper, cast iron, steel, PVC and polyethylene pipe with each length marked with name or trademark of manufacturer and type of pipe; with each shipping unit marked with purchase order number, metal or alloy designation, temper, size, and name of supplier.
- C. Any installed material not meeting specification requirements must be replaced with material that meets these specifications without additional cost to Owner.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Promptly inspect shipments to insure that material is undamaged and complies with specifications.
- B. Cover pipe to prevent corrosion or deterioration while allowing sufficient ventilation to avoid condensation.
- C. Do not store materials directly on grade.
- D. Protect pipe, tube, and fitting ends so they are not damaged.
- E. Where end caps are provided or specified, take precautions so caps remain in place.
- F. Protect fittings, flanges, and unions by storage inside or by durable, waterproof, above ground packaging.
- G. Offsite storage agreements will not relieve Contractor from using proper storage techniques.
- H. Storage and protection methods must allow inspection to verify products.

1.6 DESIGN CRITERIA

- A. Use only new material, free of defects, rust and scale, and meeting latest revision of ASTM or CISPI specifications as listed in this specification.
- B. Construct all piping for highest pressures and temperatures in respective system.

- C. Non-metallic piping will be acceptable only for services indicated. It will not be acceptable in ventilation plenum spaces, including plenum ceilings.
- D. Where weld fittings or mechanical grooved fittings are used, use only long radius elbows having a centerline radius of 1.5 pipe diameters.
- E. Where ASTM A53 type F pipe is specified, grade A type E or S, or grade B type E or S may be substituted at Contractor's option. Where grade or type is not specified, Contractor may choose from those commercially available.
- F. Where ASTM B88, Type L, H58 drawn temper copper tubing is specified, ASTM B88, Type K, H58 drawn temper copper tubing may be substituted at Contractor's option.

PART 2 PRODUCTS

2.1 SANITARY WASTE AND VENT

- A. Interior Above Ground:
 - 1. Hubless cast iron soil pipe and fittings, ASTM A888; with no-hub couplings, CISPI 310, CISPI 310, ASTM A74.
 - 2. Pipe and fittings shall be marked with collective trademark of Cast Iron Pipe Institute or receive prior approval of Engineer.
 - 3. Type M copper water tube, H (drawn) temper, ASTM B88; with cast copper drainage fittings (DWV), ASME16.23; wrought copper drainage fittings (DWV), ASME16.29; lead free, less than 0.2 percent solder, ASTM B32; flux, ASTM B813; copper phosphorous brazing alloy, AWS A5.8 BCuP.
 - 4. PVC Plastic Pipe: Schedule 40, Class 12454-B (PVC 1120), ASTM D1785; PVC plastic drain, waste and vent pipe and fittings, ASTM D2665; socket fitting patterns, ASTM D3311; primer, ASTM F656; solvent cement, ASTM D2564.
 - 5. Galvanized Steel Pipe: Schedule 40, Type F, Grade A, ASTM A53; with cast iron threaded drainage fittings, ASTM B16.12.
- B. Pressurized Interior Above Ground:
 - 1. Type L copper water tube, H58 drawn temper, ASTM B88; with cast copper drainage fittings (DWV), ASME B16.23; wrought copper drainage fittings (DWV), ASME 16.29; lead free, less than 0.2 percent solder, ASTM B32; flux, ASTM B813.
 - 2. Galvanized steel pipe, Schedule 40, Type F, Grade A, ASTM A53; with cast iron threaded drainage fittings, ASTM B16.12.
- C. Interior Below Ground:
 - 1. Cast iron soil pipe and fittings, hub and spigot, service weight, ASTM A74, with neoprene rubber compression gaskets, ASTM C564, CISPI 301, and CISPI HSN 85.
 - 2. Pipe and fittings shall be marked with collective trademark of Cast Iron Pipe Institute.

3. PVC plastic pipe, Schedule 40, Class 12454-B (PVC 1120), ASTM D1785; PVC plastic drain, waste and vent pipe and fittings, ASTM D2665; socket fitting patterns, ASTM D3311; primer, ASTM F656; solvent cement, ASTM D2564.
- D. Exterior Below Ground 15-Inch and Smaller:
1. Cast iron soil pipe and fittings, CISPI 301, ASTM A74 or ASTM A888 with neoprene rubber compression gaskets, ASTM C564 and CISPI HSN 85. Pipe and fittings shall be marked with collective trademark of Cast Iron Pipe Institute.
 2. PVC plastic pipe, Schedule 40, Class 12454-B (PVC 1120), ASTM D1785; PVC plastic drain, waste and vent pipe and fittings, ASTM D2665; socket fitting patterns, ASTM D3311; primer, ASTM F656; solvent cement, ASTM D2564.
 3. Type PSM PVC sewer pipe and socket fittings, SDR 35, Class 12454-B (PVC 1120), ASTM D3034; primer, ASTM F656; solvent cement, ASTM 2564; or integral bell and flexible elastomeric seal, ASTM D3212.
 4. Corrugated PVC pipe and fittings with smooth interior, ASTM F949; gasketed joint, ASTM D3212; elastomeric gasket, ASTM F477.
- E. Pressurized Below Ground 3-Inch and Smaller:
1. PVC plastic pipe, Schedule 40, Class 12454-B (PVC 1120), ASTM D1785; PVC plastic drain, waste and vent pipe and fittings, ASTM D2665; socket fitting patterns, ASTM D3311; primer, ASTM F656; solvent cement, ASTM D2564.
 2. Type K copper water tube, H58 draw) temper, ASTM B88; with cast copper drainage fittings (DWV), ASME B16.23; wrought copper drainage fittings (DWV), ASME B16.29; lead free, less than 0.2 percent solder, ASTM B32; flux, ASTM B813.
- F. Pressurized Below Ground 3-Inch and Larger:
1. PVC pressure pipe, DR 18, Class 150, AWWA C900; with integral bell and elastomeric gaskets, ASTM D3139.
 2. Fittings and fitting polyethylene encasement to be same as noted above for ductile iron.

PART 3 EXECUTION

3.1 GENERAL

- A. Install pipe and fittings in accordance with reference standards, manufacturers' recommendations and recognized industry practices.

3.2 PREPARATION

- A. Cut pipe ends square. Ream ends of piping to remove burrs. Clean scale and dirt from interior and exterior of each section of pipe and fitting prior to assembly.

3.3 ERECTION

- A. Install piping parallel to building walls and ceilings and at heights not obstructing any portion of window, doorway, stairway, or passageway.
- B. Where interferences develop in field, offset or reroute piping as required clearing such interferences.
- C. Coordinate locations of plumbing piping with piping, ductwork, conduit and equipment of other trades to allow sufficient clearances.
- D. In all cases, consult Drawings for exact location of pipe spaces, ceiling heights, door and window openings, or other architectural details before installing piping.
- E. Where copper or steel piping is embedded in masonry or concrete, provide protective sleeve of elastomeric pipe insulation.

3.4 PIPE JOINTS

- A. Copper Pipe Joints:
 1. Remove slivers and burrs remaining from cutting operation by reaming and filing both pipe surfaces.
 2. Clean fitting and tube with metal brush, emery cloth, or sandpaper.
 3. Remove residue from cleaning operation, apply flux, and assemble joint to socket stop.
 4. Apply flame to fitting until solder melts when placed at joint.
 5. Remove flame and feed solder into joint until full penetration of cup and ring of solder appears. Wipe excess solder and flux from joint.
- B. Welded Pipe Joints:
 1. Make welded joints by fusion welding in accordance with ASME Codes, ASMR B31, and state Codes where applicable. "Weldolets" and "Threadolets" may be used for branch takeoffs up to one-half (1/2) diameter of main.
- C. Threaded Pipe Joints:
 1. Use a thread lubricant or teflon tape when making joints. No hard setting pipe thread cement or caulking will be allowed.
- D. Solvent Welded Pipe Joints:
 1. Install in accordance with ASTM D2855.
 2. Saw cut piping square and smooth.
 3. Tube cutters may be used if they are fitted with wheels designed for use with PVC/CPVC pipe that do not leave raised bead on pipe exterior.
 4. Support and restrain pipe during cutting to prevent nicks and scratches.
 5. Bevel ends 10-15 degrees and deburr interior.
 6. Remove dust, drips, moisture, grease, and other superfluous materials from pipe interior and exterior.

7. Check dry fit of pipe and fittings.
8. Reject materials which are out of round or do not fit within close tolerance.
9. Use heavy body solvent cement for large diameter fittings.
10. Maintain pipe, fittings, primer, and cement between 40 and 100 degrees F during application and curing.
11. Apply primer and solvent using separate daubers (3-inch and smaller piping only) or clean natural bristle brushes about 1/2 size of pipe diameter.
12. Apply primer to fitting socket and pipe surface with scrubbing motion.
13. Check for penetration and reapply as needed to dissolve surface to depth of 4-5 thousandths.
14. Apply solvent cement to fitting socket and pipe in amount greater than needed to fill any gap.
15. While both surfaces are wet, insert pipe into socket fitting with quarter turn to bottom of socket.
16. Solvent cement application and insertion must be completed in less than one minute.
17. Minimum of 2 installers is required on piping 4-inch and larger.
18. Hold joint for 30 seconds or until set.
19. Reference manufacturers' recommendations for initial set time before handling and for full curing time before pressure testing.
20. Cold weather solvent/cement may be utilized only under unusual circumstances and when specifically approved by Engineer/Architect.

3.5 PIPE CONNECTIONS

A. Mechanical Hubless Pipe Connections:

1. Place gasket on end of one pipe or fitting and clamp assembly on end of other pipe or fitting.
2. Firmly seat pipe or fitting ends against integrally molded shoulder inside neoprene gasket.
3. Slide clamp assembly into position over gasket.
4. Tighten fasteners to manufacturers recommended torque.

B. Mechanical Joint Pipe Connections:

1. Comply with AWWA C600/C605 installation requirements.
2. Clean pipe end and socket.
3. Clean and lubricate pipe end, socket and gasket with soapy water or gasket lubricant.
4. Place gland and gasket, properly oriented, on pipe end.
5. Insert pipe end fully into socket and press gasket evenly into recess keeping joint straight.
6. Press gland evenly against gasket, insert bolts and hand tighten nuts.
7. Make joint deflection prior to tightening bolts.
8. Evenly tighten bolts in sequence to recommended torque.

C. Push-On Gasketed Pipe Connections:

1. Clean pipe end, bell, gasket seat and gasket of dirt or debris.
2. Coat end of pipe and gasket with gasket lubricant.
3. Insure pipe is supported off ground so lubricant does not pick up dirt.
4. Push spigot end into gasket bell with levered pipe joining tool recommended by pipe manufacturer.
5. Large diameter exterior mains may be joined by pushing end of pipe section with backhoe against wood blocking over pipe end.
6. Insert to fully seated position or to reference mark on pipe.

D. Mechanical Grooved Pipe Connections:

1. Use pipe factory grooved in accordance with coupling manufacturer's specifications or field grooved pipe in accordance with same specifications using specially designed tools specially designed for application.
2. Lubricate pipe and coupling gasket, align pipe, and secure joint in accordance with coupling manufacturer's specifications.

3.6 MECHANICALLY FORMED TEE FITTINGS

- A. Form mechanically extracted collars in a continuous operation, consisting of drilling a pilot hole and drawing out tube surface to form collar having height of not less than three times thickness of tube wall.
- B. Use an adjustable collaring device. Notch and dimple branch tube.
- C. Braze joint with neutral flame oxy-acetylene torch, applying heat properly so that pipe and tee do not distort; remove distorted connections.

3.7 SANITARY WASTE AND VENT

- A. Verify invert elevations and building elevations prior to installation.
- B. Install exterior piping pitched to drain at indicated elevations and slope.
- C. Install interior piping pitched to drain at minimum slope of 1/4-inch per foot where possible and in no case less than 1/8-inch per foot for piping 3-inch and larger.
- D. Install exterior piping below predicted frost level and shall maintain not less than 5-foot of bury depth to top of pipe wherever possible.
- E. Where piping is located above predicted frost level, provide frost protection as required.
- F. Flush piping inlets including floor drains, hub drains, mop basins, and fixtures, with high flow of water at completion of project to demonstrate full flow capacity.
- G. Remove blockages and make necessary repairs wherever flow is impeded.

3.8 PIPING SYSTEM LEAK TESTS

- A. Isolate or remove components not rated for test pressure from system.
- B. Test piping in sections or entire system as required by sequence of construction.
- C. Do not insulate or conceal pipe until it has been successfully tested.
- D. If required for additional pressure load under test, provide temporary restraints at fittings or expansion joints.
- E. Backfill underground water mains prior to testing with exception of thrust restrained valves which may be exposed to isolate potential leaks.
- F. For hydrostatic tests, use clean water and remove all air from piping being tested by means of air vents or loosening of flanges and unions.
- G. Measure and record test pressure at high point in system.
- H. For air or nitrogen tests, gradually increase pressure to not more than one half of test pressure; then increase pressure in steps of approximately one-tenth of test pressure until required test pressure is reached.
- I. Examine joints and connections with a soap bubble solution or equivalent method. System will not be approved until it can be demonstrated that there is no measurable loss of test pressure during test period.
- J. Inspect system for leaks. Where leaks occur, repair area with new materials and repeat test; caulking will not be acceptable.

System	Medium	Test Pressure	Test Duration
Sanitary Waste and Vent	Water	10-foot water	2 hour
Pressurized Sanitary Waste & Vent	Water	100 psig	2 hour
Acid Waste and Vent	Water	10-foot water	2 hour

END OF SECTION

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SECTION 22 14 00

FACILITY STORM DRAINAGE

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes
 - 1. Plumbing pipe and pipe fittings.
- B. Related Sections
 - 1. Applicable provisions of Division 01 shall govern all work under this Section.
 - 2. Section 22 05 14 - Plumbing Specialties.
 - 3. Section 22 05 29 - Hangers and Supports for Plumbing.

1.2 REFERENCES

- A. American Society of Mechanical Engineers (ASME)
 - 1. ASME B16.3 - Malleable Iron Threaded Fittings.
 - 2. ASME B16.4 - Cast Iron Threaded Fittings.
 - 3. ASME B16.5 - Pipe Flanges and Flanged Fittings.
 - 4. ASME B16.22 - Wrought Copper and Wrought Copper Alloy Solder Joint Pressure Fittings.
 - 5. ASME B16.29 - Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings – DWV.
- B. American Water Works Association (AWWA)
 - 1. AWWA C104 - Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water.
 - 2. AWWA C105- - Polyethylene Encasement for Ductile-Iron Pipe Systems.
 - 3. AWWA C110 - Ductile-Iron and Gray-Iron Fittings for Water.
 - 4. AWWA C111 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
 - 5. AWWA C151 - Ductile-Iron Pipe, Centrifugally Cast, for Water or Other Liquids.
 - 6. AWWA C153 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
 - 7. AWWA C900 - Polyvinyl Chloride (PVC) Pressure Pipe, and Fabricated Fittings, 4 Inch - 12 Inch, for Water Distribution.
- C. ASTM International
 - 1. ASTM A53 - Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless.
 - 2. ASTM A74 - Specification for Cast Iron Soil Pipe and Fittings.
 - 3. ASTM A105 - Specification for Forgings, Carbon Steel, for Piping Components.
 - 4. ASTM A126 - Specification for Gray Cast Iron Castings for Valves, Flanges, and Pipe Fittings.
 - 5. ASTM A234 - Specification for Pipe Fittings of Wrought Carbon Steel and Alloy

- Steel for Moderate and Elevated Temperatures.
6. ASTM A861 - Specification for High Silicon Iron Pipe and Fittings.
 7. ASTM A888 - Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications.
 8. ASTM B32 - Specification for Solder Metal.
 9. ASTM B88 - Specification for Seamless Copper Water Tube.
 10. ASTM B306 - Specification for Copper Drainage Tube (DWV).
 11. ASTM B813 - Specification for Liquid and Paste Fluxes for Soldering Applications of Copper and Copper Alloy Tube.
 12. ASTM C76 - Specification for Reinforced Concrete Culvert, Storm Drain and Sanitary Pipe.
 13. ASTM C443 - Specification for Joints for Circular Concrete Pipe Sewer and Culvert Pipe Using Rubber Gaskets.
 14. ASTM C564 - Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings.
 15. ASTM C1540 - Specification for Heavy Duty Shielded Couplings for Joining Hubless Cast Iron Soil Pipe and Fittings.
 16. ASTM D1785 - Specification for Poly Vinyl Chloride (PVC) Plastic Pipe.
 17. ASTM D2321 - Practice for Underground Installation of Flexible Thermoplastic Sewer Pipe.
 18. ASTM D2241 - Specification for Poly Vinyl Chloride (PVC) Pressure-Rated Pipe (SDR Series).
 19. ASTM D2464 - Specification for Threaded Poly Vinyl Chloride (PVC) Plastic Pipe Fittings, Schedule 80.
 20. ASTM D2466 - Specification for Poly Vinyl Chloride (PVC) Plastic Pipe Fittings, Schedule 40.
 21. ASTM D2513 - Specification for Thermoplastic Gas Pressure Pipe, Tubing, and Fittings.
 22. ASTM D2564 - Specification for Solvent Cements for Poly Vinyl Chloride (PVC) Plastic Pipe and Fittings.
 23. ASTM D2657 - Practice for Heat Fusion Joining of Polyolefin Pipe and Fittings.
 24. ASTM D2665 - Specification for Poly Vinyl Chloride (PVC) Plastic Drain, Waste and Vent Pipe and Fittings.
 25. ASTM D2729 - Specification for Poly Vinyl Chloride (PVC) Sewer Pipe and Fittings.
 26. ASTM D2774 - Practice for Underground Installation of Thermoplastic Pressure Piping.
 27. ASTM D2855 - Practice for Making Solvent Cemented Joints with Poly Vinyl Chloride (PVC) Pipe and Fittings.
 28. ASTM D3034 - Specification for Type PSM Poly Vinyl Chloride (PVC) Sewer Pipe and Fittings.
 29. ASTM D3139 - Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.
 30. ASTM D3212 - Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.

31. ASTM D3311 - Specification for Drain, Waste and Vent (DWV) Plastic Fitting Patterns.
 32. ASTM D4101 - Specification for Propylene Plastic Injection and Extrusion Materials.
 33. ASTM F405 - Specification for Corrugated Polyethylene (PE) Tubing and Fittings.
 34. ASTM F437 - Specification for Threaded Chlorinated Poly Vinyl Chloride (CPVC) Plastic Pipe Fittings, Schedule 80.
 35. ASTM F438 - Specification for Socket Type Chlorinated Poly Vinyl Chloride (CPVC) Plastic Pipe Fittings, Schedule 40.
 36. ASTM F441 - Specification for Chlorinated Poly Vinyl Chloride (CPVC Plastic Pipe, Schedules 40 and 80.
 37. ASTM F656 - Specification for Primers for Use in Solvent Cement Joints of Poly Vinyl Chloride (PVC) Plastic Pipe and Fittings.
- D. Cast Iron Soil Pipe Institute (CISPI)
1. CISPI 301 - Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste and Vent Piping Applications.
 2. CISPI 310 - Couplings For Use In Connection With Hubless Cast Iron Soil Pipe And Fittings For Sanitary And Storm Drain, Waste And Vent Piping Applications.

1.3 SUBMITTALS

- A. Division 01 - Submittal Procedures: Requirements for submittals.
- B. Statement from manufacturer on his letterhead that pipe furnished meets ASTM, AWWA, or CISPI specification contained in this section.

1.4 QUALITY ASSURANCE

- A. Substitution of Materials: In accordance with Division 01.
- B. Order copper, cast iron, steel, PVC and polyethylene pipe with each length marked with name or trademark of manufacturer and type of pipe; with each shipping unit marked with purchase order number, metal or alloy designation, temper, size, and name of supplier.
- C. Any installed material not meeting specification requirements must be replaced with material that meets these specifications without additional cost to Owner.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Promptly inspect shipments to insure that the material is undamaged and complies with specifications.
- B. Cover pipe to prevent corrosion or deterioration while allowing sufficient ventilation to avoid condensation.

- C. Do not store materials directly on grade.
- D. Protect pipe, tube, and fitting ends so they are not damaged.
- E. Where end caps are provided or specified, take precautions so caps remain in place.
- F. Protect fittings, flanges, and unions by storage inside or by durable, waterproof, above ground packaging.
- G. Offsite storage agreements will not relieve Contractor from using proper storage techniques.
- H. Storage and protection methods must allow inspection to verify products.

1.6 DESIGN CRITERIA

- A. Use only new material, free of defects, rust and scale, and meeting latest revision of ASTM, AWWA, or CISPI specifications as listed in this specification.
- B. Construct all piping for highest pressures and temperatures in respective system.
- C. Non-metallic piping will be acceptable only for services indicated. It will not be acceptable in ventilation plenum spaces, including plenum ceilings.
- D. Where weld fittings or mechanical grooved fittings are used, use only long radius elbows having a centerline radius of 1.5 pipe diameters.
- E. Where ASTM A53 type F pipe is specified, grade A type E or S, or grade B type E or S may be substituted at Contractor's option. Where the grade or type is not specified, Contractor may choose from those commercially available.
- F. Where ASTM B88, Type L, H58 drawn temper copper tubing is specified, ASTM B88, type K, H58 drawn temper copper tubing may be substituted at Contractor's option.

PART 2 PRODUCTS

2.1 STORM AND CLEARWATER WASTE AND VENT

- A. Interior Above Ground:
 - 1. Hubless cast iron soil pipe and fittings, ASTM A888; with no-hub couplings, CISPI 301, CISPI 310, ASTM A74.
 - 2. Pipe and fittings shall be marked with collective trademark of Cast Iron Pipe Institute.
 - 3. Type M copper water tube, H58 drawn temper, ASTM B88; with cast copper drainage fittings (DWV), ASME B16.23; wrought copper drainage fittings (DWV), ASME B16.29; lead free, less than 0.2 percent solder, ASTM B32; flux, ASTM B813; copper phosphorous brazing alloy, AWS A5.8 BCuP.

4. Mechanically formed brazed tee connections may be used in lieu of specified tee fittings for clearwater waste vent branch takeoffs up to one-half (1/2) diameter of main.
 5. Copper drainage tube (DWV), ASTM B306; with cast copper drainage fittings (DWV), ASME B16.23; wrought copper drainage fittings (DWV), ASME B16.29; lead free, less than 0.2 percent solder, ASTM B32; flux, ASTM B813; copper phosphorous brazing alloy, AWS A5.8 BCuP.
 6. Mechanically formed brazed tee connections may be used in lieu of specified tee fittings for clearwater waste vent branch takeoffs up to one-half (1/2) diameter of main.
 7. PVC plastic pipe, Schedule 40, Class 12454-B (PVC 1120), ASTM D1785; PVC plastic drain, waste and vent pipe and fittings, ASTM D2665; fitting patterns, ASTM D3311; primer, ASTM F656; solvent cement, ASTM D2564.
- B. Pressurized Interior Above Ground:
1. Type L copper water tube, H58 drawn temper, ASTM B88; with cast copper drainage fittings (DWV), ASME B16.23; wrought copper drainage fittings (DWV), ASME B16.29; lead free, less than 0.2 percent solder, ASTM B32; flux, ASTM B813.
 2. Galvanized steel pipe, Schedule 40, Type F, Grade A, ASTM A53; with cast iron threaded drainage fittings, ASTM B16.12.
- C. Interior Below Ground 15-Inch and Smaller:
1. Cast iron soil pipe and fittings, hub and spigot, service weight, CISPI 301, ASTM A74; ASTM A888 with neoprene rubber compression gaskets, ASTM C564 and CISPI HSN 85. Pipe and fittings shall be marked with collective trademark of Cast Iron Pipe Institute.
 2. PVC plastic pipe, Schedule 40, Class 12454-B (PVC 1120), ASTM D1785; PVC plastic drain, waste and vent pipe and fittings, ASTM D2665; fitting patterns, ASTM D3311; primer, ASTM F656; solvent cement, ASTM D2564.
- D. Exterior Below Ground 15-Inch and Smaller:
1. Cast iron soil pipe and fittings, hub and spigot, service weight, CISPI 301, ASTM A74; ASTM A888 with neoprene compression rubber gaskets, ASTM C564 and CISPI HSN 85. Pipe and fittings shall be marked with collective trademark of Cast Iron Pipe Institute.
 2. PVC plastic pipe, Schedule 40, Class 12454-B (PVC 1120), ASTM D1785; PVC plastic drain, waste and vent pipe and fittings, ASTM D2665; fitting patterns, ASTM D3311; primer, ASTM F656; solvent cement, ASTM 2564.
 3. Type PSM PVC sewer pipe and fittings, SDR 35, Class 12454-B (PVC 1120), ASTM D3034; primer, ASTM F656; solvent cement, ASTM 2564; or integral bell and flexible elastomeric seal, ASTM D3212.
 4. Corrugated PVC pipe and fittings with smooth interior, ASTM F949; gasketed joint, ASTM D3212; elastomeric gasket, ASTM F477.

5. Corrugated polyethylene pipe with smooth interior and minimum pipe stiffness of 50 psi, ASTM F-405/ASTM F-667, AASHTO M-252/AASHTO M-294 Type S; PVC gasketed fittings, ASTM F1336; elastomeric gasket, ASTM F477.
- E. Exterior Below Ground 12-Inch and Larger:
1. Reinforced concrete culvert, storm drain and sewer pipe, Class III, ASTM C76; rubber gasket joints, ASTM C443; bell and spigot or tongue and groove ends.
- F. Pressurized Below Ground 3-Inch and Smaller:
1. PVC plastic pipe, Schedule 40, Class 12454-B (PVC 1120), ASTM D1785; PVC plastic drain, waste and vent pipe and fittings, ASTM D2665; socket fitting patterns, ASTM D3311; primer, ASTM F656; solvent cement, ASTM D2564.
 2. Type K copper water tube, H (drawn) temper, ASTM B88; with cast copper drainage fittings (DWV), ASME B16.23; wrought copper drainage fittings (DWV), ASME B16.29; lead free (<0.2 percent) solder, ASTM B32; flux, ASTM B813.
- G. Pressurized Below Ground 3-Inch and Larger:
1. Ductile iron pipe, mechanical or push on joint, thickness Class 52, AWWA C151; with standard thickness cement mortar lining, AWWA C104; ductile iron or gray iron mechanical joint cement mortar lined fittings, Class 250, AWWA C110; ductile iron mechanical joint compact fittings, Class 350, AWWA C153; rubber gasket joints with gasket lubricant, AWWA C111. Provide 8-mil tube or sheet polyethylene encasement of iron pipe and pipe fittings, AWWA C105.
 2. PVC pressure pipe, DR 18, Class 150, AWWA C900; with integral bell and elastomeric gaskets, ASTM D3139. Fittings and fitting polyethylene encasement to be same as noted above for ductile iron.

PART 3 EXECUTION

3.1 GENERAL

- A. Install pipe and fittings in accordance with reference standards, manufacturers' recommendations and recognized industry practices.

3.2 PREPARATION

- A. Cut pipe ends square. Ream ends of piping to remove burrs.
- B. Clean scale and dirt from interior and exterior of each section of pipe and fitting prior to assembly.

3.3 ERECTION

- A. Install piping parallel to building walls and ceilings and at heights not obstructing any portion of a window, doorway, stairway, or passageway.

- B. Where interferences develop in field, offset or reroute piping as required clearing such interferences.
- C. Coordinate locations of plumbing piping with piping, ductwork, conduit, and equipment of other trades to allow sufficient clearances.
- D. In all cases, consult Drawings for exact location of pipe spaces, ceiling heights, door and window openings, or other architectural details before installing piping.
- E. Where copper or steel piping is embedded in masonry or concrete, provide protective sleeve of elastomeric pipe insulation.
- F. Maintain piping in clean condition internally during construction.
- G. Provide clearance for installation of insulation, access to valves and piping specialties.
- H. Provide anchors, expansion joints, swing joints, or expansion loops so that piping may expand and contract without damage to itself, equipment, or building.
- I. Do not route piping through transformer vaults or above transformers, panelboards, or switchboards, including required service space for this equipment, unless piping is serving this equipment.
- J. Install valves and piping specialties, including items furnished by others, as specified and detailed.
- K. Provide access to valves and specialties for maintenance.
- L. Make connections to equipment, fixtures, and systems installed by others where same requires piping services indicated in this section.

3.4 PIPE JOINTS

- A. Copper Pipe Joints:
 - 1. Remove all slivers and burrs remaining from cutting operation by reaming and filing both pipe surfaces.
 - 2. Clean fitting and tube with metal brush, emery cloth or sandpaper.
 - 3. Remove residue from cleaning operation, apply flux, and assemble joint to socket stop.
 - 4. Apply flame to fitting until solder melts when placed at joint.
 - 5. Remove flame and feed solder into joint until full penetration of cup and ring of solder appears.
 - 6. Wipe excess solder and flux from joint.
- B. Threaded Pipe Joints:

1. Use a thread lubricant or teflon tape when making joints.
2. No hard setting pipe thread cement or caulking will be allowed.

C. Solvent Welded Pipe Joints:

1. Install in accordance with ASTM D2855.
2. Saw cut piping square and smooth.
3. Tube cutters may be used if they are fitted with wheels designed for use with PVC/CPVC pipe that do not leave raised bead on pipe exterior.
4. Support and restrain pipe during cutting to prevent nicks and scratches.
5. Bevel ends 10-15 degrees and deburr interior.
6. Remove dust, drips, moisture, grease, and other superfluous materials from pipe interior and exterior.
7. Check dry fit of pipe and fittings.
8. Reject materials which are out of round or do not fit within close tolerance.
9. Use heavy body solvent cement for large diameter fittings.
10. Maintain pipe, fittings, primer, and cement between 40 and 100 degrees F during application and curing.
11. Apply primer and solvent using separate daubers (3-inch and smaller piping only) or clean natural bristle brushes about 1/2 size of pipe diameter.
12. Apply primer to fitting socket and pipe surface with a scrubbing motion.
13. Check for penetration and reapply as needed to dissolve surface to a depth of 4-5 thousandths.
14. Apply solvent cement to fitting socket and pipe in an amount greater than needed to fill any gap.
15. While both surfaces are wet, insert pipe into socket fitting with a quarter turn to bottom of socket.
16. Solvent cement application and insertion must be completed in less than 1 minute.
17. Minimum of 2 installers is required on piping 4-inch and larger.
18. Hold joint for 30 seconds or until set.
19. Reference manufacturers' recommendations for initial set time before handling and for full curing time before pressure testing.
20. Cold weather solvent and cement may be utilized only under unusual circumstances and when specifically approved by Engineer/Architect.

3.5 PIPE CONNECTIONS

A. Mechanical Hubless Pipe Connections:

1. Place gasket on end of one pipe or fitting and clamp assembly on end of other pipe or fitting.
2. Firmly seat pipe or fitting ends against integrally molded shoulder inside neoprene gasket.
3. Slide clamp assembly into position over gasket.
4. Tighten fasteners to manufacturers recommended torque.

- B. Mechanical Joint Pipe Connections:
 1. Comply with AWWA C600/C605 installation requirements.
 2. Clean pipe end and socket.
 3. Clean and lubricate pipe end, socket, and gasket with soapy water or gasket lubricant.
 4. Place gland and gasket, properly oriented, on pipe end.
 5. Insert pipe end fully into socket and press gasket evenly into recess keeping joint straight.
 6. Press gland evenly against gasket, insert bolts, and hand tighten nuts.
 7. Make joint deflection prior to tightening bolts.
 8. Evenly tighten bolts in sequence to recommended torque.

- C. Push-On Gasketed Pipe Connections:
 1. Clean pipe end, bell, gasket seat, and gasket of dirt or debris.
 2. Coat end of pipe and gasket with gasket lubricant.
 3. Insure pipe is supported off ground so lubricant does not pick up dirt.
 4. Push spigot end into gasket bell with levered pipe joining tool recommended by pipe manufacturer.
 5. Large diameter exterior mains may be joined by pushing end of pipe section with backhoe against wood blocking over pipe end.
 6. Insert to fully seated position or to reference mark on pipe.

- D. Mechanical Grooved Pipe Connections:
 1. Use pipe factory grooved in accordance with coupling manufacturer's specifications or field grooved pipe in accordance with same specifications using tools specially designed for application.
 2. Lubricate pipe and coupling gasket, align pipe, and secure joint in accordance with coupling manufacturer's specifications.

3.6 MECHANICALLY FORMED TEE FITTINGS

- A. Form mechanically extracted collars in a continuous operation, consisting of drilling pilot hole and drawing out tube surface to form collar having height of not less than three times thickness of tube wall.
- B. Use adjustable collaring device. Notch and dimple branch tube.
- C. Braze joint with neutral flame oxy-acetylene torch, applying heat properly so that pipe and tee do not distort; remove distorted connections.

3.7 STORM AND CLEARWATER WASTE AND VENT

- A. Verify invert elevations and building elevations prior to installation.
- B. Install exterior piping pitched to drain at indicated elevations and slope.

- C. Install interior piping pitched to drain at minimum slope of 1/8-inch per foot where possible and in no case less than 1/16-inch per foot for piping 3-inch and larger.
- D. Install exterior piping below predicted frost level and not less than 5-foot bury depth to top of pipe wherever possible.
- E. Where piping is located above predicted frost level, provide frost protection in accordance with local building code requirements.

3.8 SUBSOIL DRAIN

- A. Verify invert elevations and building elevations prior to installation.
- B. Install piping sloped to drain to locations indicated.
- C. Where subsoil drains are required to penetrate foundation work, sleeve subsoil drains or use non-perforated sections of piping and place prior to foundation work.
- D. Secure joints and piping where corrugated polyethylene is used to prevent movement during laying and backfill.
- E. Route piping in straight lines. Plug dead ends of pipe with pipe caps or concrete plugs.
- F. Extend filter fabric cover over all piping and fittings with fabric cover joints overlapping and banded.
- G. Bed piping on and backfill around subsoil drains with clear draining stone material to level 12 inches above or as indicated.

3.9 PIPING SYSTEM LEAK TESTS

- A. Isolate or remove components not rated for test pressure from system.
- B. Perform final testing for medical and lab gas with all system components in place.
- C. Test piping in sections or entire system as required by sequence of construction.
- D. Do not insulate or conceal pipe until it has been successfully tested.
- E. If required for additional pressure load under test, provide temporary restraints at fittings or expansion joints.
- F. Backfill underground water mains prior to testing with exception of thrust restrained valves which may be exposed to isolate potential leaks.
- G. For hydrostatic tests, use clean water and remove all air from piping being tested by means of

air vents or loosening of flanges and unions. Measure and record test pressure at high point in system.

- H. For air or nitrogen tests, gradually increase pressure to not more than one half of test pressure; then increase pressure in steps of approximately one-tenth of test pressure until required test pressure is reached.
- I. Examine all joints and connections with soap bubble solution or equivalent method.
- J. System will not be approved until it can be demonstrated that there is no measurable loss of test pressure during test period.
- K. Inspect system for leaks. Where leaks occur, repair area with new materials and repeat test. Caulking will not be acceptable.

System	Medium	Test Pressure	Test Duration
Clearwater Waste and Vent	Water	10' water	2 hours
Storm and Clearwater Waste	Water	10' water	2 hours
Pressurized Storm/Clearwater Waste	Water	100 psig	2 hours

END OF SECTION

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SECTION 22 30 00

PLUMBING EQUIPMENT

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes
 - 1. Water heaters.
 - 2. Water softeners
 - 3. Pumps.

- B. Related Sections
 - 1. Applicable provisions of Division 01 shall govern all work under this Section.
 - 2. Section 22 05 13 - Motor Requirements for Plumbing Equipment.
 - 3. Section 22 05 14 - Piping Specialties.
 - 4. Section 22 05 23 - Valves for Plumbing Piping.
 - 5. Section 22 07 00 - Plumbing Insulation.
 - 6. Division 26 – Electrical.

1.2 REFERENCES

- A. American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE)
 - 1. ASHRAE 90.1 - Energy Standard for Buildings Except Low-Rise Residential Buildings.

- B. American Society of Mechanical Engineers (ASME)
 - 1. BPVC Section IV - Rules for Construction of Heating Boilers.
 - 2. BPVC Section VIII - Rules for Construction of Pressure Vessels.

- C. ASTM International
 - 1. ASTM A53 – Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
 - 2. ASTM B88 – Specification for Seamless Copper Water Tube.
 - 3. ASTM C443 – Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets.
 - 4. ASTM C478 – Specification for Precast Reinforced Concrete Manhole Sections.
 - 5. ASTM C923 - Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals.
 - 6. ASTM C990 - Specification for Joints for Concrete Pipe, Manholes and Precast Box Sections Using Preformed Flexible Joint Sealants.
 - 7. ASTM D4101 - Specification for Polypropylene Injection and Extrusion Materials.

- D. National Association of Corrosion Engineers (NACE)
 - 1. NACE No. 1 - White Metal Blast Cleaning.

- E. Society for Protective Coatings (SSPC)
 - 1. SSPC SP 5 - White Metal Blast Cleaning.

1.3 QUALITY ASSURANCE

- A. Substitution of Materials: In accordance with Division 01.
- B. Plumbing products requiring approval by State of Wisconsin Department of Commerce must be approved or have pending approval at time of Shop Drawing submission.

1.4 SUBMITTALS

- A. Division 01 - Submittal Procedures: Requirements for submittals.
- B. Include data concerning dimensions, capacities, materials of construction, ratings, certifications, weights, pump curves with net positive suction head requirements, manufacturer's installation requirements, manufacturer's performance limitations, and appropriate identification.

PART 2 PRODUCTS

2.1 RESIDENTIAL ELECTRIC WATER HEATER

- A. Manufacturers:
 - 1. American Water Heater Company.
 - 2. A.O. Smith Water Products Company.
 - 3. Bradford White Corporation.
 - 4. Lochinvar Corporation.
 - 5. Rheem Manufacturing Company.
 - 6. Ruud Manufacturing Company.
 - 7. State Water Heaters.
 - 8. Substitutions In accordance with Division 01.
- B. Type: Electric storage domestic water heater. Design to be UL listed with 3 year commercial use tank warranty and 1 year parts warranty.
- C. Efficiency:
 - 1. 20 gallons and ≤ 12 kW 0.94 Minimum Energy Factor
 - 2. ≥ 30 gallons and ≤ 12 kW 0.93 Minimum Energy Factor
- D. Tank: Steel glass lined tank rated for 150 psig complete with removable magnesium anode rod, plastic diffuser type dip tube, inlet and outlet heat trap fittings, minimum R-20 polyurethane foam insulation, painted steel jacket, drain valve, and temperature and pressure relief valve.

- E. Elements: Dual 4500-watt heating elements to be replaceable, threaded low watt density incoloy sheath with adjustable thermostat control, energy cutoff, and wired for non-simultaneous operation.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install plumbing equipment where indicated in accordance with manufacturer's recommendations. Coordinate equipment location with piping, ductwork, conduit, and equipment of other trades to allow sufficient clearances. Locate equipment and arrange plumbing piping to provide access space for servicing all components.
- B. Set commercial water heaters, commercial water softeners, storage tanks, and booster pumps on concrete housekeeping pads. Adjust and level equipment.
- C. Connect equipment to water and drain piping using unions or flanges and isolation valves.
- D. Size temperature and relief valves per CSA ratings. Pipe temperature and pressure relief valves to floor drain or floor as indicated.
- E. Startup and test equipment adjusting operating and safety controls for proper operation.

END OF SECTION

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SECTION 22 42 00

PLUMBING FIXTURES

PART 1 GENERAL

1.1 SCOPE

- A. Section Includes
 - 1. Plumbing fixtures.
 - 2. Faucets.
 - 3. Trim.

- B. Related Sections
 - 1. Applicable provisions of Division 01 shall govern all work under this Section.
 - 2. Section 22 05 14 - Plumbing Specialties.
 - 3. Section 22 05 29 – Hangers and Supports for Plumbing.
 - 4. Section 22 11 00 - Facility Water Distribution.
 - 5. Section 22 13 00 - Facility Sanitary Sewerage.
 - 6. Section 22 14 00 - Facility Storm Drainage.
 - 7. Section 22 15 13 - General Service Compressed Air Piping.

1.2 REFERENCES

- A. Air-Conditioning and Refrigeration Institute (ARI)
 - 1. ARI-1010-94 - Drinking Fountains and Self-Contained Mechanically Refrigerated Drinking Water Coolers.

- B. American National Standards Institute (ANSI)
 - 1. ANSI Z124.1 - Plastic Bathtub Units.
 - 2. ANSI Z124.2 - Plastic Shower Receptors and Shower Stalls.

- C. American Society of Mechanical Engineers (ASME)
 - 1. ASME A112.6.1M - Supports for Off Floor Plumbing Fixtures for Public Use.
 - 2. ASME A112.18.1 - Finished and Rough Brass Plumbing Fixture Fittings.
 - 3. ASME A112.19.1 - Enameled Cast Iron Plumbing Fixtures.
 - 4. ASME A112.19.2M - Vitreous China Plumbing Fixtures.
 - 5. ASME A112.19.5 - Trim for Water Closet Bowls, Tanks and Urinals.

- D. American Society of Safety Engineers (ASSE)
 - 1. ASSE 1011-93 - Hose Connection Vacuum Breakers.
 - 2. ASSE 1014-90 - Handheld Showers.
 - 3. ASSE 1035-93 - Laboratory Faucet Backflow Preventers.

1.3 QUALITY ASSURANCE

- A. Substitution of Materials: In accordance with Division 01.
- B. Plumbing products requiring approval by code authority having jurisdiction, must be approved or have pending approval at time of Shop Drawing submission.

1.4 SUBMITTALS

- A. Division 01 - Submittal Procedures: Requirements for submittals.
- B. Submit data concerning sizes, utility sizes, rough in-dimensions, capacities, materials of construction, ratings, weights, trim, finishes, manufacturer's installation requirements, manufacturer's performance limitations, and appropriate identification.

1.5 ENERGY EFFICIENCY REQUIREMENTS

- A. Plumbing fixtures must meet the following maximum water usage requirements based upon Federal Energy Management Program (FEMP) performance requirements.
 - 1. Lavatory Faucets, flow of 2 gpm or less and .25 gallon per cycle or less (based on inlet pressure of 60 psi).
 - 2. Showerheads, flow of 2.2 gpm or less (based on inlet pressure of 80 psi).
 - 3. Urinal Flush Valves, 1.0 gallon per flush or less.
 - 4. Water Closet Flush Valves, 1.6 gallon per flush or less.

PART 2 PRODUCTS

2.1 PLUMBING FIXTURES

- A. Manufacturers: Fixture descriptions establish fixture type, quality, materials, features and size. Products of the following manufacturers determined to be equal by Engineer will be accepted.
 - 1. Water Closets - American Standard, Kohler, and Zurn.
 - 2. Water Closet Seats - Bemis, Beneke, Centoco, and Olsonite Sperzel.
 - 3. Urinals – American Standard, Kohler, and Zurn.
 - 4. Lavatories – American Standard, Kohler, and Zurn.
 - 5. Faucets - Chicago Faucet, Kohler, Speakman, Symmons, T&S Brass, and Zurn.
 - 6. Drains - Chicago Faucet, Engineered Brass Co., Kohler, and McGuire.
 - 7. Stops and Supplies - Chicago Faucet Co., T&S Brass, and McGuire. (Heavy-Duty Type Only)
 - 8. Flush Valves - Coyne & Delany, Sloan Royal, and Zurn AV.
 - 9. Traps - Kohler, McGuire, Dearborn, and Engineered Brass Co. (17-gauge minimum)
 - 10. Carriers and Supports - Josam, Smith, Wade, Watts Drainage, and Zurn.
 - 11. Sinks - American Standard, Elkay, Just, and Kohler.
 - 12. Laundry Trays - Fiat, Mustee, and Stern-Williams.
 - 13. Mop Basins - Fiat, Mustee, and Stern-Williams.
 - 14. Showers - Leonard, Powers, Speakman, and Symmons.
 - 15. Drinking Fountains - Elkay, Halsey Taylor, Haws, Filtrine, Oasis, and Sunroc.

16. Emergency Eyewash Fountains and Showers - Bradley, Chicago Faucet Co., Guardian, Haws, and Speakman.

2.2 WATER CLOSETS

- A. WC-1 - Floor mount bottom outlet white vitreous china siphon jet water closet with elongated bowl, 1-1/2-inch top spud, 2-1/4-inch passageway, 15-inch rim height and 1.6-gallon flush. Flush valve handle 24 inches above rim.
 1. Fixture: Kohler Wellcomme K-4349.
 2. Flush Valve: Sloan Royal 116-1.5-YK.
 3. Seat: Bemis 1655-SS/C white solid plastic open front.

2.3 LAVATORIES

- A. Lavatory faucets must meet maximum water usage requirements of 2 gpm flow or less and .25 gallon per cycle or less (based on inlet pressure of 60 psi.).
- B. L-1 - Wall mount white vitreous china lavatory drilled for concealed arm carrier with 4-inch on center faucet openings.
 1. Fixture: Kohler Greenwich K-2027.
 2. Faucet: Chicago Faucet No. 802-336CP. Self-closing.
 3. Drain: Kohler K-7715 perforated strainer and 1-1/4-inch tailpiece.
 4. Trap: 1-1/4-inch x 1-1/2-inch, 17-gauge cast brass trap and tubular wall bend. With C.O. plug.
 5. Supplies and Stops Chicago Faucet No. 1006CP.
 6. Carrier: Smith floor mounted concealed arm carrier adjusted for 31-inch height rim height.

2.4 SERVICE SINKS

- A. SS-1 - Wall mounted enameled cast iron service sink with stainless steel rim guard and wall hanger supports.
 1. Fixture: Kohler Bannon K-6719.
 2. Faucet: Chicago Faucet No. 897RCF with Watts 8BC vacuum breaker.
 3. Drain: Kohler K-6673 3-inch trap with strainer, cleanout, and floorplate.
 4. Stops: Integral with faucet.

2.5 SHOWERS

- A. SH-1 - Pressure balanced shower valve with ceramic valving, check stops, adjustable temperature limit stop and volume control, lever handle operated. With lever operated diverter valve, stationary shower head and hand-held adjustable head with 44-inch slide bar, 72-inch hose, in-line vacuum breaker, and supply elbow. ADA compliant.
 1. Valve: Speakman SM-1427-SCS.
 2. Shower Head: Speakman S-2270-AF, 2.2 gpm at 80 psi).
 3. Shower Arm: Speakman S-2500.

4. Diverter: Speakman S-1182.
5. Hand Held Head: Speakman VS-100-AF/VS-124/VS117.
6. Supply Ell: Speakman VS-115.
7. Hose: Speakman VS-142.

2.6 EMERGENCY EYEWASH FOUNTAINS AND SHOWERS

- A. EEWS-1 - Floor mounted emergency eyewash and shower with plastic shower head and bowl, brass eyewash fittings, 1-inch spring return shower valve with pull handle, 1/2-inch eyewash ball valve with push flag operator, and 1-1/4-inch galvanized steel pipe stand with floor flange.
 1. Fixture: Bradley S19-310.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install plumbing fixtures in accordance with manufacturer's instructions. Set level and plumb. Secure in place to counters, floors and walls providing solid bearing and secure mounting. Bolt fixture carriers to floor and wall. Secure rough-in fixture piping to prevent movement of exposed piping.
- B. Install each fixture with trap easily removable for servicing and cleaning. Install fixture stops in readily accessible location for servicing.
- C. Install barrier free fixtures in compliance with IBC 1108 and 3408, code authority having jurisdiction and Federal ADA Accessibility Guidelines.
- D. Install barrier free lavatory traps parallel and adjacent to wall and supplies and stops elevated to 27 inches above floor to avoid contact by wheelchair users.
- E. Provide unions at water connections to drinking fountains and electric water coolers.
- F. Each fixture shall have a stop valve installation to control fixture. Stop valves shall be heavy-duty type with brass stems and screwed or sweat inlet connections. Compression type inlets are not acceptable.
- G. Cover pipe penetrations with escutcheons. Exposed traps, stops, piping, and escutcheons to be chrome-plated brass. Same items in concealed locations may be of rough brass finish.
- H. Set floor mounted water closets, floor mounted service sinks, counter mounted lavs and sinks; lav and sink faucets and drains with full setting bed of flexible non-staining plumber's putty. Cover exposed water closet bolts with bolt covers.
- I. Seal openings between walls, floors, and fixtures with mildew-resistant silicone sealant same color as fixture.

- J. Test fixtures to demonstrate proper operation. Replace malfunctioning units or components. Adjust valves for intended water flow rate to fixtures without splashing, noise, or overflow. Adjust self-closing lavatory faucets to 15 second cycle. Adjust shower valve temperature limit stops to 110 degrees F maximum outlet temperature.
- K. Protect fixtures during construction. At completion, clean plumbing fixtures and trim using manufacturer's recommended cleaning methods and materials.

END OF SECTION

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SECTION 23 05 00

BASIC HVAC REQUIREMENTS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes
 - 1. Reference Standards.
 - 2. References.
 - 3. Regulatory Requirements.
 - 4. Quality Assurance.
 - 5. Drawings.
 - 6. Continuity of Existing Services.
 - 7. Protection of Products and Finished Surfaces.
 - 8. Sleeves and Openings.
 - 9. Sealing and Firestopping.
 - 10. Equipment Furnished By Owner.
 - 11. Provisions for Future.
 - 12. Product Substitution Procedures.
 - 13. Submittals.
 - 14. Off Site Storage.
 - 15. Request and Certification for Payment.
 - 16. Certificates and Inspections.
 - 17. Operating and Maintenance Instructions.
 - 18. Training of Owner Personnel.
 - 19. Record Drawings.
 - 20. Manufacturer's Field Services and Reports.
 - 21. Access Panels and Doors.
 - 22. Identification.
 - 23. Sealing and Firestopping.
 - 24. Demolition.
 - 25. Excavation and Backfill.
 - 26. Concrete Work.
 - 27. Cutting and Patching.
 - 28. Building Access.
 - 29. Equipment Access.
 - 30. Coordination.
 - 31. Lubrication.
 - 32. Sleeves.

- B. Related Sections
 - 1. Applicable provisions of Division 01 shall govern all work under this Section.

2. Section 23 05 13 - Motor Requirements for HVAC.
3. Section 23 33 00 - Air Duct Accessories.

1.2 REFERENCE STANDARDS

- A. Abbreviations of standards organizations referenced in other sections are as follows:
1. AABC Associated Air Balance Council.
 2. ABMA American Boiler Manufacturers Association.
 3. ADC Air Diffusion Council.
 4. AGA American Gas Association.
 5. AMCA Air Movement and Control Association.
 6. ANSI American National Standards Institute.
 7. ARI Air-Conditioning and Refrigeration Institute.
 8. ASHRAE American Society of Heating, Refrigerating and Air Conditioning Engineers.
 9. ASME American Society of Mechanical Engineers.
 10. ASTM American Society for Testing and Materials.
 11. AWWA American Water Works Association.
 12. AWS American Welding Society.
 13. CGA Compressed Gas Association.
 14. EPA Environmental Protection Agency.
 15. GAMA Gas Appliance Manufacturers Association.
 16. IEEE Institute of Electrical and Electronics Engineers.
 17. ISA Instrument Society of America.
 18. MCA Mechanical Contractors Association.
 19. MICA Midwest Insulation Contractors Association.
 20. MSS Manufacturer's Standardization Society of the Valve & Fitting Industry, Inc.
 21. NBS National Bureau of Standards.
 22. NEBB National Environmental Balancing Bureau.
 23. NEC National Electric Code.
 24. NEMA National Electrical Manufacturers Association.
 25. NFPA National Fire Protection Association.
 26. SMACNA Sheet Metal and Air Conditioning Contractors' National Association. Inc.
 27. UL Underwriters Laboratories Inc.

1.3 REFERENCES

- A. ASTM International
1. ASTM E84 - Test Method for Surface Burning Characteristics of Building Materials.
 2. ASTM E814 - Test Method for Fire Tests of Through-Penetration Fire Stops.
- B. Underwriters Laboratories, Inc. (UL)

1. UL 1479 - Fire Tests of Through-Penetration Firestops.
2. UL 723 - Surface Burning Characteristics of Building Materials.

1.4 REGULATORY REQUIREMENTS

- A. Specified systems shall be installed in compliance with federal, state and local codes and regulations.
- B. Contractor shall secure and pay for permits, licenses and certificates of inspection applicable to this work.
- C. Contractor shall pay taxes applicable to this work.

1.5 QUALITY ASSURANCE

- A. Where equipment or accessories are used which differ in arrangement, configuration, dimensions, ratings, or engineering parameters from those indicated in the Contract Documents, Contractor is responsible for all costs involved in integrating equipment or accessories into system and for obtaining performance from system into which these items are placed.
- B. This may include changes found necessary during testing, adjusting, and balancing phase of project.

1.6 DRAWINGS

- A. The Drawings show the general arrangement of piping, equipment and appurtenances and shall be followed as close as possible the actual building construction and work of other Contractors.
- B. Work shall conform to requirements indicated on Drawings. Architectural and structural Drawings shall take precedence.
- C. Due to the scale of the Drawings, it is not possible to indicate all offsets, fittings and accessories that may be required.
- D. Investigate architectural and structural conditions affecting work and arrange work accordingly, providing offsets, fittings and accessories as may be required to meet constructed design.
- E. HVAC equipment and systems, including piping and ductwork shall also be installed to maintain required operation and maintenance clearances.
- F. Work shall conform to requirements indicated on the Drawings

1.7 CONTINUITY OF EXISTING SERVICES

- A. Do not interrupt or change existing services without prior written approval from Owner's Representative.
- B. When interruption is required, coordinate down-time with Owner to minimize disruption to his activities.
- C. Unless specifically stated, all work involved in interrupting or changing existing services is to be done during normal working hours.

1.8 PROTECTION OF PRODUCTS AND FINISHED SURFACES

- A. Furnish one can of touch-up paint for each different color factory finish which is to be final finished surface of product.
- B. Deliver touch-up paint with other "loose and detachable parts" to Owner as specified.
- C. Transport and handle products in accordance with manufacturer's instruction.
- D. Promptly inspect shipments to ensure products comply with requirements, quantities are correct, and products are undamaged.
- E. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage.
- F. Store and protect products in accordance with manufacturer's instructions.
- G. Store with seals and labels intact and legible.
- H. Store sensitive products in weather tight, climate controlled, enclosures in an environment favorable to product.
- I. For exterior storage of fabricated products, place on sloped supports above ground.
- J. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.
- K. Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.
- L. Structural mechanical iron, iron pipe supports, platforms, and any equipment which is not furnished with an enamel prime coat finish and furnished under this section of work, shall be wire brushed free of rust and scale and given two (2) coats of brown colored rust-proof paint applied by this Division of Work.
- M. Any surfaces of existing or new equipment, in areas of work where finish has been used or destroyed, shall be refinished to match original finish.

1.9 SLEEVES AND OPENINGS

A. Sleeve Requirements:

1. Provide steel pipe for sleeves penetrating floors.
2. Set sleeves two inches above floor of equipment rooms and caulk tight so water leakage cannot occur between sleeves and floors.
3. Furnish each sleeve having an inside diameter one inch larger than outside diameter of each uncovered pipe and one inch larger than outside diameter of covering for each covered pipe.
4. Pack void between sleeve and pipe or insulate with fire retardant insulation and caulking.
5. Provide 18 gage galvanized sleeves for ducts passing through walls of concrete or masonry, and critical walls of other types of construction.
6. For ducts through floor construction of equipment rooms, extend sleeve two inches above floor and finish off with 2-inch x 2-inch angles and caulk tight so water leakage cannot occur between sleeves and floor.
7. Sleeves for ductwork shall be one inch larger than outside duct dimensions and of sufficient length to pass through entire floor, wall or roof construction including finish.
8. Pack void between sleeves and duct or insulation with fire retardant insulation and caulking.

B. Curb and Base Requirements:

1. Contractor shall provide concrete bases, footing, piers, platforms, and curbs for equipment as required or as indicated on Drawings or identified in specification sections.
2. Contractor shall be responsible for location, size and any changes required by substitution of equipment.
3. Provide alignment, foundation template drawings, anchor bolts and Embeco non-shrink grouting for bases in accordance with manufacturer's instructions.
4. Rigging and Setting of Curbs:
 - a. Contractor shall rig unit curbs and set counter-flashing of curbs.
 - b. Curbs shall be set and shimmed level.

1.10 SEALING AND FIRESTOPPING

- A. Sealing and firestopping of sleeves/openings between ductwork, piping, and sleeves, structural or partition opening shall be responsibility of Contractor whose work penetrates an opening.
- B. The responsible Contractor shall hire individuals skilled in such work, such as sealing and fireproofing. These individuals hired shall normally and routinely be employed in sealing and fireproofing occupation.

1.11 PRODUCT SUBSTITUTION PROCEDURES

- A. Engineer will consider requests for Substitutions only within 15 days after date of Owner-Contractor Agreement.
- B. Substitutions may be considered when a product becomes unavailable through no fault of Contractor.
- C. Document each request with complete data substantiating compliance of proposed Substitution with Contract Documents.
- D. A request constitutes a representation that Contractor:
 - 1. Has investigated proposed product and determined that it meets or exceeds quality level of specified product.
 - 2. Will provide same warranty for Substitution as for specified product.
 - 3. Will coordinate installation and make changes to other Work that may be required for Work to be complete with no additional cost to Owner.
 - 4. Waives claims for additional costs or time extension that may subsequently become apparent.
 - 5. Will reimburse Owner and Engineer for review or redesign services associated with re-approval by authorities having jurisdiction.
- E. Substitutions will not be considered when they are indicated or implied on Shop Drawing or Product Data submittals, without separate written request, or when acceptance will require revision to Contract Documents.
- F. Substitution Submittal Procedure:
 - 1. Submit two copies of request for Substitution for consideration. Limit each request to one proposed Substitution.
 - 2. Submit Shop Drawings, Product Data, and certified test results attesting to proposed product equivalence. Burden of proof is on proposer.
 - 3. Engineer will notify Contractor in writing of decision to accept or reject request.
- G. Only one request for substitution will be considered for each product. When substitution is not accepted, provide specified product.

1.12 SUBMITTALS

- A. Division 01 - Submittal Procedures: Requirements for submittals.
- B. Submit for equipment and systems as indicated in respective specification sections, marking each submittal with that specification section number.

- C. Mark general catalog sheets and drawings to indicate specific items being submitted and proper identification of equipment by name and/or number, as indicated in Contract Documents.
- D. Before submitting electrically powered equipment, verify that electrical power and control requirements for equipment are in agreement with motor starter schedule on electrical Drawings.
- E. Contractor shall include a statement on Shop Drawing transmittal to Engineer/Architect that equipment submitted and motor starter schedule are in agreement or indicate any discrepancies.
- F. Include wiring diagrams of electrically powered equipment.
- G. Submit sufficient quantities of Shop Drawings to allow the following distribution:
 - 1. Operating and Maintenance Manuals: Three (3) copies.
 - 2. Testing, Adjusting and Balancing Contractor: One (1) copy.
 - 3. Engineer/Architect: One (1) copy each.
 - 4. Contractor and Manufacturer: As required.
- H. Shop Drawings Submittal Procedures:
 - 1. Shop drawings shall include detailed dimensions, capacities, gauges, arrangement and operating clearances.
 - 2. Incomplete submittals shall not be reviewed and Contractor will be held responsible for correction of work not having final approval.
 - 3. Engineer will review or take other appropriate action on Contractor submittals, such as certified shop drawings, product data, samples and other data, which Contractor is required to submit, but only for limited purpose of checking for conformance with design concept and Contract Documents.
 - 4. This review shall not include review of accuracy or completeness of details, such as quantities, dimensions, capacities, weights or gauges, fabrication processes, construction means or methods, coordination of work with other trades or construction safety precautions, all of which are sole responsibility of Contractor.
 - 5. Engineer's review will be conducted with reasonable promptness while allowing sufficient time in Engineer's judgment to permit adequate review.
 - 6. Review of specific items shall not indicate that Engineer has reviewed entire assembly of which said item is a component.
 - 7. Engineer will not be responsible for any deviations from Contract Documents not submitted to Engineer in writing by Contractor.
 - 8. Engineer will not be required to review partial submissions or those for which submissions of correlated items have not been received.
 - 9. Review of certified drawings does not relieve Contractor of responsibility of furnishing and installing all system components, as per drawings and specifications for proper system operation with particular respect to BTU outputs, water and air

flow capacities, minimum noise requirements and space limitations, nor from responsibility for errors or omissions of any sort in submittal drawings.

10. Engineer assumes no responsibility for Contractor calculated dimensions or exact quantities of materials on shop drawings.
11. Reviews by Engineer is subject to limitations of general conditions of the contract for construction.
12. Contractor shall thoroughly check all shop drawings prepared by subcontractors for materials or equipment suppliers with regard to measurements, size of members, materials and details to satisfy specifications and drawings.
13. Each drawing shall have a date of approval and signature of Contractor's reviewer.
14. If Contractor's shop drawings have been submitted and reviewed by Engineer for a particular product and Engineer has stamped "rejected", "revised and resubmit" or "submit specified items" after two reviews, any further review by Engineer for that particular product will require contractor to compensate Engineer for time spent for further review of that product at a rate of one hundred fifty dollars (\$150.00) per hour.
15. Furnish approved and corrected shop drawings to all other Contractors whose work is affected.

1.13 OFF SITE STORAGE

- A. Prior approval by Owner's Representative is required.
- B. Ductwork and metal for making ductwork, duct lining, sleeves, pipe/pipe fittings and similar rough-in material will not be accepted for off site storage.
- C. For pipe material that can be stored off site, no material will be accepted for off-site storage unless Shop Drawings for that material have been approved.
- D. Provide proof of bonded and insured off-site storage and protection when site does not permit on-site storage or protection.
- E. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.
- F. Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.

1.14 CERTIFICATES AND INSPECTIONS

- A. Obtain and pay for Authorities Having Jurisdiction required inspections except those provided by Owner's Representative in accordance with governing building code.
- B. Deliver originals of these certificates to Owner's Representative.

- C. Include copies of certificates in Operating and Maintenance Instructions.

1.15 OPERATING AND MAINTENANCE INSTRUCTIONS

- A. Contractor shall submit to Engineer for review three bound copies of typewritten instructions covering complete maintenance and operation of the system.
- B. Assemble material in three-ring or post binders, using an index at front of each volume and tabs for each system or type of equipment. In addition to data indicated in General Requirements, include following information:
 - 1. Copies of all approved Shop Drawings.
 - 2. Manufacturer's wiring diagrams for electrically powered equipment.
 - 3. Records of tests performed to certify compliance with system requirements.
 - 4. Certificates of inspection by regulatory agencies.
 - 5. Temperature control Record Drawings and control sequences.
 - 6. Parts lists for manufactured equipment.
 - 7. Valve schedules.
 - 8. Lubrication instructions, including list/frequency of lubrication done during construction.
 - 9. Warranties.
 - 10. Testing, Adjusting and Balancing Data.
 - 11. Additional information as indicated in technical specification sections.
- C. Maintenance instructions shall include manufacturer's literature on system major equipment components.
- D. Maintenance instructions shall be explicit concerning time intervals for servicing and preventative maintenance, type and grades of oil and grease, packing materials, normal and abnormal clearances, cleaning, methods of equipment adjustments and complete description and list of replacement parts and materials for wearing items.
- E. Operation instructions shall include detailed step-by-step startup and shutdown procedures, normal operating ranges such as temperatures and pressures and yearly system changeover procedure.

1.16 TRAINING OF OWNER PERSONNEL

- A. Instruct Owner's personnel in proper operation and maintenance of systems and equipment provided as part of this project. Videotape all training sessions.
- B. Include not less than 16 hours of instruction, over a total of 2 training sessions, using Operating and Maintenance manuals during this instruction.
- C. Demonstrate startup and shutdown procedures for all equipment. All training to be during normal working hours.

- D. Coordinate with Owner at least two weeks prior to scheduling training sessions.

1.17 RECORD DRAWINGS

- A. In addition to data required by General Conditions, maintain temperature control Record Drawings on originals prepared by installing contractor and subcontractor. Include copies of these Record Drawings with Operating and Maintenance manuals.
- B. Record Drawings shall be maintained by the Contractor on a daily basis.

1.18 MANUFACTURERS' FIELD SERVICES AND REPORTS

- A. When specified in individual specification Sections, require material or product suppliers or manufacturers to provide qualified staff personnel to observe site conditions, conditions of surfaces and installation, quality of workmanship, start-up of equipment, test, adjust, and balance of equipment as applicable, and to initiate instructions when necessary.
- B. Submit qualifications of observer to Engineer 30 days in advance of required observations. Observer is subject to approval of Engineer/Architect and Owner.
- C. Individuals are to report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions.
- D. Submit report in duplicate within (15) fifteen days of observation to Engineer for review.

PART 2 PRODUCTS

2.1 IDENTIFICATION

- A. Stencils: Not less than one-inch high letters/numbers for marking pipe and equipment.
- B. Snap-On Pipe Markers: Cylindrical self-coiling plastic sheet that snaps over piping insulation and is held tightly in place without use of adhesive, tape or straps. Not less than one-inch high letters/numbers and flow direction arrows for piping marking.
 - 1. W. H. Brady.
 - 2. Seton.
 - 3. Marking Services.
 - 4. Champion America.
 - 5. Or an approved equal.
- C. Engraved Name Plates: White letters on a black background, 1/16-inch thick plastic laminate, beveled edges, screw mounting.
 - 1. Setonply Style 2060 by Seton Name Plate Company
 - 2. Emedolite- Style EIP by EMED Co.
 - 3. Marking Services.

4. W. H. Brady.
 5. Or an approved equal.
- D. Valve Tags: Round brass tags with 1/2-inch numbers, 1/4-inch system identification abbreviation, 1-1/4-inch minimum diameter, with brass jack chains or brass "S" hooks around valve stem.
1. EMED Co.
 2. Seton Name Plate Company.
 3. Marking Services
 4. W. H. Brady.
 5. Or an approved equal.

2.2 SEALING AND FIRESTOPPING

- A. FIRE AND/OR SMOKE RATED PENETRATIONS:
- B. Manufacturers:
1. 3M.
 2. Hilti.
 3. Rectorseal.
 4. STI/SpecSeal.
 5. Tremco.
 6. Or an approved equal.
- C. Firestopping systems shall be provided by same manufacturer.
- D. Submittals: Contractor shall submit product data for each firestop system.
- E. Submittals shall include product characteristics, performance and limitation criteria, test data, MSDS sheets, installation details and procedures for each method of installation applicable to this project.
- F. For non-standard conditions where no UL tested system exists, submit manufacturer's drawings for UL system with known performance for which an engineering judgment can be based upon.
- G. Product: Fire stop systems shall be UL listed or tested by an independent testing laboratory approved by Authority Having Jurisdiction.
- H. Use product that has rating not less than rating of wall or floor being penetrated. Reference Architectural Drawings for identification of fire and/or smoke rated walls and floors.
- I. Contractor shall use firestop putty, caulk sealant, intumescent wrapstrips, intumescent firestop collars, firestop blocks, firestop mortar, or a combination of these products to provide UL listed system for each application required for this project.

J. Provide mineral wool backing where specified in manufacturer's application detail.

2.3 NON-RATED PENETRATIONS:

- A. Pipe Penetrations Through Below Grade Walls: In exterior wall openings below grade, use modular mechanical type seal consisting of interlocking synthetic rubber links shaped to continuously fill annular space between uninsulated pipe and cored opening or water-stop type wall sleeve.
- B. Pipe Penetrations: At pipe penetrations of non-rated interior partitions, floors, and exterior walls above grade, use urethane caulk in annular space between pipe insulation and sleeve. For non-rated drywall, plaster or wood partitions where sleeve is not required use urethane caulk in annular space between pipe insulation and wall material.
- C. Duct Penetrations:
 - 1. Annular space between duct, with or without insulation, and non-rated partition or floor opening shall not be larger than two inches. Where existing openings have an annular space larger than two inches, patch space to match existing construction to within two inches around duct.
 - 2. Where shown or specified, pack annular space with fiberglass batt insulation or mineral wool insulation. Provide four-inch sheet metal escutcheon around duct on both sides of partition or floor to cover annular space.

PART 3 EXECUTION

3.1 EXCAVATION AND BACKFILL

- A. Perform excavation and backfill work to accomplish indicated mechanical systems installation in accordance with Division 31 - Earthwork.
- B. Blasting will not be allowed without written permission of Owner's Representative and Owner.
- C. Install lines passing under foundations with minimum of 1-1/2-inch clearance to concrete and insure there is no disturbance of bearing soil.
- D. Prior to burying pipe, dimensionally locate piping on Record Drawings.
- E. Existing utility lines to be retained are indicated on Drawings or locations which are made known to the Contractor prior to excavation, as well as utility lines uncovered during excavation operations, shall be protected from damage during excavation and backfilling and if damaged, shall be repaired by the Contractor at their own expense.

3.2 CONCRETE WORK

- A. Division 03 – Concrete: Contractor shall provide cast-in-place concrete, unless otherwise noted.
- B. Provide layout drawings, anchor bolts, metal shapes, and templates to be cast into concrete or used to form concrete for support of mechanical equipment.

3.3 CUTTING AND PATCHING

- A. Cutting and patching of existing general construction (except pipe openings), as required to accommodate new system, will be provided by General Contractor. Reference Division 01 - Cutting and Patching.
- B. If Contractor should neglect to inform other Sections of work of his opening requirements before that portion of building construction has been complete, this Contractor shall cut their own openings and provide framing and lintels as required.
- C. Before cutting or drilling, Contractor must obtain permission from Engineer, and Contractor shall repair any damage to Engineer/Architect satisfaction.
- D. In the event holes must be cut through reinforced concrete, drill carefully so as to avoid spalling and unnecessary damage or weakening of structural members.
- E. No chopping or breaking will be permitted.
- F. Repair surfaces damaged during installation of new system to complete satisfaction of Owner and Engineer/Architect.
- G. Do not cut through any building structural members without prior approval from Engineer.
- H. Openings in general construction shall be neatly cut with smooth edges and opening shall be made only large enough to accommodate new system.
- I. Pipe openings through reinforced concrete construction shall be core drilled.
- J. Other openings shall be machine sawed.
- K. Breaking or chopping out will not be permitted.

3.4 BUILDING ACCESS

- A. Arrange for necessary openings in building to allow for admittance of all apparatus.
- B. When building access was not previously arranged and must be provided by this Contractor, restore any opening to its original condition after apparatus has been brought into building.

3.5 EQUIPMENT ACCESS

- A. Install piping, conduit, ductwork, and accessories to permit access to equipment for maintenance and service.
- B. Coordinate exact location of wall and ceiling access panels and doors with General Contractor, making sure that access is available for all equipment and specialties.
- C. Where access is required in plaster walls or ceilings, furnish access doors to General Contractor.
- D. Provide color-coded thumb tacks or screws, depending on surface, for use in accessible ceilings which do not require access panels.

3.6 COORDINATION

- A. Verify that devices are compatible for surfaces on which they will be used including, but not limited to, diffusers, register, grilles, and recessed or semi-recessed heating and cooling terminal units installed in or on architectural surfaces.
- B. Coordinate work with other contractors prior to installation.
- C. Any installed work that is not coordinated and that interferes with other contractor's work shall be removed or relocated at installing contractor's expense.
- D. Cooperate with test and balance agency in ensuring compliance with Section 23 05 93 – Testing, Adjusting and Balancing for HVAC.
- E. Verify system completion to test and balance agency including;
 - 1. Flushing.
 - 2. Pressure testing.
 - 3. Chemical treatment.
 - 4. Filling of liquid systems.
 - 5. Pressurization and air venting of hydronic systems.
 - 6. Provide clean filters.
 - 7. Provide clean strainers.
 - 8. Duct and pipe system cleaning.
 - 9. Controls adjusted and calibrated.
 - 10. Controls cycled through their sequences are ready for testing, adjusting and balancing work.
- F. Install dampers, shutoff and balancing valves, flow measuring devices, gauges, and temperature controls required for functional and balanced systems.
- G. Demonstrate starting, interlocking and control features of each system so test and balance agency can perform its work.

3.7 IDENTIFICATION

- A. Identify equipment in mechanical equipment rooms by stenciling equipment number and service with one coat of black enamel against a light background or white enamel against a dark background.
- B. Use a primer where necessary for proper paint adhesion.
- C. Do not label equipment such as cabinet heaters and ceiling fans in occupied spaces.
- D. Where stenciling is not appropriate for equipment identification, engraved nameplates may be used.
- E. Identify piping not less than once every 30 feet, not less than once in each room, adjacent to each access door or panel, and on both side of partition where exposed piping passes through walls, floors, or roofs.
- F. Place flow directional arrows at each pipe identification location.
- G. Use one coat of black enamel against a light background or white enamel against a dark background for stenciling, or provide snap-on pipe markers as specified.
- H. Identify valves with brass tags bearing system identification and valve sequence number.
- I. Valve tags are not required at a terminal device unless valves are greater than ten feet from device or located in another room not visible from terminal unit.
- J. Provide a typewritten valve schedule indicating valve number and equipment or areas supplied by each valve; locate schedules in each mechanical room and in each Operating and Maintenance manual.
- K. Schedules in mechanical rooms to be framed under clear plastic.
- L. Use engraved nameplates to identify control equipment.
- M. Identify all fire and smoke dampers. Dampers shall be permanently identified on the exterior of the duct with a label, or painted, having a minimum letter height of one-inch. Identification shall read either "Fire Damper", "Smoke Damper", or "Fire/Smoke Damper".

3.8 LUBRICATION

- A. Lubricate bearings with lubricant as instructed by manufacturer before equipment is operated for any reason.
- B. Once equipment has been run, maintain lubrication in accordance with manufacturer's instructions until the work is accepted by Engineer/Architect.

- C. Maintain a log of lubricants used and frequency of lubrication and include this information in Operating and Maintenance Manuals at completion of project.

3.9 SLEEVES

A. Pipe Sleeves:

1. Provide galvanized sheet metal sleeves for pipe penetrations through interior and exterior walls to provide a backing for sealant or firestopping.
2. Patch wall around sleeve to match adjacent wall construction and finish.
3. Grout area around sleeve in masonry construction.
4. In finished spaces where pipe penetration through wall is exposed to view, sheet metal sleeve shall be installed flush with face of wall.
5. Pipe sleeves are not required in interior non-rated drywall, plaster, or wood partitions and sleeves are not required in existing poured concrete walls where penetrations are core drilled.
6. Pipe sleeves in new poured concrete construction shall be schedule 40 steel pipe, sized to allow insulated pipe to run through sleeve, cast in place.
7. Extend top of sleeve one-inch above adjacent floor in piping floor penetrations located in mechanical rooms and wet locations listed below. In finished areas, sleeves shall be flush with rough floor.
8. For floor pipe penetrations through existing floors in mechanical rooms and wet locations listed below, core drill opening and provide 1-1/2 x 1-1/2 x 1/8-inch galvanized steel angles fastened to floor surrounding penetration or group of penetrations to prevent water from getting to penetration.
9. Place urethane sealant between angles and floor and fasten angles to floor minimum 8 inches on center.
10. Seal corners water tight with urethane sealant or core drill sleeve opening large enough to insert schedule 40 sleeve and grout area around sleeve with hydraulic setting, non-shrink grout.
11. If pipe penetrating sleeve is supported by a pipe clamp resting on sleeve, weld a collar or struts to sleeve that will transfer weight to existing floor structure.
12. Wet locations include:
 - a. Chemical storage and hazardous waste storage rooms.
 - b. Compactor areas.
13. For pipe penetrations through existing floors located in food service areas, core drill sleeve opening large enough to insert schedule 40 sleeve and grout area around sleeve with hydraulic setting, non-shrink grout.
14. Size sleeve to allow insulated pipe to run through sleeve and paint sleeve.
15. Pipe sleeves are not required in cored floor pipe penetrations through existing floors that are not located in mechanical rooms, food service areas or wet locations listed above.

B. Duct Sleeves:

1. Duct sleeves are not required in non-rated partitions or floors.

2. Provide sleeve required for fire dampers in fire-rated partitions and floors.
3. Reference fire damper details on Drawings.
4. For duct penetrations through mechanical room floors and wet locations listed below, provide 1-1/2 x 1-1/2 x 1/8-inch galvanized steel angles fastened to floor around perimeter of duct opening to prevent water from getting to floor opening.
5. Provide urethane caulk between angles and floor and fasten angles to floor 8 inches on center.
6. Seal corners water tight with urethane caulk.
7. Wet locations include:
 - a. Chemical storage and hazardous waste storage rooms.
 - b. Compactor areas.

3.10 SEALING AND FIRESTOPPING

- A. Fire and Smoke Rated Penetrations
 1. Install approved product in accordance with manufacturer's instructions where pipes penetrate a fire and smoke rated surface.
 2. When pipe is insulated, use a product which maintains integrity of insulation and vapor barrier.
 3. Where firestop mortar is used to infill large fire-rated floor openings that could be required to support weight, provide permanent structural forming.
 4. Firestop mortar alone is not adequate to support any substantial weight.
 5. Reference Division 7 – Firestopping.
- B. Non-Rated Partitions:
 1. In exterior wall openings below grade, assemble rubber links of mechanical seal to proper size for pipe and tighten in place, in accordance with manufacturer's instructions.
 2. At interior partitions and exterior walls, pipe penetrations are required to be sealed.
 3. Apply sealant to both sides of penetration in such a manner that annular space between pipe sleeve or cored opening and pipe or insulation is completely blocked.
 4. Duct penetrations through non-rated partitions shall require sheet metal escutcheons with fiberglass or mineral wool insulation fill for spaces that include laboratories, clean rooms, animal rooms, kitchens, cart wash rooms, janitor closets, cart wash rooms, toilet rooms, mechanical rooms, conference rooms, private consultation rooms, and as indicated on Drawings.

3.11 PROJECT CLOSEOUT

- A. Contractor shall provide the following submittal data prior to final site walk-through review.
- B. Closeout Data Submittals:
 1. Record Drawing submission.

2. Air and water balance test reports.
3. Operating and maintenance manuals.
4. Instructional walk-through and training.
5. Piping and valve charts.
6. Inspector's test reports as follows:
 - a. Fire department inspector.
 - b. HVAC inspector.
 - c. Boiler inspection certification.
7. Pipe Pressure test reports as follows:
 - a. Special systems.
 - b. Underground hot water piping.
 - c. Building hot water heating piping.
 - d. Refrigerant leak test.
8. System startup reports:
 - a. Heating equipment.
 - b. Variable frequency devices.
 - c. Temperature control equipment.
9. Chemical treatment reports:
 - a. Hot water heating.
 - b. Heat Reclaim Water.
10. Closeout statements:
 - a. Work completion.
 - b. Warranty statements.
 - c. Punch list completion.

3.12 HVAC PAINTING

- A. Reference Division 09 – Finishes for paint and coating application requirements.
- B. All exposed steel support structures including all metal surfaces located both inside and outside the building, shall be painted after installation with one coat of compatible metal primer coat and two finish coat applications. Color shall be gray unless specified.
- C. All exposed piping, including uninsulated piping located inside the building, exposed to weather and exposed piping inside building shall be painted after installation with one coat of compatible metal primer and two finish coat applications.
- D. Paint piping in accordance with the following color charts;
 1. Heat Reclaim Water – Green
 2. Hot Water – Orange
- E. Piping systems shall be clearly identified after painting with pipe markings as specified.

END OF SECTION

SECTION 23 05 13

MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Three Phase, Single Speed Motors.
 - 2. Single Phase, Single Speed Motors.
 - 3. Motors Used on Variable Frequency Drives.

- B. Related Sections:
 - 1. Applicable provisions of Division 01 shall govern Work under this Section.
 - 2. Section 23 05 00 - Basic HVAC Requirements.
 - 3. Section 23 05 14 - Variable Frequency Drives.
 - 4. Section 23 09 14 - Pneumatic and Electric Instrumentation and Control Devices for HVAC.
 - 5. Section 23 09 23 – Direct Digital Control System for HVAC.
 - 6. Division 26 - Electrical.

1.2 REFERENCES

- A. American National Standards Institute:
 - 1. ANSI/IEEE 112 - Test Procedure for Polyphase Induction Motors and Generators.
 - 2. ANSI/NEMA MG-1 - Motors and Generators.
 - 3. ANSI/NFPA 70 - National Electrical Code.

1.3 SUBMITTALS

- A. Division 01 - Submittal Procedures: Requirements for submittals.

- B. Include with equipment which motor drives, the following motor information:
 - 1. Motor manufacturer.
 - 2. Horsepower.
 - 3. Voltage.
 - 4. Phase.
 - 5. Hertz.
 - 6. RPM.
 - 7. Full load efficiency.
 - 8. Include project wiring diagrams prepared by Contractor specifically for this work.

1.4 OPERATING AND MAINTENANCE INSTRUCTIONS

- A. Include manufacturer's instructions in manuals with specific equipment to which they apply.

Also include the following information if not previously documented on shop drawings:

1. Full Load Power Factor.
2. Service Factor.
3. NEMA Design Designation.
4. Insulation Class.
5. Frame Type.

1.5 ELECTRICAL COORDINATION

- A. All starters, overload relay heater coils, disconnect switches and fuses, relays, wire, conduit, pushbuttons, pilot lights, and other devices required for control of motors or electrical equipment are furnished and installed by Electrical Contractor, except as specifically noted.
- B. Mechanical drawings show number and horsepower rating of all motors furnished by this Contractor, together with their actuating devices if these devices are furnished by Electrical Contractor.
- C. Should discrepancy in size, horsepower rating, electrical characteristics or means of control be found for any motor or other electrical equipment after contracts are awarded, Contractor is to immediately notify Engineer of such discrepancy.
- D. Costs involved in any changes required due to equipment substitutions initiated by this Contractor will be responsibility of this Contractor.
- E. Electrical Contractor will provide power wiring and control wiring, except temperature control wiring.
- F. Furnish project specific wiring diagrams to Electrical Contractor for equipment and devices furnished by this Contractor and indicated to be wired by Electrical Contractor.

1.6 PRODUCT CRITERIA

- A. Motors to conform to applicable requirements of NEMA, IEEE, ANSI, and NEC standards and shall be listed by U.L. for service specified.
- B. Select motors for conditions in which they will be required to perform such as general purpose, splashproof, explosion proof, standard duty, high torque or any other special type as required by equipment or motor manufacturer's recommendations.
- C. Furnish motors for starting in accordance with utility requirements and compatible with starters as specified.

PART 2 PRODUCTS

2.1 THREE PHASE, SINGLE SPEED MOTORS

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- A. Use NEMA rated 460 volt, three phase, 60 hertz motors for motors 1/2 HP and larger unless specifically indicated.
- B. Use NEMA General Purpose, Continuous Duty, Design B, Normal Starting Torque, T-frame or U-frame motors with Class B or better insulation unless manufacturer of equipment on which motor is being used has different requirements.
- C. Use open drip-proof motors unless totally enclosed fan-cooled, totally enclosed non-ventilated, explosion-proof, or encapsulated motors are specified in equipment sections.
- D. Use grease lubricated anti-friction ball bearings with housings equipped with plugged and capped provision for relubrication, rated for minimum AFBMA 9, L-10 life of 20,000 hours.
- E. Calculate bearing load with NEMA minimum V-belt pulley with belt center line at end of NEMA standard shaft extension. Stamp bearing sizes on nameplate.
- F. Open drip-proof motors to have a 1.15 service factor. Other motor types may have minimum 1.0 service factors.
- G. Motors 1 HP and larger, except specially wound motors and inline pump motors 56 frame and smaller, to be high efficiency design with full load efficiencies which meet or exceed values listed below when tested in accordance with NEMA MG 1.

Table 1

Full Load Nominal Motor Efficiency by Motor Size and Speed

MOTOR HP	(Open Drip-Proof Motors) Nominal Motor Speed		
	1200 RPM	1800 RPM	3600 RPM
1	82.5	85.5	77.0
1-1/2	86.5	86.5	84.0
2	87.5	86.5	85.5
3	88.5	89.5	85.5
5	89.5	89.5	86.5
7-1/2	90.2	91.0	88.5
10	91.7	91.7	89.5
15	91.7	93.0	90.2
20	92.4	93.0	91.0
25	93.0	93.6	91.7
30	93.6	94.1	91.7
40	94.1	94.1	92.4
50	94.1	94.5	93.0
60	94.5	95.0	93.6
75	94.5	95.0	93.6
100	95.0	95.4	93.6
125	95.0	95.4	94.1
150	95.4	95.8	94.1
200	95.4	95.8	95.0

Table 2

Full Load Nominal Motor Efficiency by Motor Size and Speed

(Totally Enclosed Fan-Cooled)
Nominal Motor Speed

MOTOR HP	1200 RPM	1800 RPM	3600 RPM
1	82.5	85.5	77.0
1-1/2	87.5	86.5	84.0
2	88.5	86.5	85.5
3	89.5	89.5	86.5
5	89.5	89.5	88.5
7-1/2	91.0	91.7	89.5
10	91.0	91.7	90.2
15	91.7	92.4	91.0
20	91.7	93.0	91.0
25	93.0	93.6	91.7
30	93.0	93.6	91.7
40	94.1	94.1	92.4
50	94.1	94.5	93.0

2.2 SINGLE PHASE, SINGLE SPEED MOTORS

- A. Use NEMA rated 115 volt, single phase, 60 hertz motors for motors 1/3 HP and smaller.
- B. Use permanent split capacitor or capacitor start, induction run motors equipped with permanently lubricated and sealed ball or sleeve bearings and Class A insulation. Service factor to be not less than 1.35.

2.3 MOTORS USED ON VARIABLE FREQUENCY DRIVES

- A. In addition to requirements specified above, motor must be suitable for use with drive specified in Section 23 05 14 – Variable Frequency Drives, including but not limited to motor cooling.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Mount motors on a rigid base designed to accept a motor, using shims if required under each mounting foot to get a secure installation.
- B. When motor will be flexible coupled to driven device, mount coupling to shafts in accordance with coupling manufacturer's recommendations.
- C. Using a dial indicator, check angular misalignment of two shafts; adjust motor position as necessary so that angular misalignment of shafts does not exceed 0.002 inches per inch diameter of coupling hub.

- D. Using dial indicator, check shaft for run-out to assure concentricity of shafts; adjust as necessary so that run-out does not exceed 0.002 inch.
- E. When motor will be connected to driven device by means of a belt drive, mount sheaves on appropriate shafts in accordance with manufacturer's instructions.
- F. Use a straight edge to check alignment of sheaves; reposition sheaves as necessary so that straight edge contacts both sheave faces squarely.
- G. After sheaves are aligned, loosen adjustable motor base so that belt(s) can be added and tighten base so that belt tension is in accordance with drive manufacturer's recommendations.
- H. Frequently re-check belt tension and adjust if necessary during first day of operation and again after 80 hours of operation.
- I. Verify proper rotation of each three-phase motor as it is being wired or before motor is energized for any reason.
- J. Lubricate motors requiring lubrication. Record lubrication material used and frequency of use. Include this information in maintenance manuals.

END OF SECTION

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SECTION 23 05 14

VARIABLE FREQUENCY DRIVES

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes
 - 1. Variable frequency drives.
 - 2. Bypass starters.

- B. Related Sections
 - 1. Applicable provisions of Division 01 shall govern all work under this Section.
 - 2. Section 23 05 00 – Basic HVAC Requirements.
 - 3. Section 23 05 15 – Motor Requirements for HVAC.
 - 4. Section 23 21 23 - Hydronic Pumps.
 - 5. Section 23 34 00 - HVAC Fans.
 - 6. Section 23 73 13 - Modular Indoor Central-Station Air-Handling Units.
 - 7. Division 26 – Electrical: Grounding and Bonding for Electrical Systems.
 - 8. Division 26 – Electrical: Identification for Electrical Systems.
 - 9. Division 26 – Electrical: Equipment Wiring Systems.

1.2 REFERENCES

- A. American National Standards Institute (ANSI)
 - 1. ANSI 37.90A

- B. Institute of Electrical and Electronic Engineers (IEEE)
 - 1. IEEE 519 - Guide for Harmonic Control and Reactive Compensation of Static Power Converters.

1.3 SUBMITTALS

- A. Division 01 - Submittal Procedures: Shop drawings, product data, and samples.

- B. Submit physical, electrical, and performance characteristics of each variable frequency drive and associated components, including:
 - 1. Dimensions.
 - 2. Weight.
 - 3. Input and Output Performance.
 - 4. Voltage.
 - 5. Phase.
 - 6. Current and Over-Current Characteristics.
 - 7. Installation Instructions.

8. Protective Features.
9. Wiring and Block Diagrams Indicating Specified Options.
10. Electrical Noise Attenuation Equipment.
11. Line Side Voltage Notch Wave Form and Line Side Current Harmonics.
12. Certified Efficiency Versus Load and Speed Curves.
13. Operating Environment.

C. Operating and Maintenance Instructions:

1. Submit operation and maintenance data under provisions of Division 01.
2. Instructions to include recommended maintenance procedures, maintenance schedules, recommended spare parts list, and vendor name for those parts.

1.4 EQUIPMENT STARTUP AND AGENCY TRAINING

- A. Provide services of a factory trained and certified technician to approve installation; start-up, test, and adjust for proper operation; and instruct and train Owner's personnel in operation and maintenance of unit(s).
- B. Upon completion of equipment startup, submit a complete manufacturer's field report, including startup and test log, signed by factory trained technician.
- C. Coordinate with Temperature Control Contractor and Balancing Contractor.
- D. Startup shall be coordinated with Division 26 - Electrical and shall be completed within ten (10) working days from startup date as set by Owner's Representative.

1.5 WARRANTY

- A. Warranty shall be for a period of twenty-four (24) months from date of project Substantial Completion.
- B. Warranty shall also include all parts, labor, travel time, administrative costs, overhead, travel expenses, technical support, and any and all other costs to provide warranty service.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Variable Frequency Drives:
 1. The ABB Group.
 2. Toshiba TEC Corporation
 3. Danfoss Corporation.
 4. General Electric Company, GE Fuji Drives.
 5. Safronics, Inc.
 6. Yaskawa Electric America.

7. Substitutions: In accordance with Division 01 – General Requirements.

2.2 DESIGN AND CONSTRUCTION

- A. Units shall be variable torque, modular design for control of motors as specified in Division 23 – Heating, Ventilating and Air Conditioning and rated at motor full load nameplate amps. Motors in HVAC equipment shall be compatible for use with AFD applications.
- B. Unit shall be UL listed, solid state, micro processor-based with a pulse width modulated (PWM) output wave form. Other types are not acceptable.
- C. VFD shall employ a full wave bridge rectifier and capacitors to minimize ripple of rectified voltage to maintain near constant DC voltage. Employ insulated gate bipolar transistors (IGBT's) as output switching device.
- D. VFD package shall contain equivalent of 5 percent impedance to reduce harmonic distortion. Provide 5 percent equivalent impedance in form of a DC bus choke, an input AC line reactor in each phase, or a combination of these two methods.
- E. Control circuitry shall be plug-in, plug-out modular basis with a corrosion resistant coating on printed circuit boards.
- F. Units to be suitable for an operating environment from 0 degrees C to 40 degrees C temperature and humidity up to 90 percent non-condensing.
- G. Electrically and physically isolate control circuitry and conductors from power circuitry and power conductors. Control conductors and power conductors shall not be run in same pathway.
- H. Unit enclosure shall be NEMA 12 as required for application minimum and components shall be fully factory assembled and tested prior to leaving manufacturing facility.
- I. Include the following operating and monitoring devices mounted on front cover:
 - 1. Disconnect switch or circuit breaker to de-energize both drive and bypass circuit with door interlocked handle and lock-open padlocking provisions.
 - 2. Operating mode selector switch marked "hand-off-auto".
 - 3. Manual speed adjustment via keypad, mounted on door.
 - 4. Manual bypass selector switch to select power through drive or bypass, if a bypass is provided.
- J. Provide manual bypass circuit and bypass starter to transfer from variable frequency drive operation to bypass operation, if bypass is provided.

2.3 PERFORMANCE REQUIREMENTS

- A. Units shall be suitable for input power of electrical system as scheduled on Drawings plus or minus 10 percent, 3-phase, 60 Hertz nominal.
- B. Use current limiting control device to limit output current to 110 percent continuous for one minute; also reference Protection Features in this section.
- C. Full load output current available from drive shall not be less than motor nameplate amperage.
- D. Full load amp rating of VFD shall not be less than values indicated in NEC Table 430-150.
- E. Output power shall be suitable for driving standard NEMA B design, three-phase alternating current induction motors at full rated speed with capability of 6:1 turndown.
- F. Additional performance capabilities to include the following:
 - 1. Ride through a momentary power outage of 15 cycles
 - 2. Start into a rotating load without damage to drive components or motor
 - 3. Capable of automatic restart into a rotating load after a preset, adjustable time delay following a power outage
 - 4. Input power factor: Min 0.95 throughout the speed range
 - 5. Minimum efficiency: 95 percent at 100 percent speed, 85 percent at 50 percent speed.

2.4 CONTROL FEATURES

- A. Use control circuits compatible with input signal from temperature control system in automatic mode and from manual speed control in manual mode.
- B. Vary motor speed in response to input control signal. Include components necessary to accept signal from temperature control system in form that it is sent. Reference Division 23 – Heating, Ventilating and Air Conditioning.
- C. Include the following additional control features:
 - 1. Hand-Off-Automatic (HOA) selector switch to select local or remote start/stop and speed control.
 - 2. Analog input, selectable 0-10v or 4-20 mA, for automatic control from temperature control system.
 - 3. Local speed control at VFD.
 - 4. Adjustable acceleration and deceleration rate so that time period from start to full speed and from full speed to stop can be field adjusted.
 - 5. Adjustable minimum and maximum speed settings for both automatic and manual modes of operation.
 - 6. Manual transfer bypass circuit.
 - 7. Field adjustment of minimum and maximum output frequency.

8. Two (2) sets of programmable form "C" contacts for remote indication of variable frequency drive condition. Note: default programming to be set for "Drive Run & Fault".
 9. Illuminated display keypad.
 10. External Fault indicator.
 11. One (1) input for a N.O. dry contact type input for a 2-wire remote start/stop.
 12. One (1) input for a N.C. dry contact type input for external faults: (freezestats, fire alarm, smokes). This input shall be factory wired to prevent both VFD and bypass starter operation when external fault is present.
 13. One (1) N.O. dry contact output for proving motor status. This output shall be programmed to detect belt or coupling break that would remove load from motor. Dry contact will open on loss of load or VFD being off.
- D. VFD controller shall convert VFD information into BACnet protocol that will be compatible with building direct digital energy management system (EMS) supplied on project.
- E. Output shall be through an RS-232 or RS-485 serial interface port or Ethernet port capable of two-way communication with building EMS.
- F. Final connection shall not require any additional intermediate gateway devices to provide throughput of data. The following data shall be provided at a minimum:
1. Fault condition.
 2. Speed.
 3. Amperage.
 4. Frequency.
 5. Voltage.
 6. Bypass status (if supplied).

2.5 PROTECTION FEATURES

- A. Use electronic protection circuitry in power circuits to provide an orderly shutdown of drive without blowing fuses or tripping circuit breakers and prevent component loss under the following abnormal conditions:
1. Activation of any safety device.
 2. Instantaneous over-current and/or over voltage of output.
 3. Power line over-voltage and under-voltage protection.
 4. Phase loss.
 5. Single and three phase short circuiting.
 6. Ground faults.
 7. Control circuit malfunction.
 8. Over-temperature.
 9. Output current over limit.

- B. Provide the following additional protective features:
 1. Input transient over-voltage protection up to 3000 volts per ANSI 37.90A.
 2. DC bus fusing or other electronic controls which limit rate of rise of DC bus current and de-energizes drive at a predetermined current level.
 3. Fusing for control circuit transformer.
 4. Grounded control chassis.
 5. Devices and control circuitry to ensure that variable frequency drive and bypass starter are not both energized and driving motor simultaneously.

2.6 DIAGNOSTICS

- A. Provide an English character display, with no error codes, with indicators for the following:
 1. Phase loss.
 2. Ground fault.
 3. Over-current.
 4. Over-voltage.
 5. Under-voltage.
 6. Over temperature.
 7. Overload.
 8. DC bus status.

2.7 QUALITY ASSURANCE TESTS

- A. Use a factory heat stress test to verify proper operation of all functions and components under full load.
- B. Field performance test of variable frequency drives to determine compliance with this specification will be performed at Engineer's discretion and may include any specified feature, including operation of protective devices through a simulated fault.
- C. Contractor will pay for initial testing. Should drive be found deficient by this testing, drive manufacturer will be required to make any and all changes necessary to bring unit(s) into compliance with specified performance and demonstrate this performance by retesting. Cost of changes and retest will be by Contractor.
- D. Variable frequency drive manufacturer or designated representative to perform field test of each drive, in presence of Owner's Representative, for the following items:
 1. Provide general inspection to verify proper installation.
 2. Demonstrate drive reaction to simulated power interruptions of two seconds and sixty seconds.
 3. Demonstrate adequate protection during switching from variable frequency drive operation to bypass starter operation and back again.

2.8 BYPASS EQUIPMENT

- A. Bypass Starters:
 1. Bypass starters for 208 volt motors, 20 HP and less; and 480 volt motors, 40 HP and less, shall be across-the-line magnetic starter type.
 2. Bypass starters for 208 volt motors, 25 HP and more; and 480 volt motors, 50 HP and more, shall be solid state reduced voltage starting type.

- B. Bypass Configuration:
 1. Provide one main disconnect switch or circuit breaker to de-energize both drive and bypass circuit.
 2. Provide a drive input disconnect switch or fuse block to allow drive to be isolated while bypass circuit is energized.
 3. Provide one output drive contactor and one output bypass contactor.
 4. Two output contactors shall be electrically interlocked to allow only one contactor to be closed at any one time.
 5. Provide motor overload protection in bypass circuit.
 6. Provide bypass equipment in a common enclosure with VFD or, if not available, in a separate enclosure.

2.9 OUTPUT LINE FILTER

- A. Provide three-phase dV/dT output filter for any 460 VAC drive with output line length of over 120 feet or as specified.

PART 3 EXECUTION

3.1 VARIABLE FREQUENCY DRIVES

- A. Install where indicated on Drawings and in accordance with approved submittals and manufacturer's published recommendations.
- B. Installation shall be performed by Division 26 – Electrical Contractor.
- C. Input power wiring shall be installed in a separate conduit, output power wiring shall be installed in a separate conduit, and control wiring shall be installed in a separate conduit.
- D. Do not mix input power, output power, or control wiring in a common conduit.
- E. Power wiring shall be furnished and installed by Division 26 - Electrical Contractor. If provided, do not mount output line filter above drive.
- F. Control signal for drive will be provided under Division 23 – Heating, Ventilating and Air Conditioning.
- G. Temperature Control Contractor shall furnish and install required temperature control wiring in metal conduit and in accordance with Division 26 – Electrical.

END OF SECTION

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SECTION 23 05 15

PIPING SPECIALTIES

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes
 - 1. HVAC piping specialties for piping systems.
- B. Related Sections
 - 1. Applicable provisions of Division 01 shall govern all work under this Section.
 - 2. Section 23 05 00 – Basic HVAC Requirements.
 - 3. Section 23 21 13 - Hydronic Piping.
 - 4. Section 23 24 00 - Internal-Combustion Engine Piping.
 - 5. Section 23 83 16 - Radiant-Heating Hydronic Piping.
 - 6. Section 23 05 23 - General-Duty Valves for HVAC Piping.
 - 7. Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.
 - 8. Section 23 07 00 - HVAC Insulation.

1.2 REFERENCES

- A. American Society of Mechanical Engineers (ASME)
 - 1. ASME B31.1 – Power Piping.
- B. ASTM International
 - 1. ASTM A53 – Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
 - 2. ASTM B650 – Specification for Electrodeposited Engineering Chromium Coatings on Ferrous Substrates.

1.3 SUBMITTALS

- A. Division 01 - Submittal Procedures: Requirements for submittals.
- B. Required for all items in this section and shall include materials of construction, dimensional data, ratings, capacities, ranges, pressure drop data where appropriate, and identification as referenced in this section and on Drawings.

1.4 QUALITY ASSURANCE

- A. Division 01: Requirements for submittals.

1.5 DESIGN CRITERIA

- A. All piping specialties are to be rated for highest pressures and temperatures in respective system in accordance with ASME B31.1, but not less than 125 psig unless specifically indicated otherwise.

PART 2 PRODUCTS

2.1 THERMOMETERS

- A. Manufacturers:
 - 1. Ashcroft.
 - 2. Marsh.
 - 3. Taylor
 - 4. H. O. Trerice.
 - 5. U. S. Gauge.
 - 6. Weiss.
 - 7. Weksler.
 - 8. Substitutions: In accordance with Division 01 – General Requirements.

- B. Stem Type, cast aluminum case, 9-inch scale, clear acrylic window. adjustable angle brass stem with stem of sufficient length so end of stem is near middle of pipe without reducing thickness of any insulation, red indicating fluid, black lettering against white background, with scale ranges as follows:

<u>Service</u>	<u>Scale Range, Degrees °F</u>	<u>Min. Increment, Degrees °F</u>
Hot Water	30 - 240	2
Glycol Water	30 - 130	2

2.2 THERMOMETER SOCKETS

- A. Brass with threaded connections suitable for thermometer stems and temperature control sensing elements in pipeline.
- B. Furnish with extension necks for insulated piping systems.

2.3 TEST WELLS

- A. Similar to thermometer sockets except with brass cap that thread into inside of test well to prevent dirt from accumulating.
- B. Secure cap to body with a short chain.
- C. Furnish with extension necks, where appropriate, to accommodate pipeline insulation.

2.4 P/T (PRESSURE/TEMPERATURE) TEST PLUGS

- A. Brass plug with 1/4-inch NPT threads, EPDM or neoprene valve core, knurled cap with cap strap.
- B. Use extended length plugs to clear insulated piping.
- C. Adaptors shall have 1/4-inch FPT connection for standard pressure gauges.
- D. Manufacturers:
 - 1. Pete's Plugs.
 - 2. Fairfax.
 - 3. Substitutions: In accordance with Division 01 – General Requirements.

2.5 PRESSURE GAUGES

- A. Manufacturers:
 - 1. Ametek/U. S. Gauge Division.
 - 2. Ashcroft.
 - 3. Marsh.
 - 4. Taylor.
 - 5. H. O. Trerice.
 - 6. Weiss.
 - 7. Weksler.
 - 8. Substitutions: In accordance with Division 01 – General Requirements.
- B. Cast aluminum case of not less than 4-1/2 inches in diameter, double strength glass window, black lettering on white background, phosphor bronze bourdon tube with bronze bushings, recalibration from front of dial, 99 percent accuracy over middle half of scale, 98.5 percent accuracy over remainder of scale, with scale range as follows:

<u>Service</u>	<u>Scale Range, psig</u>	<u>Min. Increment, psig</u>
Hot Water	0 - 100	1
Glycol Water	0 - 100	1

- C. Pressure Snubbers:
 - 1. Bronze construction, suitable for system working pressure, 1/4-inch size.
- D. Coil Siphons
 - 1. Bronze or steel construction, suitable for system working pressure, 1/4-inch size.
- E. Gauge Valves:
 - 1. Use valves as specified in Section 23 05 23 - General-Duty Valves for HVAC Piping.
 - a. For water systems, use 1/4-inch ball valves.

- b. For steam systems, use 1/4-inch gate valves suitable for system working pressure.

2.6 EXPANSION COMPENSATORS

- A. Manufacturers:
 - 1. MetraFlex HP Series
 - 2. Vibrations Mountings and Controls.
 - 3. Hyspan.
 - 4. Flexonics Model H or HP.
 - 5. Substitutions: In accordance with Division 01 – General Requirements.
- B. Constructed of two ply stainless steel bellows with carbon steel shrouds, carbon steel threaded or flanged end fittings or copper solder joint fittings, internal guides for full length of bellows travel, and positive internal anti-torque device to prevent twist or torque during installation.
- C. Units to be rated at 150 psi at not less than 400 degrees F.

2.7 STRAINERS

- A. Manufacturers:
 - 1. Armstrong.
 - 2. Hoffman.
 - 3. Illinois.
 - 4. Keckley.
 - 5. Metraflex.
 - 6. Mueller Steam.
 - 7. Sarco.
 - 8. Substitutions: In accordance with Division 01 – General Requirements.
- B. Water Systems:
 - 1. Y type, cast iron body; stainless steel screens; bolted or threaded screen retainer tapped for a blowoff valve; threaded body in sizes through 2-inch and rated at not less than 175 psi WOG; flanged body in sizes over 2-inch and rated at not less than 125 psi WOG at 240 degrees F.
 - 2. Screen to be 20 mesh for line sizes 2-inch and less, 0.125-inch perforations for line sizes 2-1/2-inch through 4-inch, and 0.25-inch perforations for line sizes 5-inch and larger.
- C. Basket Type:
 - 1. Cast iron body with clamped cover.
 - 2. Stainless steel screens.
 - 3. Body tapped for blowoff valve; 125 psig flanged body for 2 1/2-inch and larger; 0.125-inch perforations for line sizes 2-1/2-inch through 4-inch, and 0.25-inch perforations for line sizes 5-inch and larger.

- D. Water Systems with Design Pressures over 150 psig:
 - 1. Y type; cast iron or cast steel body.
 - 2. Stainless steel screens.
 - 3. Bolted or threaded screen retainer tapped for blowoff valve; threaded or socket weld body in sizes through 2-inch and rated at not less than 300 psi WOG at 150 degrees F; flanged or butt weld body in sizes over 2-inch and rated at not less than 300 psi WOG at 150 degrees F.
 - 4. Screen perforations to be 0.057-inch for line sizes 2-inch and less, 0.125-inch for line sizes 2-1/2-inch through 4-inch, and 0.25-inch for line sizes 5-inch and larger.

2.8 CENTRIFUGAL SEPARATORS

- A. Centrifugal vortex type separator constructed of carbon steel and furnished with flanged inlet and outlet, collection chamber that is openable for inspection or cleaning, flanged separator section to allow interior inspection or cleaning, flanged collection chamber outlet for removing collected material, relief line from venturi chamber to collection chamber to improve solids collection, 1/2-inch gauge connections in main inlet and outlet connections, and suitable for an operating pressure of not less than 125 psig.
- B. Assembly to be capable of removing 98 percent by weight of all particles 75-microns or larger and having a specific gravity of at least 1.8.
- C. Furnish with a purge assembly consisting of motorized ball valve and a controller suitable for 120-volt operation and mounting independently near valve.
- D. Ball valve to be suitable for 125 psig operation at 100 degrees F.
- E. Controller to allow setting of purge time between 15 seconds and 30 minutes with frequencies between one minute and 16 hours.
- F. Include controls to allow automatic operation, manual operation, or de-energizing controller.
- G. Manufacturers:
 - 1. Lakos
 - 2. Alfa Laval
 - 3. Westfalia
 - 4. Substitutions: In accordance with Division 01 – General Requirements.

2.9 EXPANSION TANKS

- A. Manufacturers:
 - 1. Bell and Gossett.
 - 2. Taco.
 - 3. Amtrol/Thrush.
 - 4. Armstrong Pumps.

5. Wessels.
6. Substitutions: In accordance with Division 01 – General Requirements.

B. Bladder Type:

1. Steel construction, tested and stamped in accordance with Section 8D of ASME Code and furnished with National Board Form U-1, rated for not less than 125 psig working pressure, precharged with air to initial fill pressure indicated on Drawings, butyl diaphragm suitable for fluid temperatures to 220 degrees F, and furnished with tank drain connection, system connection, mounting saddles for horizontal installation or base for vertical installation, prime coated, size/capacity as indicated on Drawings.
2. Tank and bladder construction must allow field replacement of bladder on its failure.

2.10 AIR SEPARATORS

A. Manufacturers:

1. Bell and Gossett.
2. Amtrol/Thrush.
3. Armstrong Pumps.
4. Taco.
5. Substitutions: In accordance with Division 01 – General Requirements.

B. 1-1/2-inch and Smaller:

1. Cast iron construction, suitable for in-line installation.
2. Top and bottom connections for use with expansion tanks specified above, rated at not less than 125 psig at 220 degrees F.

C. 2-inch and Larger:

1. Welded steel construction.
2. ASME constructed and stamped for a working pressure not less than 125 psig at 220 degrees F, threaded or flanged connections for 2 inch size, flanged or grooved connections if grooved piping is allowed for all sizes over 2-inch, suitable for use with expansion tanks specified above, drain connection at bottom of unit, vent/tank connection at top of unit, suitable for system flow rates as indicated on Drawings.

D. Include stainless steel strainer with provisions in unit shell for strainer removal.

E. Provide blow-down connection located so that inside surface of strainer can be cleaned by draining system fluid through blowdown connection.

2.11 AIR VENTS

- A. Manual Key Type Vents: Bronze body with nonferrous internal parts, screwdriver operated, designed to relieve air from system when vent is opened, rated at not less than 125 psig at 220 degrees F;

1. Bell and Gossett Model 4V.
 2. Eaton/Dole Model 9, 9B, or 14A.
 3. Substitutions: In accordance with Division 01 – General Requirements.
- B. Manual Ball Valve Vents:
1. Provide 1/4-inch ball valves for manual venting of air handling unit coils and where indicated elsewhere on Drawings and details.
 2. Reference specification Section 23 05 23 – General Duty Valves for HVAC Piping.
- C. Automatic Vents: Cast iron body with nonferrous internal parts, designed to vent air automatically with float principle without allowing air to enter system, rated at not less than 125 psig at 220 degrees F.
1. Amtrol/Thrush Model 720.
 2. Bell and Gossett Model 107.
 3. Watson McDaniel Model 830.
 4. Substitutions: In accordance with Division 01 – General Requirements.

2.12 SUCTION DIFFUSERS

- A. Suction Diffusers: Design to replace suction line strainer and long entrance pipe at a pump suction; constructed with strainer blow down connection, provisions for field supplied support foot, and bolted flange for strainer removal and cleaning; rated at not less than 125 psi working pressure at not less than 250 degrees F.
1. Manufacturers:
 - a. Amtrol/Thrush.
 - b. Armstrong Pumps
 - c. Bell and Gossett.
 - d. Taco.
 - e. Substitutions: In accordance with Division 01 – General Requirements.
- B. Closed Systems:
1. Body constructed of cast iron, ductile iron or carbon steel; cast iron or steel straightening vanes; steel, galvanized steel or stainless steel strainer; brass or bronze fine mesh startup strainer, strainer blow down connection, inlet pressure gauge connection, provisions for a field supplied support foot, and bolted flange for strainer removal and cleaning; rated at not less than 125 psi working pressure at not less than 250 degrees F.
- C. Open Systems:
1. Body constructed of cast iron, ductile iron or carbon steel; cast iron, steel or stainless steel straightening vanes; galvanized steel or stainless steel strainer; strainer blow down connection, inlet pressure gauge connection, provisions for field supplied support foot, and bolted flange for strainer removal and cleaning; rated at not less than 125 psi working pressure at not less than 250 degrees F.

2.13 VACUUM BREAKERS

- A. Where vacuum breakers are not furnished integral with equipment by equipment manufacturer, provide 15-degree swing check valve.
- B. Reference Section 23 05 23 - General-Duty Valves for HVAC Piping.

2.14 FLOW SENSING DEVICES

- A. For water flow sensing devices 2-inch and smaller, use balance valves as specified in Section 23 05 23 - General-Duty Valves for HVAC Piping.
- B. Pitot Tube Flow Sensors – Type 1:
 - 1. Manufacturer:
 - a. Dieterich Standard/Annubar.
 - b. Preso.
 - c. Substitutions: In accordance with Division 01 – General Requirements.
 - 2. Multi-port averaging type flow sensor designed to sense velocity of fluid flowing in pipe and produce pressure output that is proportional to fluid velocity.
 - 3. Sensor to consist of a type 316 stainless steel probe with a diamond or elliptical shape of sufficient length to sense flow completely across pipe section and to accommodate insulation specified for pipeline; brass body gate, needle, or ball instrument connection valves with appropriate fitting for connection to a meter
 - a. Single forged steel weld type installation fitting for pipe sizes through 6-inch, double forged steel weld type installation fittings for use on opposite ends of sensor for larger pipe sizes if recommended by manufacturer for application.
 - 4. Accurate within 2 percent of actual flow with a turndown ratio of 10:1 or better; permanently stamped nameplate attached to sensor indicating flow/differential pressure characteristics of sensor; suitable for use on systems to 150 psig at 250 degrees F.

2.15 DIFFERENTIAL PRESSURE GAUGE

- A. Manufacturer:
 - 1. Barton 247A.
 - 2. Midwest 809.
 - 3. Substitutions: In accordance with Division 01 – General Requirements.
- B. Bellows Type, differential pressure meter kit that includes 6-inch diameter gauge with 270-degree arc having an accuracy of ± 1 percent of full scale or better and suitable for differential pressures of flow meters supplied for this project, over range protection on meter, color coded hoses not less than ten feet in length with brass connectors suitable for connection to low and high pressure connections on balance valves, inline strainers,

instrument valving so meter can be vented and drained, pressure and temperature rating at least equal to that of valves.

- C. Provide meter and all accessories in a durable case with carrying handle.

2.16 COLD WATER METERS

- A. Bronze body, minimum 3/4-inch NPT ends, positive displacement disc type meter with built-in strainer, magnetic drive, and thermoplastic disc/register gearing.
- B. Meters shall meet AWWA C700.
- C. Sealed register shall be odometer type totalization display having 10,000,000 gallon capacity.
- D. Register shall also have 360-degree sweep hand with 10 gallon range and 0.1 per gallon increments.
- E. Meters shall be suitable for 150 psig pressure at 80 degrees F.
 - 1. Manufacturer:
 - a. Badger Recordall Disc Meter.
 - b. Carlon Meter Co.
 - c. Neptune.
 - d. Hersey.
 - e. Venture Measurement Niagara.
 - f. Substitutions: In accordance with Division 01 – General Requirements.

PART 3 EXECUTION

3.1 THERMOMETERS

- A. Stem Type: Install in piping systems as indicated on Drawings and details using separable socket in each location.
- B. Dial Type for Air Temperature Measurement:
 - 1. Install in ductwork where detailed or specified.
 - 2. Support capillary inside duct so it measures a uniform sample of air.
 - 3. Mount readout so it is readily visible on portion of ductwork that is not externally insulated or on a sheet metal angle support secured to a nearby structural element.
- C. Thermometers shall be readable by person standing on floor.
- D. Provide thermometers on inlet and outlet piping from boilers, chillers, heat exchangers, and central air handling unit coils.

3.2 THERMOMETER SOCKETS

- A. Install at each point where thermometer or temperature control sensing element is located in pipeline.

3.3 TEST WELLS

- A. Install in piping systems as indicated on Drawings and details wherever provisions are needed for inserting a thermometer at a later date.

3.4 P/T (PRESSURE/TEMPERATURE) TEST PLUGS

- A. Install in piping systems as indicated on Drawings and details.
- B. Do not insulate over test plugs.

3.5 PRESSURE GAUGES

- A. Install in locations where indicated on Drawings and details, including any gauge piping, with scale range appropriate to system operating pressures.
- B. Pressure gauges shall be readable by person standing on floor.
- C. Pressure Snubbers: Install in gauge piping for all gauges used on water services.
- D. Coil Siphons: Install in gauge piping for all gauges used on steam services.
- E. Gauge Valves: Install at each gauge location as close to main as possible and at each location where a gauge tapping is indicated.

3.6 EXPANSION LOOPS

- A. Install where indicated on Drawings or details, locating anchors and guides as detailed.

3.7 EXPANSION COMPENSATORS

- A. Install where indicated on Drawings or details, locating anchors and guides as detailed.

3.8 STRAINERS

- A. Install all strainers where indicated on Drawings, allowing sufficient space for screens to be removed.
- B. Rotate screen retainer where required by installation so blow down can remove accumulated dirt from strainer body.
- C. Water Systems: Install ball valve for blow down in tapped screen retainer; valve to be same size as tapping.

- D. Reference Section 23 05 23 – General Duty Valves for HVAC Piping.

3.9 CENTRIFUGAL SEPARATORS

- A. Install centrifugal separator in bypass arrangement around secondary chilled water system pumps where indicated on Drawings.
- B. Allow sufficient clearance at top of unit for head removal and cleaning.
- C. Support stand with angle iron and other structural support members.
- D. Install shutoff valve upstream and downstream of separator.
- E. Install pressure gauge with gauge valves, piped so pressure differential across separator can be read.
- F. Install motorized drain valve in collection chamber outlet downstream of manual shutoff valve, extend piping to adjacent floor drain.
- G. Controller will be installed under temperature control specification section.

3.10 EXPANSION TANKS

- A. Install tanks where indicated on Drawings, coordinating concrete base installation with Contractor or fabricating steel supports to suit application.
- B. Install all specified tank accessories.
- C. Bladder Tanks:
 1. Verify proper air charge and recharge as needed.
 2. Install isolation valve in piping connecting tank to system.
 3. In piping between tank and isolation valve, install pressure gauge and drain valve with hose adapter.
 4. Install drain valve with hose adapter in drain connection of tank.
 5. Make sure that all drains are accessible and hose can be attached.

3.11 AIR SEPARATORS

- A. Mount in hot and chilled water lines as indicated on Drawings and details.
- B. Install ball valve with hose adapter in bottom blow down connection.
- C. Open drain valve and blow down strainer after system cleaning and again after 30 days of operation.

3.12 AIR VENTS

- A. Manual Key Type Vents:
 1. Install at all high points where air may collect and not be carried by system fluid.
 2. Use soft Type L copper "pigtail" so vent can be positioned for venting and collecting any water that might escape.
- B. Manual Ball Valve Vents:
 1. Install on air handling coils and where indicated elsewhere as shown on Drawings and details.
- C. Automatic Vents:
 1. Install on top of air separators on systems using bladder type expansion tanks.
 2. Install at other locations as indicated on Drawings and details.
 3. All locations to have ball valve installed upstream of vent for maintenance purposes.

3.13 SUCTION DIFFUSERS

- A. Install at each pump suction connection for end suction pumps where shown.
- B. Provide sufficient space for removal of strainer.
- C. Install a capped drain valve in blow down connection.
- D. Install support below suction diffuser so weight of suction piping does not rest on pump suction connection.
- E. Install pressure gauge across suction diffuser, valved so that single gauge can be used to read inlet and outlet pressure across strainer.
- F. Use gauge valves as specified with gauges.
- G. Gauge can be same one used to read pressures across pump. Select gauge range appropriate to system pressures.
- H. Open drain valve and blow down strainer after system cleaning and again after 30 days of operation.
- I. If unit is furnished with fine mesh startup strainer, remove this strainer after system has been flushed and cleaned.

3.14 VACUUM BREAKERS

- A. Install on steam heating coils, steam-to-water heat exchangers, and elsewhere as indicated on Drawings and details.

3.15 FLOW SENSING DEVICES

- A. Provide portable meter to Owner at completion of all balancing work.
- B. Pitot Tube Flow Sensors:
 - 1. Install where indicated on Drawings and details for flow sensing in hydronic and/or steam piping systems.
 - 2. Butterfly valves installed at location of flow sensing device are to have memory stop.

3.16 DIFFERENTIAL PRESSURE GAUGE

- A. Handle as loose and detachable part as outlined in Division 01 – General Requirements.

3.17 WATER METERS

- A. Install water meters on makeup water line to hot water and chilled water systems ahead of water pressure reducing valve.

END OF SECTION

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SECTION 23 05 23

GENERAL-DUTY VALVES FOR HVAC PIPING

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Water system valves.
- B. Related Sections:
 - 1. Applicable provisions of Division 01 shall govern Work under this Section.
 - 2. Section 23 05 00 – Basic HVAC Requirements.
 - 3. Section 23 05 15 - Piping Specialties.
 - 4. Section 23 09 14 - Pneumatic and Electric Instrumentation and Control Devices for HVAC.

1.2 REFERENCES

- A. American Society of Mechanical Engineers (ASME)
 - 1. ASME B16.4 - Gray Iron Threaded Fittings.
- B. ASTM International
 - 1. ASTM A105 - Specification for Carbon Steel Forgings for Piping Applications.
 - 2. ASTM A126 - Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
 - 3. ASTM A216 – Specification for Steel Castings, Carbon, Suitable for Fusion Welding, for High-Temperature Service.
- C. National Fire Protection Association (NFPA)
 - 1. NFPA 30 - Flammable and Combustible Liquids Code.

1.3 SUBMITTALS

- A. Division 01 – General Requirements: Requirements for submittals.
- B. Contractor shall submit a schedule of valves indicating type of service, dimensions, materials of construction, and pressure/temperature ratings for valves used on project. Temperature ratings specified are for continuous operation.

1.4 DESIGN CRITERIA

- A. Where valves are specified for individual mechanical services (such as hot water heating, steam) and valves shall be of same manufacturer unless prior written approval is obtained

from Engineer.

PART 2 PRODUCTS

2.1 WATER SYSTEM VALVES

- A. Water system valves shall be rated at not less than 125 psig water working pressure at 240 degrees F, unless noted otherwise.
- B. Gate Valves:
 - 1. 2-Inch and Smaller: Use ball valves; gate valves will not be accepted in sizes 2-inch and smaller.
 - 2. 2-1/2-Inch and Larger: Use butterfly valves. Gate valves and ball valves will not be accepted in sizes 2-1/2-inch and larger.
- C. Ball Valves:
 - 1. 2-Inch and Smaller: Two piece bronze body; threaded or soldered ends, as appropriate to pipe material; stainless steel or chrome plated brass/bronze ball; conventional port; glass filled teflon seat; threaded packing gland follower; blowout-proof stem; 600 psig WOG.
 - 2. Valve stems shall allow operators to clear insulation without interference. Provide stem extensions when valve operators interfere with pipe insulation.
 - 3. Manufacturers:
 - a. Apollo 70-100/200 Series.
 - b. Hammond 8301/8311.
 - c. Milwaukee BA100/150.
 - d. Nibco T/S 585-70.
 - e. Stockham S206/216.
 - f. Substitutions: In accordance with Division 01 – General Requirements.
- D. Butterfly Valves:
 - 1. 2-Inch and Smaller: Use ball valves; butterfly valves will not be accepted in sizes 2-inch and smaller.
 - 2. 2-1/2-Inch and Larger: Cast iron body; stainless steel shaft; Teflon, nylatron, or acetal bearings; EPDM resilient seat. Disk to be bronze, aluminum-bronze, nickel-plated ductile iron, cast iron with welded nickel edge, or stainless steel. Pressure rated to 150 psig. Valve assembly to be bi-directionally bubble tight to 150 psig with no downstream flange or pipe attached. Polymid or polyamide coated valves are not acceptable.
 - 3. Valve stems shall allow operators to clear insulation without interference. Provide stem extensions when valve operators interfere with pipe insulation.
 - 4. Use threaded lug type valves for installation with class 125/150 flanges.
 - 5. Manufacturers:
 - a. Centerline Series 200.

- b. DeZurik BGS II.
 - c. Keystone Fig. 222.
 - d. Nibco LD2000 (2-1/2 - 12-inch)/LD1000 (14-inch and above)
 - e. Victaulic 300 series (2-1/2 – 12-inch)/709 series (14 – 24-inch).
 - f. Substitutions: In accordance with Division 01 – General Requirements.
6. Provide ten-position lever actuators for valves 6-inch and smaller. Provide worm gear operators for valves 8-inch and larger.
7. Where butterfly valves are indicated or specified to be installed at location of a flow sensing device, provide butterfly valves with a memory stop.
- E. Globe Valves: Do not use globe valves for water service, except in temperature control applications.
- F. Swing Check Valves:
- 1. 2-Inch and Smaller:
 - a. Class 125, bronze body, threaded or soldered ends, regrindable seat, bronze disc, threaded cap, suitable for installation in a horizontal or vertical line with flow upward.
 - b. Manufacturers:
 - 1) Crane 137/1342.
 - 2) Hammond IB912/IB940.
 - 3) Lunkenheimer 2144/2145.
 - 4) Milwaukee 509/1509.
 - 5) Nibco T-413-B/S-413-B.
 - 6) Powell 578/1825.
 - 7) Stockham B-309/B-319.
 - 8) Substitutions: In accordance with Division 01 – General Requirements.
 - 2. 2-1/2-Inch and Larger:
 - a. Class 125, cast iron body, flanged ends, bronze trim, bolted cap, renewable bronze seat and disc, non-asbestos gasket, suitable for installation in a horizontal or vertical line with flow upward.
 - b. Manufacturers:
 - 1) Crane 373.
 - 2) Hammond IR1124.
 - 3) Lunkenheimer 1790.
 - 4) Milwaukee F2974.
 - 5) Nibco F918.
 - 6) Powell 559.
 - 7) Stockham G-931.
 - 8) Substitutions: In accordance with Division 01 – General Requirements.
- G. Balance Valves:

1. 2-Inch and Smaller:
 - a. Bronze or copper alloy body with calibrated ball, globe or venturi/valve arrangement, integral pointer and calibrated scale to register degree of valve opening, memory stop, drain tapping, threaded or soldered ends, with or without integral unions, P/T or Shraeder pressure taps with integral check valves and seals, adjustable memory stop, suitable for 200 psig water working pressure at 250 degrees F.
2. Manufacturers:
 - a. Armstrong CBV.
 - b. Bell & Gossett Circuit Setter Plus.
 - c. Griswald Quickset.
 - d. Illinois 6000 Series.
 - e. Nexus Orturi.
 - f. Nibco 1710 Series.
 - g. Taco Accu-Flo.
 - h. Tour & Anderson STAS/STAD.
 - i. Victaulic series 786/787.
 - j. Substitutions: In accordance with Division 01 – General Requirements.
3. Include one bellows type differential pressure meter kit that includes a 6-inch diameter gauge with 270-degree arc readout and having accuracy of +/- 1 percent of full scale or better and suitable for differential pressures of valves supplied for this project. Provide over-range protection, color coded hoses not less than ten feet in length with brass connectors suitable for connection to low and high pressure connections on balance valves, instrument valving so meter can be vented and drained, and pressure and temperature rating at least equal to that of valves. Provide meter and accessories in a durable case with carrying handle.
 - a. Manufacturers:
 - 1) Barton 247A.
 - 2) Midwest 809.
 - 3) Substitutions: In accordance with Division 01 – General Requirements.
4. 2-1/2-Inch and Larger:
 - a. Use butterfly valves as specified in this section along with a flow sensing device as specified in Section 23 05 15 – Piping Specialties.
5. 2-1/2 Inch and 3 Inch:
 - a. Bell & Gosset Circuit Setter Model CB;
 - 1) Cast iron body with brass ball, integral pointer and calibrated scale to register degree of valve opening, adjustable memory stop 1/4 inch NPT drain tapping, flanged ends, integral brass pressure taps with check valves and EPT inserts.
 - 2) Valve shall be rated for 175 psig working water pressure at 250 degrees F.
 - b. Nibco Model 737, Globe Style Valve;
 - 1) Cast iron body, with calibrated scale to register degree of valve

- opening, adjustable memory stop, two integral metering test ports with internal check valve and caps.
 - 2) Valve shall be rated for 175 psig working water pressure at 250 degrees F.
 - 6. 4 Inches and Larger (Pipe Line):
 - a. Use butterfly valves as specified in this section along with flow metering device PTFM-1.
 - 7. 4 Inches to 8 Inches (Pump Discharge Only)
 - a. Bell & Gossett Circuit Setter Model CB;
 - 1) Cast iron body and bonnet with bronze seat, replaceable bronze disc with EPDM insert, stainless steel stem, teflon-graphite packing, integral pointer and calibrated scale to register degree of valve opening, adjustable memory stop, flanged ends, integral brass pressure taps with check valves and EPT inserts.
 - 2) Valve shall be rated for 175 psig working water pressure at 250 degrees F.
- H. Drain Valves:
 - 1. Use 3/4-inch ball valve with threaded hose adapter except strainer blow down valves to be same size as blow down connection.
- I. Combination Shut-Off, Check, and Balance Valves:
 - 1. 2-Inch and Larger:
 - a. Cast or ductile iron body, threaded or flanged or grooved end connections, stainless steel spring, bronze disc with EPDM seat, calibrated memory stop, backseating valve stem, inlet and outlet pressure tappings, capable of being repacked under full line pressure, and suitable for a minimum working pressure of 175 psig at 240 degrees F when used in hot water heating systems.
 - b. Manufacturers:
 - 1) Armstrong Flo-Trex.
 - 2) Bell & Gossett Triple Duty.
 - 3) Taco Multi Purpose Valve.
 - 4) Thrush-Amtrol Tri-Flow.
 - 5) Substitutions: In accordance with Division 01 – General Requirements.
- J. Water Pressure-Reducing Valves:
 - 1. Brass or bronze body, diaphragm operated, with an integral anti-siphon check valve, inlet strainer, and adjustable reduced pressure range but pre-set for scheduled pressure, 125 psig at 225 degrees F.
 - 2. Manufacturers:
 - a. Bell & Gossett.
 - b. Cash-Acme.
 - c. Watts.
 - d. Substitutions: In accordance with Division 01 – General Requirements.

- K. Water Relief Valves:
 - 1. Iron or bronze body, direct pressure actuated, teflon seat, stainless steel stem and spring, suitable for 125 psig water working pressure at 240 degrees F and ASME stamped, with Btu capacity and set point as scheduled.
 - 2. Manufacturers:
 - a. Bell & Gossett.
 - b. Cash-Acme.
 - c. Consolidated.
 - d. Kunkle.
 - e. Watts.
 - f. Substitutions: In accordance with Division 01 – General Requirements.

PART 3 EXECUTION

3.1 GENERAL

- A. Properly align piping before installation of valves in an upright position; operators installed below valves will not be accepted.
- B. Install valves in strict accordance with valve manufacturer's installation recommendations. Do not support weight of piping system on valve ends.
- C. Install temperature control valves.
- D. Install valves with stem in upright position.
- E. Contractor may install valves with stem in horizontal position only where space limitations do not allow installation in an upright position or where providing large valves with chain wheel operators.
- F. Where valves 2-1/2-inch and larger are located more than 12'-0" above mechanical room floors, install valve with stem in horizontal position and provide a chain wheel operator. Valves installed with stems down, will not be accepted.
- G. Install stem extensions when shipped loose from valve.
- H. Prior to flushing of piping systems, place valves in full-open position.

3.2 SHUT-OFF VALVES

- A. Install shut-off valves at equipment, at each branch take-off from mains, and at each automatic valve for isolation or repair.
- B. Water System: Butterfly valves installed at location of a flow sensing device are to have a memory stop.

3.3 BALANCING VALVES

- A. Provide balancing valves for major equipment and at each major branch takeoff and at discharge of each pump as indicated on Drawings and details.
- B. Calibrated Balance Valves: Install where indicated on Drawings and details for balancing of hydronic systems.

3.4 DRAIN VALVES

- A. Provide drain valves for complete drainage of systems.
- B. Locations of drain valves include low points of piping systems, equipment locations specified or detailed including reheat coils, other locations required for drainage of systems.

3.5 SAFETY RELIEF VALVES

- A. Use air pressure to clean piping prior to installation of safety relief valves.
- B. Install relief valves in locations indicated on Drawings, downstream of pressure-reducing valves, and on boilers.
- C. Install valves in vertical position, with drain holes, including those from dip pan elbows, piped to nearest drain.
- D. Inlet and outlet piping connecting to valves must be same size as valve connections or larger.
- E. Vent steam safety valves to a location outside of building, in most direct manner possible. Install drip pan elbow as detailed at first vertical rise of vent pipe.
- F. Keep pipe between safety valve and drip pan elbow as short and straight as possible.
- G. Support piping and drip pan elbow independently to prevent stress at connections to safety valves. Install vent pipe so that its weight does not rest on drip pan elbow.
- H. Extend drain line from drip pan elbow and relief valve to nearest drain.
- I. Pipe discharge from water system relief valves to nearest drain.

3.6 SWING CHECK VALVES

- A. Provide swing check valves where specified, detailed, and at steam condensate lines where they rise at outlet of traps.
- B. In such cases, provide isolation valves to allow repair or replacement of check valve.

3.7 COMBINATION SHUT-OFF, CHECK, AND BALANCING VALVES

- A. Contractor may use combination shut-off, check, and balancing valves where separate shut-off valve, check valve, and balancing valve are specified or detailed in pump discharge piping.

3.8 PRESSURE REDUCING VALVES

- A. Provide gate valve and strainer at inlet. Provide gate valve at outlet.
- B. Install pressure gauges to indicate inlet and outlet pressure at each pressure-reducing valve in accordance with Section 23 05 15 - Piping Specialties.
- C. Use eccentric reducers at inlet and outlet of reducing valves where connections are not same size as adjacent piping.

END OF SECTION

SECTION 23 05 29

HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Structural supports.
 - 2. Pipe hangers and supports.
 - 3. Beam clamps.
- B. Related Sections:
 - 1. Applicable provisions of Division 01 shall govern all work under this Section.
 - 2. Section 23 05 00 - Basic HVAC Requirements.
 - 3. Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment.
 - 4. Section 23 07 00 - HVAC Insulation.

1.2 REFERENCES

- A. ASTM International:
 - 1. ASTM A123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - 2. ASTM B695 - Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel.
- B. Manufacturers Standardization Society (MSS):
 - 1. MSS SP-58 - Pipe Hangers and Supports - Materials, Design and Manufacture.
 - 2. MSS SP-69 - Pipe Hangers and Supports - Selection and Application.

1.3 DESCRIPTION

- A. Provide supporting devices as required for installation of mechanical equipment and materials.
- B. Supports and installation procedures are to conform to latest requirements of ANSI Code for pressure piping.
- C. Do not hang any mechanical item directly from a metal deck or run piping so it rests on bottom chord of any truss or joist.
- D. Support apparatus and material under all conditions of operation, variations in installed and operating weight of equipment and piping, to prevent excess stress, and allow for proper expansion and contraction.

- E. Protect insulation at all hanger points.

1.4 SUBMITTALS

- A. Division 01 - Submittal Procedures: Requirements for submittals.
- B. Submit schedule of all hanger and support devices indicating shields, attachment methods, and type of device for each pipe size and type of service. Reference Section 23 05 00 – Basic HVAC Requirements.

1.5 DESIGN CRITERIA

- A. Materials and application of pipe hangers and supports shall be in accordance with MSS Standard Practice SP-58 and SP-69 unless noted otherwise.
- B. Piping connected to base mounted pumps, compressors, or other rotating or reciprocating equipment is to have vibration isolation supports for a distance of one hundred pipe diameters or three supports away from equipment, whichever is greater.
- C. Standard pipe hangers and supports as specified in this section are required beyond 100 pipe diameter/3 support distance.
- D. Piping flexible connections and vibration isolation supports are required for piping connected to coils that are in a fan assembly where entire assembly is mounted on vibration supports.
- E. Vibration isolation supports are required for a distance of one hundred pipe diameters or three supports away from equipment, whichever is greater.
- F. Piping flexible connection and vibration isolation supports are not required when fan section is separately and independently isolated by means of vibration supports and duct flexible connections.
- G. Standard pipe hangers/supports as specified in this section are required when there are no vibration isolation devices in piping and beyond 100 pipe diameter/3 support distance.
- H. Piping supported by laying on bottom chord of joists or trusses will not be accepted.
- I. Fasteners depending on soft lead for holding power or requiring powder actuation will not be accepted.
- J. Allow sufficient space between adjacent pipes and ducts for insulation, valve operation, routine maintenance, and the like.

PART 2 PRODUCTS

2.1 PIPE HANGER AND SUPPORT MANUFACTURERS

- A. Manufacturers:
 - 1. B-Line.
 - 2. Fee and Mason.
 - 3. Grinnell.
 - 4. Kindorf.
 - 5. Michigan Hanger.
 - 6. Unistrut.
 - 7. Substitutions: In accordance with Division 01 – General Requirements.

- B. Grinnell figure numbers are listed below; equivalent material by other manufacturers is acceptable.

2.2 STRUCTURAL SUPPORTS

- A. Provide all supporting steel required for installation of mechanical equipment and materials, whether or not it is specifically indicated or sized, including angles, channels, beams, etc. to suspend or floor support tanks and equipment.

2.3 PIPE HANGERS AND SUPPORTS

- A. Hangers for Steel Pipe Sizes 1/2-Inch through 2-Inch: Carbon steel, adjustable, clevis, black finish. Provide Grinnell Figure 65 or 260.

- B. Hangers for Steel Pipe Sizes 2-1/2-Inch and Over: Carbon steel, adjustable, clevis, black finish; or adjustable steel yoke, cast iron roll, double hanger. Provide Grinnell Figure 260. Provide Grinnell Figure 181 for steam lines.

- C. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods if calculations are submitted.

- D. Wall Support:
 - 1. Welded steel bracket with hanger. B-Line 3068 Series, Grinnell 194 Series.
 - 2. Perforated epoxy painted finish, 16-12-gauge minimum, steel channels securely anchored to wall structure with interlocking, split type, bolt secured, galvanized pipe/tubing clamps.
 - 3. B-Line type S channel with B-2000 series clamps, Grinnell Type PS200 H with PS 1200 clamps.
 - 4. When copper piping is being supported, provide flexible elastomeric / thermoplastic isolation cushion material to completely encircle piping and avoid contact with channel or clamp, equal to B-Line B1999 Vibra Cushion or provide manufacturers clamp and cushion assemblies, B-Line BVT Series, Grinnell PS 1400 Series.

- E. Vertical Riser Support: Carbon steel riser clamp, copper plated when used with copper pipe. Grinnell Figure 261 for steel pipe, figure CT121 for copper pipe.
- F. Floor Support for Pipe Sizes through 4-Inch: Cast iron adjustable pipe saddle, locknut nipple, floor flange, and concrete pier or steel support.
- G. Floor Support for Pipe Sizes 5-inch and Over: Adjustable cast iron roll and stand, steel screws, and concrete pier or steel support.
- H. Copper Pipe Support: Carbon steel ring, adjustable, copper plated or polyvinylchloride coated.
- I. Insulation Protection Shields: Galvanized carbon steel of not less than 18-gauge for use on insulated pipe 2-1/2-inch and larger. Minimum shield length is 12 inches. Equal to Grinnell figure 167.
- J. Steel Hanger Rods:
 - 1. Threaded ends, threaded one end, or continuous threaded, black finish.
 - 2. Size rods for individual hangers and trapeze support as indicated in the following schedule.
 - 3. Total weight of equipment, including valves, fittings, pipe, pipe content, and insulation, are not to exceed limits indicated.

Maximum Load (Lbs.) <u>(650 Degrees F Maximum Temp.)</u>	Rod Diameter <u>(inches)</u>
610	3/8
1130	1/2
1810	5/8
2710	3/4
3770	7/8
4960	1
8000	1-1/4

- 4. Provide rods complete with adjusting and lock nuts.

2.4 BEAM CLAMPS

- A. MSS SP-69 Type 23 malleable black iron clamp for attachment to beam flange to 0.62 inches thick for single threaded rods of 3/8, 1/2, and 5/8-inch diameter, for use with pipe sizes 4-inch and less. Furnish with hardened steel cup point set screw. Grinnell Figure 86.
- B. MSS SP-69 Type 28 or Type 29 forged steel jaw type clamp with a tie rod to lock clamp in place, suitable for rod sizes to 1-1/2-inch diameter but limited in application to pipe sizes 8-inch and less without prior approval. Grinnell Figure 228.

2.5 EQUIPMENT CURBS

- A. Manufacturers:
 - 1. Custom Curb.
 - 2. Pate.
 - 3. Roof Products and Systems.
 - 4. ThyCurb.
 - 5. Vent Products.
 - 6. Substitutions: In accordance with Division 01 – General Requirements.

- B. Constructed of not less than 18-gauge galvanized steel reinforced so it is structurally capable of supporting intended load with no penetrations through curb flashing, inside and outside corner sections that are mitered and continuously welded, filled with 3 pound density insulation, integral deck mounting flange, nominal 2-inch wood nailer, galvanized steel counterflashing.

- C. Do not use built-in metal base flashings or cants. Use 18-inch high equipment curbs where curb completely surrounds perimeter of equipment and there is no roof exposed to weather.

2.6 PIPE PENETRATION THROUGH ROOF

- A. Manufacturers:
 - 1. Custom Curb.
 - 2. Pate.
 - 3. Roof Products and Systems.
 - 4. ThyCurb.
 - 5. Vent Products.
 - 6. Substitutions: In accordance with Division 01 – General Requirements.

- B. Curb assembly constructed of not less than 18-gauge galvanized steel reinforced so it is structurally capable of supporting intended load, inside and outside corner sections that are mitered and continuously welded, filled with 3 pound density insulation, integral deck mounting flange, nominal 2-inch wood nailer, laminated acrylic clad thermoplastic cover with graduated step boots to accommodate various size pipes, fastening screws for cover, and stainless steel clamps for securing boots around pipe.

- C. Do not use built-in metal base flashings or cants. Height of assembly shall be minimum of 11 inches.

2.7 CORROSIVE ATMOSPHERE COATINGS

- A. Factory coat supports and anchors used in corrosive atmospheres with hot dip galvanizing after fabrication, ASTM A123, 1.5 ounces/square foot of surface, each side.

- B. Mechanically galvanize threaded products, ASTM B695 Class 150, 2.0 mil coating.

- C. Field cuts and damaged finishes shall be field coated with zinc rich paint of comparable thickness of factory coating.
- D. Corrosive atmospheres include the following locations:
 - 1. Exterior locations
 - 2. Chemical storage and hazardous waste storage rooms

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install supports to provide for free expansion of piping and duct system.
- B. Support piping from structure using concrete inserts, beam clamps, ceiling plates, wall brackets, or floor stands.
- C. Fasten ceiling plates and wall brackets securely to structure and test to demonstrate adequacy of fastening.
- D. Coordinate hanger and support installation to properly group piping of all trades.
- E. Where piping can be conveniently grouped to allow use of trapeze type supports, use standard structural shapes or continuous insert channels for supporting steel.
- F. Where continuous insert channels are used, pipe supporting devices made specifically for use with channels may be substituted for specified supporting devices provided that similar types are used and all data is submitted for prior approval.
- G. Perform welding in accordance with standards of American Welding Society.
- H. Clean surfaces of loose scale, rust, paint, or other foreign matter and properly align before welding.
- I. Use wire brush on welds after welding.
- J. Welds shall show uniform section, smoothness of weld metal, and freedom from porosity and clinkers.
- K. Where necessary to achieve smooth connections, joints shall be dressed smooth.

3.2 HANGER AND SUPPORT SPACING

- A. Place hanger within 12 inches of each horizontal elbow, valve, strainer, or similar piping specialty item.
- B. Where several pipes can be installed in parallel and at same elevation, provide multiple or

trapeze hangers.

- C. Support riser piping independently of connected horizontal piping.
- D. Adjust hangers to obtain slope specified in piping section of this specification.
- E. Space hangers for pipe as follows:

<u>Pipe Material</u>	<u>Pipe Size (inches)</u>	<u>Maximum Spacing</u>
Steel	1/2 through 1-1/4	6'-6"
Steel	1-1/2 through 6	10'-0"
Steel	8 through 12	14'-0"
Steel	14 and over	20'-0"
Thermoplastic	All sizes	6'-0"
Copper	1/2 through 1-1/4	5'-0"
Copper	1-1/2 and larger	8'-0"

3.3 EQUIPMENT CURBS

- A. Secure bottom of support flat on roof deck. Secure equipment to curb in accordance with equipment manufacturer's instructions.
- B. Flashing and counter-flashing shall be provided and installed by General Contractor.

3.4 PIPE PENETRATION THROUGH ROOF

- A. Install at points where pipes penetrate roof.
- B. Install as indicated on approved Shop Drawings, as detailed, and according to manufacturer's installation instructions.
- C. Flashing and counter-flashing shall be provided and installed by General Contractor.

END OF SECTION

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SECTION 23 05 53

IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Nameplates.
 - 2. Tags.
 - 3. Stencils.
- B. Related Sections:
 - 1. Applicable provisions of Division 01 shall govern all work under this Section.
 - 2. Section 23 05 00 - Basic HVAC Requirements.

1.2 REFERENCES

- A. American Society of Mechanical Engineers (ASME):
 - 1. ASME A13.1 - Scheme for the Identification of Piping Systems.

1.3 SUBMITTALS

- A. Division 01 - Submittal Procedures: Procedures for submittals.
- B. Submit list of wording, symbols, letter size, and color coding for mechanical identification.
- C. Product Data: Provide manufacturers catalog literature for each product required.

PART 2 PRODUCTS

2.1 IDENTIFICATION PRODUCTS

- A. Manufacturers:
 - 1. Seton Identification Products.
 - 2. Brady Corporation
 - 3. Champion America.
 - 4. Or approved equal.

2.2 COMPONENTS

- A. Nameplates:
 - 1. Laminated three-layer plastic with engraved black letters on white contrasting background color.
- B. Plastic Tags:

1. Laminated three-layer plastic with engraved black letters on white contrasting background color. Tag size minimum 1-1/2 inches diameter.
- C. Metal Tags:
1. Brass with stamped letters' tag size minimum 1-1/2 inches diameter with smooth edges.
- D. Information Tags:
1. Clear plastic with printed "Danger," "Caution," or "Warning" and message; size 3-1/4 x 5-5/8 inches with grommet and self-locking nylon ties.
- E. Stencils: With clean cut symbols and letters of following size:
1. Up to 2 inch Outside Diameter of Insulation or Pipe: 1/2 inch high letters.
 2. 2-1/2 to 6 inches Outside Diameter of Insulation or Pipe: 1 inch high letters.
 3. Over 6 inches Outside Diameter of Insulation or Pipe: 1-3/4 inches high letters.
 4. Ductwork and Equipment: 1-3/4 inches high letters.
- F. Stencil Paint: As specified in Article 9, semi-gloss enamel, colors and lettering size conforming to ASME A13.1.

PART 3 EXECUTION

3.1 PREPARATION

- A. Degrease and clean surfaces to receive adhesive for identification materials.
- B. Prepare surfaces in accordance with Article 9.5 for stencil painting.

3.2 INSTALLATION

- A. Install identifying devices after completion of coverings and painting.
- B. Install plastic nameplates with corrosive-resistant mechanical fasteners, or adhesive.
- C. Install labels with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.
- D. For unfinished canvas covering, apply paint primer before applying labels.
- E. Install tags using corrosion resistant chain. Number tags consecutively by location.
- F. Apply stencil painting in accordance with manufacturer's instruction.

- G. Identify air handling units, pumps, heat transfer equipment, tanks, and water treatment devices with plastic nameplates.
- H. Small devices, such as in-line pumps, may be identified with tags.
- I. Identify control panels and major control components outside panels with plastic nameplates.
- J. Identify valves in main and branch piping with tags.
- K. Identify air terminal units and radiator valves with numbered tags.
- L. Tag automatic controls, instruments, and relays. Key to control schematic.
- M. Identify piping, concealed or exposed, with plastic pipe markers.
- N. Identify service, flow direction, and pressure.
- O. Install in clear view and align with axis of piping.
- P. Locate identification not to exceed 20 feet on straight runs including risers and drops, adjacent to each valve and tee, at each side of penetration of structure or enclosure, and at each obstruction.
- Q. Identify ductwork with plastic nameplates. Identify with air handling unit identification number and area served.
- R. Locate identification at air handling unit, at each side of penetration of structure or enclosure, and at each obstruction.

END OF SECTION

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SECTION 23 05 93

TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes
 - 1. Air and water systems testing, adjusting and balancing.
- B. Related Sections
 - 1. Applicable provisions of Division 01 shall govern all work under this Section.
 - 2. Section 23 05 00 - Basic HVAC Requirements.
 - 3. Division 23 - Heating, Ventilating, and Air-Conditioning (HVAC) for HVAC Shop Drawings to be given to test and balance agency and for coordination between Contractor and firm performing the work in this section.
 - 4. Division 23 - Heating, Ventilating, and Air-Conditioning: Drawings and specifications which define scope of systems to be balanced. Reference to construction bulletins for proposed changes and to change orders for changes that have been accepted.
 - 5. Division 26 – Electrical: Electrical drawings and specifications which define scope of electrical systems that serve mechanical equipment.

1.2 REFERENCES

- A. Associated Air Balance Council (AABC)
 - 1. AABC - National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems, Current Edition.
- B. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)
 - 1. ASHRAE - ASHRAE Handbook, HVAC Applications - Testing Adjusting and Balancing, Current Edition.
- C. National Environmental Balancing Bureau (NEBB)
 - 1. NEBB - Procedural Standards for Testing Adjusting Balancing of Environmental Systems, Current Edition.

1.3 PRE-INSTALLATION MEETING

- A. Test and balance agency shall be required to attend a pre-installation meeting with other project Contractors before construction process is started.
- B. Test and balance agency shall provide input on time requirements for work required in this section.

1.4 PRE-BALANCE MEETING

- A. Four weeks prior to beginning testing, adjusting and balancing, schedule and conduct a meeting with Owner's Representative and mechanical system and temperature control system installing Contractors.
- B. The objective is final coordination and verification of system operation and readiness for testing, adjusting and balancing procedures and scheduling procedures with above mentioned parties. Indicate work required to be completed prior to testing, adjusting, and balancing and identify party responsible for completion of that work.

1.5 SUBMITTALS

- A. Division 01 - Submittal Procedures: Requirements for submittals.
- B. Submit testing, adjusting and balancing reports bearing seal and signature of NEBB or AABC Certified Test and Balance Supervisor.
- C. Reports to be certified proof that systems have been tested, adjusted and balanced in accordance with referenced standards; are an accurate representation of how systems have been installed and are operating; and are an accurate record of final quantities measured to establish normal operating values of systems.
- D. Submit four complete sets of reports. If information is incomplete or further testing, adjusting and balancing is deemed necessary, resubmit complete sets.
- E. Format: Bind report forms in three-ring binders or portfolio binders.
- F. Label edge or front with label identifying project name, project number and descriptive title of contents.
- G. Divide contents of report into below listed divisions, separated by divider tabs:
 - 1. General information.
 - 2. Summary.
 - 3. Air systems.
 - 4. Hydronic systems.
 - 5. Special systems.
- H. Contents: Provide the following minimum information, forms and data:
 - 1. General Information:
 - a. Inside cover sheet identifying Test and Balance Agency, Contractor, Architect, Engineer, Construction Manager, Project Name, and Project Number.
 - b. Include addresses, contact names and telephone numbers.

- c. Also include a certification sheet containing seal and signature of Test and Balance Supervisor.
- 2. Summary:
 - a. Provide summary sheet describing mechanical system deficiencies.
 - b. Describe objectionable noise or drafts found during testing, adjusting, and balancing.
 - c. Provide recommendations for correcting unsatisfactory performances and indicate whether modifications required are within scope of the contract, are design related or installation related.
 - d. List instrumentation used during testing, adjusting and balancing procedures.
- 3. Remainder of report to contain appropriate standard NEBB or AABC forms for each respective item and system. Fill out forms completely. Where information cannot be obtained or is not applicable indicate same.

1.6 TESTING, ADJUSTING AND BALANCING REQUIREMENTS

- A. Project requires separate contract with independent test and balance agency to perform all testing, adjusting, and balancing of air and hydronic systems required for this project. Work related to testing, adjusting, and balancing that must be performed by installing mechanical contractor is specified in other section of these specifications.
- B. Provide total mechanical systems testing, adjusting and balancing. Requirements include balance of air and water distribution, adjustment of new and existing systems to provide design quantities indicated on Drawings, electrical measurement and verification of performance of all equipment, all in accordance with standards published by AABC or NEBB.
- C. Balancing work shall be performed by AABC or NEBB certified air balance agency. Certification number and seal of registration shall be included with each balancing report.
- D. Test, adjust and balance all air and hydronic systems so that each room, piece of equipment or terminal device is using quantities indicated on Drawings and in specifications.
- E. Accomplish testing, adjusting and balancing work in timely manner that allows partial occupancy of major buildings, occupancy of one building when project involves many buildings, and completion of entire project in time stated in Instruction to Bidders and in accordance with completion schedule established for this project.
- F. Test and balance agency is encouraged to make periodic site visits to make sure that provisions are being made to accomplish specified testing, adjusting and balancing work.

PART 2 PRODUCTS

2.1 INSTRUMENTATION

**Dane County Transfer Station
and Clean Sweep Building
05/11/2010**

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- A. Provide required instrumentation to obtain proper measurements.
- B. Application of instruments and accuracy of instruments and measurements to be in accordance with requirements of NEBB or AABC Standards and instrument manufacturer's specifications.
- C. Instruments used for measurements shall be accurate, and calibration histories for each instrument to be available for examination by Owner upon request.
- D. Calibration and maintenance of all instruments to be in accordance with requirements of NEBB or AABC Standards

PART 3 EXECUTION

3.1 PRELIMINARY PROCEDURES

- A. Obtain preconstruction meeting report, applicable construction bulletins, applicable change orders, and approved Shop Drawings of equipment, outlets/inlets, and temperature controls.
- B. Check filters for cleanliness, dampers and valves for correct positioning, equipment for proper rotation and belt tension, temperature controls for completion of installation and hydronic systems for proper charge and purging of air.
- C. Notify Owner's Representative on daily basis during balancing.
- D. Identify deficiencies preventing completion of testing, adjusting, and balancing procedures. Do not proceed until systems are fully operational with components necessary for complete testing, adjusting, and balancing.
- E. Installing Contractors are required to provide personnel to check and verify system completion, readiness for balancing, and assist Balancing Agency in providing specified system performance.

3.2 EXISTING EQUIPMENT

- A. Engine Cooling Circuits.

3.3 PERFORMING TESTING, ADJUSTING AND BALANCING

- A. Perform testing, adjusting, and balancing procedures on each system identified, in accordance with detailed procedures outlined in referenced standards except as may be modified below.
- B. Unless specifically instructed in writing, all work in this specification section is to be performed during normal workday.

- C. In areas containing ceilings, remove ceiling tile to accomplish balancing work; replace tile when work is complete and provide new tile for any tile that are damaged by this procedure.
- D. If ceiling construction is such that access panels are required for work of this section and panels have not been provided, inform Engineer/Architect.
- E. Cut insulation, ductwork and piping for installation of test probes to minimum extent necessary for adequate performance of procedures.
- F. Patch using materials identical to those removed, maintaining vapor barrier integrity and pressure rating of systems.
- G. In air systems employing filters, blank off sufficient filter area to simulate pressure drop that is midway between that of clean filter and that of dirty filter.
- H. Measure and record system measurements at fan and pump to determine total flow.
- I. Adjust equipment as required to yield specified total flow at terminals.
- J. Proceed taking measurements in mains and branches as required for final terminal balancing.
- K. Perform terminal balancing to specified flows balancing branch dampers, deflectors, extractors, and valves prior to adjustment of terminals.
- L. Measure and record static air pressure conditions across fans, coils and filters.
- M. Indicate in report if cooling coil measurements were made on wet or dry coil and if filter measurements were made on clean or dirty filter.
- N. Spot check static air pressure conditions directly ahead of terminal units.
- O. Determine air handling system total supply and return airflow and return and exhaust fan total airflow at each piece of equipment utilizing pitot tube duct traverse. Summation of air terminal inlet/outlet CFM's is not acceptable, unless pitot tube traverse is impractical. If summation of air inlets/outlets is used in lieu of traverse method, valid explanation shall be submitted along with balancing reports. Insufficient back-up information to support use of summation method is cause for rejection of balancing reports without review.
- P. Submit static pressure profile for each air handling unit system. Unit static pressure profile shall be done at both minimum outside air CFM and at maximum outside air CFM (full economizer cycle) and also with face and bypass dampers (when provided on air handling systems) in full bypass position as well as full face position. Reports submitted without air handling system static pressure profiles is cause for rejection of balancing reports without review.

- Q. Adjust outside air, return air, and relief air dampers for design conditions at both minimum and maximum settings and record both sets of data.
- R. Balance modulating dampers at extreme conditions and record both sets of data.
- S. Balance variable air volume systems at maximum air flow rate, full cooling, and minimum flow rate, full heating; and record data.
- T. Adjust register, grille, and diffuser vanes and accessories to achieve proper air distribution patterns and uniform space temperatures free from objectionable noise and drafts within capabilities of installed system.
- U. Provide fan and motor drive sheave adjustments necessary to obtain design performance.
- V. Include in scope of services drive changes specifically noted on Drawings, if any.
- W. If work of this section indicates that any drive or motor is inadequate for application, advise Engineer by giving properly sized motor and drive information.
- X. Verify that any change will keep duct and piping system within its design limitations with respect speed of device and pressure classification of distribution system.
- Y. Time and material for motor/drive changes will be considered reimbursable expense and will require itemized cost breakdown of all time and drive changes submitted to Engineer; prior authorization is needed before this work is started.
- Z. Areas or rooms designed to maintain positive, negative, or balanced air pressures with respect to adjacent spaces, as indicated by design air quantities, require special attention.
- AA. Adjust fan drives, distribution dampers, terminals, and controls to maintain indicated pressure relationship.
- BB. Final air system measurements to be within the following range of specified cfm:
 - 1. Fans: -5 percent to +10 percent.
 - 2. Supply grilles, registers, diffusers: -5 percent to +10 percent.
 - 3. Return/exhaust grilles, registers: +5 percent to -10 percent
 - 4. Room pressurization air: -5 to +5 percent.
 - 5. Supply grilles, registers, diffusers in operating rooms, procedure rooms, isolation rooms and similar hospital spaces requiring a pressure differential: 0 percent to +10 percent
 - 6. Return/exhaust grilles, registers in operating rooms, procedure rooms and similar hospital spaces requiring a pressure differential: 0 percent to -10 percent
 - 7. Exhaust grilles and registers in isolation rooms and similar hospital spaces requiring a negative pressure differential: 0 percent to +10 percent.

- CC. Final water system measurements must be within the following range of specified gpm:
 - 1. Heating flow rates: +5 percent to -10 percent.
 - 2. Cooling flow rates: -5 percent to +5 percent.
- DD. Contact Temperature Control Contractor for assistance in operation and adjustment of controls during testing, adjusting, and balancing procedures.
- EE. Cycle controls and verify proper operation and setpoints. Include in report description of temperature control operation and any deficiencies found.
- FF. Permanently mark equipment settings, including damper and valve positions, control settings, and similar devices allowing settings to be restored. Set and lock memory stops.
- GG. Leave systems in proper working order, replacing belt guards, closing access doors and electrical boxes, and restoring temperature controls to normal operating settings.
- HH. Coordinate and assist CxP with verification activities defined within Commissioning specifications.

3.4 DEFICIENCIES

- A. Mechanical Contractor to correct any installation deficiencies found by test and balance agency that were specified and shown on Contract Documents to be performed as part of that division of work.
- B. Test and balance agency shall notify Engineer of these items and instructions will be issued to Mechanical Contractor for correction of deficient work.
- C. Corrective work to be done at no cost to Owner.

END OF SECTION

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SECTION 23 07 00

HVAC INSULATION

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes insulation for heating, ventilating and air conditioning piping, ductwork and equipment.
- B. Related Sections:
 - 1. Applicable provisions of Division 01 shall govern all work under this Section.
 - 2. Section 23 05 00 - Basic HVAC Requirements.
 - 3. Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.
 - 4. Section 23 21 13 - Hydronic Piping.
 - 5. Section 23 31 00 - HVAC Ducts and Casings.
 - 6. Section 23 83 16 - Radiant-Heating Hydronic Piping.

1.2 REFERENCES

- A. ASTM International
 - 1. ASTM B209 - Specification for Aluminum and Aluminum Alloy Sheet and Plate.
 - 2. ASTM C165 - Test Method for Compressive Properties of Thermal Insulations.
 - 3. ASTM C177 – Test Method for Heat Flux and Thermal Transmission Properties.
 - 4. ASTM C195 - Specification for Mineral Fiber Thermal Insulation Cement.
 - 5. ASTM C240 - Specification for Cellular Glass Insulation Block.
 - 6. ASTM C302 - Test Method for Density of Preformed Pipe Insulation.
 - 7. ASTM C303 - Test Method for Density of Preformed Block Insulation.
 - 8. ASTM C411 – Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
 - 9. ASTM C449 - Specification for Mineral Fiber Hydraulic Setting Thermal Insulation Cement.
 - 10. ASTM C518 - Test Method for Heat Flux and Thermal Transmission Properties.
 - 11. ASTM C533 - Specification for Calcium Silicate Block and Pipe Thermal Insulation.
 - 12. ASTM C534 - Specification for Preformed Flexible Elastomeric Thermal Insulation.
 - 13. ASTM C547 - Specification for Mineral Fiber Preformed Pipe Insulation.
 - 14. ASTM C552 - Specification for Cellular Glass Block and Pipe Thermal Insulation.
 - 15. ASTM C553 - Specification for Mineral Fiber Blanket and Felt Insulation.
 - 16. ASTM C578 - Specification for Preformed, Block Type Cellular Polystyrene Thermal Insulation.
 - 17. ASTM C591 - Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation.
 - 18. ASTM C610 - Specification for Expanded Perlite Block and Thermal Pipe Insulation.

19. ASTM C612 - Specification for Mineral Fiber Block and Board Thermal Insulation.
20. ASTM C916 - Specification for Adhesives for Duct Thermal Insulation.
21. ASTM C921 – Practice for Determining Properties of Jacketing Materials for Thermal Insulation.
22. ASTM C1071 – Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material).
23. ASTM C1136 - Specification for Flexible Low Permeance Vapor Retarders for Thermal Insulation.
24. ASTM C1338 – Test Method for Determining Fungi Resistance of Insulation Materials and Facings.
25. ASTM E84 – Test Method for Surface Burning Characteristics of Building Materials.
26. ASTM E119 – Standard Test Methods for Fire Tests of Building Construction and Materials.
27. ASTM E814 – Standard Test Method for Fire Tests of Through-Penetration Fire Stops.
28. ASTM G21 - Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.

- B. Midwest Insulation Contractors Association (MICA)
 1. MICA - National Commercial & Industrial Insulation Standards.
- C. National Fire Protection Association (NFPA)
 1. NFPA 225 - Surface Burning Characteristics of Building Materials.
- D. Underwriters Laboratories, Inc. (UL)
 1. UL 723 - Surface Burning Characteristics of Building Materials.

1.3 QUALITY ASSURANCE

- A. Substitutions: In accordance with Division 01 – General Requirements.
- B. Label insulating products delivered to construction site with manufacturer's name and description of materials.

1.4 DESCRIPTION

- A. Furnish and install insulating materials and accessories as specified or as required for a complete installation. Following types of insulation are specified in this section:
 1. Pipe insulation.
 2. Duct insulation.
 3. Equipment insulation.
- B. Install insulation in accordance with latest edition of MICA standard and manufacturer's installation instructions.

- C. Exceptions to these standards will only be accepted where specifically modified in these specifications, or where prior written approval has been obtained from Engineer/Architect.

1.5 DEFINITIONS

- A. Concealed: Shafts, furred spaces, space above finished ceilings, utility tunnels and crawl spaces. All other areas, including walk-through tunnels, shall be considered as exposed.
- B. Exposed to Weather: Ducts located outdoors, either on grade, on a wall, or on a roof, in a location where sun, wind, rain snow, and other elements will come in contact with ductwork.
- C. Unconditioned Spaces: Unheated or non-cooled attics, utility tunnels and crawl spaces where ambient temperatures may rise above 90 degrees F, or drop below 50 degrees F. Ducts in these instances are considered to be located outside of building thermal envelope.

1.6 SUBMITTALS

- A. Division 01 – Submittal Procedures: Shop drawings, product data and samples.
- B. Submit schedule of all insulating materials to be used on project, including adhesives, fastening methods, fitting materials along with material safety data sheets and intended use of each material.
- C. Include manufacturer's technical data sheets indicating density, thermal characteristics, jacket type, and manufacturer's installation instructions.
- D. Duct liner including data on thermal conductivity, air friction correction factor, and limitation on temperature and velocity.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Materials or accessories containing asbestos will not be accepted.
- B. Use composite insulation systems, including insulation, jackets, sealants, mastics, and adhesives that have flame spread rating of 25 or less and smoke developed rating of 50 or less, with following exceptions:
 - 1. Pipe insulation not located in an air plenum may have a flame spread rating not over 25 and a smoke developed rating no higher than 150.

2.2 INSULATION AND JACKETS

- A. Manufacturers:
 - 1. Armacell.
 - 2. Certainteed.

3. Manson.
 4. Childers.
 5. Dow.
 6. Extol.
 7. Fibrex.
 8. H.B. Fuller.
 9. Imcoa.
 10. Johns Manville.
 11. Knauf.
 12. Owens-Corning.
 13. Partek.
 14. Pittsburgh Corning.
 15. Rubatex.
 16. Substitutions: In accordance with Division 01 – General Requirements.
- B. Insulating materials shall be fire retardant, moisture and mildew resistant, and vermin proof. Insulation shall be suitable to receive jackets, adhesives and coatings as indicated.
- C. Flexible Fiberglass Insulation:
1. Minimum nominal density of 0.75 lbs. per cu. ft., and thermal conductivity of not more than 0.3 at 75 degrees F, rated for service to 250 degrees F.
 2. Foil-scrim-kraft vapor barrier jacket, factory applied to insulation, maximum permeance of 0.02 perms.
- D. Rigid Fiberglass Insulation:
1. Minimum nominal density of 3 lbs. 6 lbs. density for exterior applications per cu. ft., and thermal conductivity of not more than 0.23 at 75 degrees F, minimum compressive strength of 25 psf at 10 percent deformation, rated for service to 450 degrees F.
 2. Piping: White kraft reinforced foil vapor barrier all service jacket, factory applied to insulation with a self-sealing pressure sensitive adhesive lap, maximum permeance of 0.02 perms and minimum beach puncture resistance of 50 units.
 3. Ductwork: Foil-scrim-kraft vapor barrier jacket, factory applied to insulation, maximum permeance of 0.02 perms.
- E. Semi-Rigid Fiberglass Insulation:
1. Minimum nominal density of 3 lbs. per cu. ft., thermal conductivity of not more than 0.28 at 75 degrees F, minimum compressive strength of 125 psf at 10 percent deformation, rated for service to 450 degrees F.
 2. Insulation fibers perpendicular to jacket and scored for wrapping cylindrical surfaces.
 3. White kraft reinforced foil vapor barrier all service jacket, factory applied to insulation with a maximum permeance of 0.02 perms and minimum beach puncture resistance of 50 units.

- F. Extruded Polystyrene Insulation:
1. Rigid closed cell, minimum nominal density of 1.6 lbs. per cu. ft., thermal conductivity of not more than 0.285 at 75 degrees F, minimum compressive strength of 20 psi, maximum water vapor permeability of 1.5 perm inch, maximum water absorption of 0.5 percent by volume, rated for service range of -290 degrees F to 165 degrees F.
- G. Polyisocyanurate Insulation:
1. Rigid closed cell polyisocyanurate, minimum nominal density of 2.0 3.0 4.0 6.0 lbs. per cu. ft., thermal conductivity of not more than 0.19 at 75 degrees F aged 180 days, minimum compressive strength of 24 50 80 140 psi parallel and 13 40 65 130 psi perpendicular, maximum water vapor permeability of 4 perm inch, maximum water absorption of 2 percent by volume, rated for service range of -290 degrees F to 300 degrees F.
- H. Mineral Wool Insulation:
1. Rigid preformed mineral fiber, minimum nominal density of 8 lbs. per cu. ft., thermal conductivity of not more than 0.29 at 200 degrees F, minimum compressive strength of 3 psi, maximum wicking of 1 percent, maximum water adsorption of 1 percent by volume, rated for service of -120 degrees F to 1200 degrees F.
- I. Fireproofing Insulation:
1. Mineral fiber with nominal density of 8 lbs. per cu. ft., flame spread index of 25, fuel contribution index of 0, and smoke developed index of 0, thermal conductivity of not more than 0.23 at 75 degrees F, rated for service of -120 degrees F to 1200 degrees F.
 2. Use rigid or semi-rigid board for duct insulations.
 3. Foil-scrim-polyethylene vapor barrier jacket, factory applied to insulation, maximum permeance of 0.02 perms.
- J. Metal Jackets: 0.016 inch thick aluminum with safety edge.
- K. Insulation Inserts and Pipe Shields
1. Manufacturers:
 - a. B-Line.
 - b. Pipe Shields.
 - c. Value Engineered Products.
 - d. In accordance with Division 01 – General Requirements.
 2. Construct inserts with calcium silicate, or polyisocyanurate for service temperatures below 300 degrees F only, minimum 140 psi compressive strength.
 3. Provide galvanized steel shield.
 4. Insert and shield to be minimum 180-degree coverage on bottom supported piping and full 360-degree coverage on clamped piping.
 5. On roller mounted piping and piping designed to slide on support, provide additional load distribution steel plate.

6. Where Contractor proposes shop and site fabricated inserts and shields, submit schedule of materials, thicknesses, gauges, and lengths for each pipe size to demonstrate equivalency to pre-engineered/pre-manufactured product described above.
7. On low temperature systems, high-density rigid polyisocyanurate may be substituted for calcium silicate provided that insert and shield length and shield gauge are increased to compensate for lower insulation compressive strength.
8. Pre-compressed 20 lb. density molded fiberglass blocks, Hamfab or an approved equal, of same thickness as adjacent insulation may be substituted for calcium silicate inserts with one 1 x 6-inch block for piping through 2-1/2-inch and three 1 x 6-inch blocks for piping through 4-inch.
9. Submit shield schedule to demonstrate equivalency to pre-engineered/pre-manufactured product described above.
10. Wood blocks shall be prohibited.

2.3 DUCT LINING

- A. Manufacturer:
 1. Johns Manville - Linatex Series.
 2. Owens-Corning - Quiet R.
 3. Certainteed - Toughgard.
 4. Substitutions: In accordance with Division 01 – General Requirements.
- B. Make 1-inch thick, 3 lbs./ft.³ density flexible, mat faced insulation from inorganic glass fibers bonded with a thermosetting resin with thermal conductivity of 0.25 Btu inch / hour sq.ft. degree F.
- C. Meet erosion testing per UL 181 or ASTM C1071 for 5000 fpm maximum air velocity. ASTM C411 maximum operating temperature rating of 250 degrees F. ASTM E84 flame spread less than 25 and smoke developed less than 50.
- D. Meet requirements of ASTM C1338 and ASTM G21 for fungi resistance.
- E. Install liner using adhesive conforming to ASTM C916.

2.4 ACCESSORIES

- A. Products shall be compatible with surfaces and materials on which they are applied, and be suitable for use at operating temperatures of systems to which they are applied.
- B. Adhesives, sealants, and protective finishes shall be as recommended by insulation manufacturer for applications specified.
- C. Insulation bands to be 3/4-inch wide, constructed of aluminum or stainless steel. Minimum thickness to be 0.015-inch for aluminum and 0.010-inch for stainless steel.

- D. Tack fasteners to be stainless steel ring grooved shank tacks.
- E. Staples to be clinch style.
- F. Insulating cement to be ASTM C195, hydraulic setting mineral wool.
- G. Finishing cement to be ASTM C449.
- H. Fibrous glass or canvas fabric reinforcing shall have a minimum untreated weight of 6 oz./sq. yd.
- I. Bedding compounds to be non-shrinking and permanently flexible.
- J. Vapor barrier coatings and tapes to have maximum applied water vapor permeance of 0.05 perms.
- K. Fungicidal water base coating, Foster 40-20 or an approved equal, to be compatible with vapor barrier coating.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install insulation, jackets and accessories in accordance with manufacturer's instructions and under ambient temperatures and conditions recommended by manufacturer.
- B. Surfaces to be insulated must be clean and dry.
- C. Do not insulate systems or equipment specified to be pressure tested or inspected, until testing, inspection, and any necessary repairs have been successfully completed.
- D. Install insulation with smooth and even surfaces.
- E. Poorly fitted joints or use of filler in voids will not be accepted.
- F. Provide neatly beveled and coated terminations at nameplates, un-insulated fittings, or at other locations where insulation terminates.
- G. Install fabric reinforcing without wrinkles. Overlap seams a minimum of 2 inches.
- H. Use full length material as delivered from manufacturer wherever possible.
- I. Scrap piecing of insulation or pieces cut undersize and stretched to fit will not be accepted.
- J. Insulation shall be continuous through sleeves and openings except where fire rated penetration materials require interruption of insulation.

- K. Maintain vapor barriers continuous through all penetrations.
- L. Provide a complete vapor barrier for insulation on following systems:
 - 1. Cold water make-up.
 - 2. Refrigerant.
 - 3. Glycol.
 - 4. Insulated duct.
 - 5. Equipment or piping with a surface temperature below 65 degrees F.

3.2 PIPING, VALVE, AND FITTING INSULATION

- A. General:
 - 1. Install insulation with butt joints and longitudinal seams closed tightly.
 - 2. Provide minimum 2-inch lap on jacket seams and 2-inch tape on butt joints, firmly cemented with lap adhesive.
 - 3. Additionally secure with staples along seams and butt joints.
 - 4. Coat staples and longitudinal and transverse seams with vapor barrier mastic on systems requiring vapor barrier.
 - 5. Install insulation continuous through pipe hangers and supports with hangers and supports on exterior of insulation.
 - 6. Where vapor barrier is not required or where roller hangers are not being used, hangers and supports may be attached directly to piping with insulation completely covering hanger or support and jacket sealed at support rod penetration.
 - 7. Where riser clamps are required to be attached directly to piping requiring vapor barrier, extend insulation and vapor barrier jacketing/coating around riser clamp.
 - 8. Fully insulate all reheat coil piping, fittings and valves, with exception of unions, up to coil connection to prevent condensation when coil is inactive during cooling season.
- B. Insulated Inserts and Pipe Shields:
 - 1. Provide insulation inserts and pipe shields at all hanger and support locations.
 - 2. Inserts may be omitted on 3/4-inch and smaller copper piping provided 12-inch long 22-gauge pipe shields are used.
- C. Fittings and Valves:
 - 1. Fittings, valves, unions, flanges, couplings and specialties may be insulated with factory molded or built up insulation of same thickness as adjoining insulation.
 - 2. Cover insulation with fabric reinforcing and mastic or where temperatures do not exceed 150 degrees F, with PVC fitting covers.
 - 3. Secure PVC fitting covers with tack fasteners and 1-1/2-inch band of mastic over ends, throat, seams and penetrations.
 - 4. On systems requiring vapor barrier, use vapor barrier mastic.
- D. Mineral Fiber:

1. Secure each 3-foot section with three stainless steel bands or five 16-gauge stainless steel or annealed copper tie wires evenly spaced and at ends.
2. Twist wire ends, snip off excess and turn ends over into insulation.
3. Stagger joints where more than one layer is used.

E. Extruded Polystyrene and Polyisocyanurate:

1. Secure insulation sections with two wraps of nylon filament tape 9-12 inches on center.
2. On single insulation layer systems and on outer layer of double insulation layer systems, apply a thin coat of elastomeric joint sealant rated for system operating temperatures to longitudinal and butt insulation joints covering entire face of joint.
3. Allow sealant to fully cure before applying protective covering.
4. For piping service below 0 degrees F, use two layers of insulation with inner and outer butt and longitudinal joints staggered and offset 90-degrees.
5. Where two layers of insulation are used, do not use sealant on inner layer or adhere inner layer to outer layer.
6. Fill voids in factory molded or built-up valve and fitting insulation with foamed in place urethane insulation.
7. Apply vapor stop bead of joint sealant between pipe and insulation on both sides of valves, expansion/contraction joints, flanges, thermometers/gauges, and attached vent and drain lines.
8. Insulate attached non-circulated lines, control lines, vents, etc. for a minimum distance of 6 inches from pipe.
9. Cover insulation with a protective covering of 2 coats of vapor barrier mastic with fabric reinforcing.
10. Do not penetrate protective covering or insulation with mechanical fasteners.

F. Protective Jackets:

1. Provide protective metal jacket for following insulated piping interior exposed hydronic piping.
2. Lap seams minimum of 2 inches. Secure with metal bands for end to end joints, and rivets or sheet metal screws for longitudinal joints.
3. Rivets, screws, and bands to be constructed of same material as jacket. Locate seams on bottom for exterior applications.
4. Install only when ambient temperature is 60 degrees F or above.
5. Thoroughly clean and dry surfaces.
6. Cut allowing minimum 4-inch overlap on ends and 6-inch on longitudinal joints.
7. Align parallel to surface.
8. On exterior applications, provide a bead of compatible caulk along exposed edges.

G. Pipe Insulation Schedule:

1. Provide insulation on new piping as indicated in following schedule:

Service	Insulation	Insulation Thickness in Inches by Pipe Size
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	Types	≤ 1-1/4"	1-1/2"	2" to ≤ 4"	4" to 6"	8" and larger
Hot Water Heating	Rigid Fiberglass	1-1/2	1-1/2	2	2	2
Refrigerant Suction 40°F to 20°F	Elastomeric/Polyol	1	1-1/2	1-1/2	1-1/2	1-1/2
Cold Water Piping	Rigid Fiberglass	1/2	1/2	1	1	1
Cool. Coil Condensate	Rigid Fiberglass	1/2	1/2	1	1	1
Boiler Blow Down Remote Generator	Rigid Fiberglass	1	1	1	1-1/2	1-1/2
Radiator Piping	Rigid Fiberglass	1-1/2	1-1/2	2	2	2

2. The following piping and fittings are not to be insulated:
 - a. Hot water piping inside radiation, convector, or cabinet heater enclosures.
 - b. Piping unions for systems not requiring a vapor barrier.
3. For systems with fluid temperatures 65 degrees F or less, furnish and install removable elastomeric insulation covers, plugs or caps for all mechanical equipment and devices that require access by balancing contractors or service and maintenance personnel. Examples include, but are not limited to:
 - a. Flow sensing devices.
 - b. Circuit setters.
 - c. Manual ball valve air vents.
 - d. Drain valves.
 - e. Blowdown valves.
 - f. Pressure and temperature test plugs.
 - g. Grease fittings.
 - h. Pump bearing caps.
 - i. Equipment labels.
 - j. Covers shall be tight fitting to ensure a complete vapor barrier.

3.3 DUCT INSULATION

- A. General:
 1. Secure flexible duct insulation on sides and bottom of ductwork over 24-inch wide and all rigid duct insulation with weld pins or speed clips.
 2. Space fasteners 18-inches on center or less as required to prevent sagging for flexible duct insulation.
 3. Space fasteners not less than 3 inches from edge or corner and 12 inches on center or less for rigid duct insulation.
 4. Install weld pins without damage to interior galvanized surface of duct.
 5. Clip pins back to washer and cover penetrations with tape of same material as jacket.
 6. Firmly butt seams and joints and cover with 4-inch tape of same material as jacket.
 7. Seal tape with plastic applicator and secure with staples.
 8. Joints, seams, edges and penetrations shall be fully vapor sealed.
 9. Stop and point insulation around access doors and damper operators to allow operation without disturbing insulation or jacket material.

10. External supply duct insulation is not required where ductwork contains continuous 1-inch acoustical liner.
11. Provide 4-inch overlap of external insulation over ends of acoustically lined sections.

B. Duct Insulation Schedule:

1. Provide duct insulation on new and existing remodeled ductwork in following schedule:

Service	Insulation Type	Thickness (Inches)
Outside air ducts	Rigid Fiberglass	2
Mixed air ducts	Rigid Fiberglass	2
Exposed supply ducts*	Rigid Fiberglass	2
Concealed supply ducts	Flexible Fiberglass	1-1/2
All ducts exposed to weather	Rigid Fiberglass	3
Heat recovery units other than kitchen hood exhaust	Rigid Fiberglass	1

Note *: Exposed supply branch ducts located in space they are serving do not require insulation. Insulate exposed supply main ducts running through spaces they serve and as exposed supply ducts scheduled above.

3.4 DUCT LINING

A. Apply lining to the following ductwork:

1. Return air ducts within 20 feet of air handling unit connection.
2. Transfer air ducts.

B. Do not apply lining to the following ductwork:

1. Outside air ductwork.
2. Supply, return and exhaust ductwork associated with shop ventilation systems where air handling units are located in shops.
3. Hazardous area fume exhaust ductwork.

C. Install liner in compliance with latest edition of NAIMA's Fibrous Glass Duct Liner Standard. Locate longitudinal joints at corners of duct only. Cut and fit to assure lapped, compressed joints. Coat all transverse and longitudinal joints and edges with adhesive. Provide metal nosing on leading edge where lined duct is preceded by unlined duct. Adhere liner to duct with full coverage area of adhesive. Additionally secure liner to duct using mechanical fasteners spaced as recommended by liner manufacturer without compressing liner more than 1/8 inch with fasteners.

D. Duct dimensions indicated on drawings are net dimensions required for air flow. Increase duct sizes to allow for liner thickness.

3.5 EQUIPMENT INSULATION

- A. General: Do not insulate over equipment access manholes, fittings, nameplates, or ASME stamps. Bevel and seal insulation at these locations.
- B. Semi-Rigid Fiberglass:
 - 1. Apply insulation to equipment shells using weld pins, bonding adhesive, banded and wired in place.
 - 2. Fill all joints, seams and depressions with insulating cement to a smooth, even surface.
 - 3. Cover with reinforcing fabric and 2 coats of mastic.
 - 4. Use vapor barrier mastic on systems requiring vapor barrier.

C. Equipment Insulation Schedule:

- 1. Provide equipment insulation as follows:

Equipment	Insulation Type	Thickness (Inches)
Air separators	Semi-Rigid Fiberglass	1-1/2
Heat exchangers	Semi-Rigid Fiberglass	2
Air Handling Unit Casings or attached component sections not factory insulated	Rigid Fiberglass	2

- 2. Insulate air handling unit casings, chambers, or plenums, filters, mixing chambers, sound attenuators, and similar equipment in accordance with requirements of adjacent duct insulation.

END OF SECTION

SECTION 23 09 14

PNEUMATIC AND ELECTRIC INSTRUMENTATION AND CONTROL DEVICES FOR HVAC

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes
 - 1. Control Dampers.
 - 2. Control Valves.
 - 3. Control System Instrumentation.
 - 4. Thermostats.
 - 5. Duct Smoke Detector and Fire Alarm Interface Modules.
 - 6. Temperature Control Panels.
 - 7. Temperature Sensors.
 - 8. Differential Pressure Switches.
 - 9. Current Status Switches.

- B. Related Sections
 - 1. Applicable provisions of Division 01 shall govern all work under this Section.
 - 2. Section 23 05 00 - Basic HVAC Requirements.
 - 3. Section 23 05 93 - Testing, Adjusting, and Balancing for HVAC: Coordination.
 - 4. Section 23 09 23 - Direct Digital Control System for HVAC.
 - 5. Section 23 09 93 - Sequence of Operation for HVAC Controls.
 - 6. Section 23 33 00 – Air Duct Accessories: Control damper installation.
 - 7. Division 23 – HVAC: Equipment provided to be controlled or monitored.
 - 8. Division 26 – Electrical - Installation requirements & Equipment provided to be controlled or monitored.

1.2 QUALITY ASSURANCE

- A. Installing Contractor must be a manufacturer's branch office or an authorized representative of control equipment manufacturer that provides engineering and commissioning of manufacturers control equipment.
- B. Submit written confirmation of such authorization from manufacturer.
- C. Indicate in letter of authorization that installing Contractor has successfully completed necessary training required for engineering, installation, and commissioning of equipment and systems to be provided for project, and that such authorization has been in effect for period of not less than three years.

1.3 REFERENCES

- A. Air Movement and Control Association (AMCA)
 - 1. AMCA 500-D-Laboratory Method of Testing Dampers for Rating.
- B. American Society of Mechanical Engineers (ASME)
 - 1. ASME B16.22 - Wrought Copper and Wrought Copper Alloy Solder Joint Pressure Fittings.
- C. ASTM International
 - 1. ASTM B32 - Specification for Solder Metal.
 - 2. ASTM B75 - Specification for Seamless Copper Tube.
 - 3. ASTM D635 - Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position.
 - 4. ASTM D1693 - Environmental Stress-Cracking of Ethylene Plastics.
- D. Fluid Controls Institute (FCI)
 - 1. FCI 70-2 - Control Valve Seat Leakage.
- E. Underwriters Laboratories, Inc. (UL)
 - 1. UL 94 - Tests for Flammability of Plastic Materials for Parts in Devices and Appliances.

1.4 SYSTEM DESCRIPTION

- A. System is to use direct digital control logic with electric actuation for air handling units; direct digital control for room temperature, room humidity, and terminal airflow control; and electric or pneumatic control for other terminal units.

1.5 SUBMITTALS

- A. Division 01 – General Requirements: Shop drawings, product data and samples.
- B. Submit the following information:
 - 1. Manufacturer's data sheets indicating model number, pressure and temperature ratings, capacity, methods and materials of construction, installation instructions, and recommended maintenance.
 - 2. General catalog sheets showing series of same device is not acceptable unless specific model is clearly marked.
 - 3. Schematic flow diagrams of systems showing fans, pumps, coils, dampers, valves, and other control devices.
 - 4. Label each device with setting or adjustable range of control.
 - 5. Indicate wiring, clearly, differentiating between factory and field installed wiring.

6. Wiring should be shown in schematics that detail contact states and relay references; Diagrammatic representations of devices alone are not acceptable.
 7. Details of construction, layout, and location of each temperature control panel within building, including instruments location in panel and labeling.
 8. Include on Shop Drawings location of mechanical equipment controlled by room number, horsepower and flow of motorized equipment when this data is available on Drawings, locations of remote sensors and control devices by room number or column lines.
 9. Schedule of control dampers indicating size, leakage rating, arrangement, pressure drop at design airflow, and number and size of operators required.
 10. Schedule of control valves indicating system in which device is to be used, rated capacity, flow coefficient, flow required by device served, actual pressure drop at design flow, size of operator required, close-off pressure, and locations where valves are to be installed.
 11. Complete description of each control sequence for equipment that is not controlled by direct digital controls.
 12. Prior to request for final payment, submit record documents which accurately record actual location of control components including panels, thermostats, wiring, and sensors. Incorporate changes required during installation and start-up.
 13. Provide complete set of Submittal Drawings to Section 23 09 24 - Direct Digital Control System for HVAC (Informational Purposes Only) DDC Contractor to enable them to coordinate interfacing of Section 23 09 14 - Pneumatic and Electrical Instrumentation and Control Devices for HVAC controls with Section 23 09 24.
 14. Contractor is also required to provide information regarding their supplied control equipment for Section 23 09 14 - Pneumatic and Electrical Instrumentation and Control Devices to HVAC Contractor so that Section 23 09 14 - Pneumatic and Electrical Instrumentation and Control Devices for HVAC for completion of engineered Submittal Drawings.
 15. Provide complete set of Record Drawings and Section 23 09 24 - Direct Digital Control System for HVAC (Informational Purposes Only) to DDC Contractor to enable them to provide complete composite set of Drawings incorporating DDC and electric and pneumatic controls as specified.
- C. Operating and Maintenance Manuals: Furnish three (3) bound operating and maintenance manuals for review and approval prior to substantial completion, performance testing, and training. Manuals to include the following:
1. Operation and maintenance instructions for equipment and systems provided.
 2. Recommendations for frequency of service and preventative maintenance.
 3. List indicating types and grades of oil and grease, packing materials, normal and abnormal tolerances for devices, and method of equipment adjustment.
 4. Description of recommended replacement parts and materials which Owner should stock.
 5. Summary of equipment vendors, or location where replacement parts can be purchased.

6. Manufacturer's literature indicating features, materials of construction, and operating limits of installed equipment. Brochures giving brief descriptions of multiple pieces of control apparatus are not acceptable.
7. A complete set of control Record Drawings.
8. Name, address, and telephone number of person or office to contact for service during warranty period.
9. Name, address, and telephone number of person or service organization to be contacted for service after warranty period.

1.6 DESIGN CRITERIA

- A. Size control apparatus to properly supply and operate and control apparatus served.
- B. Provide control devices subject to corrosive environments with corrosion protection or construct control devices so they are suitable for use in such an environment.
- C. Provide devices exposed to outside ambient conditions with weather protection or construct devices so they are suitable for outdoor installation.
- D. Use only UL labeled products that comply with NEMA Standards. Electrical components and installation to meet requirements of electrical sections in Division 26 – Electrical.

1.7 TRAINING

- A. Provide minimum of 8 hours of training to Owner's personnel, concerning proper operation and maintenance of all control systems and all sensing, monitoring, and control equipment. Conduct training sessions during normal business hours after system start-up and acceptance by Owner.
- B. Submit operating and maintenance manuals to Owner's Representative minimum of five (5) working days prior to training session. Use these manuals as basis for instruction at all training sessions.
- C. Provide two (2) follow-up visits for troubleshooting, one six months after substantial completion and the other at end of warranty period. Length of each visit to be at discretion of Owner, for time necessary to provide required information and complete troubleshooting and inspection activity.

1.8 MATERIAL DELIVERY AND STORAGE

- A. Provide factory shipping cartons for each piece of equipment and control device. Contractor is responsible for storage of equipment and materials inside and protected from weather.

PART 2 PRODUCTS

2.1 INSTRUMENTATION AND CONTROL DEVICES

- A. Manufacturers:
 1. Johnson Controls, Inc.
 2. Honeywell.
 3. Siemens.
 4. Invensys, Siebe.
 5. Kreuter, KMC.
 6. Substitutions: In accordance with Division 01.

2.2 CONTROL DAMPERS

- A. Provide control dampers shown on Drawings and as required to perform specified functions.
- B. Dampers shall be rated for velocities that will be encountered at maximum system design and rated for pressure equal or greater than ductwork pressure class as specified in Section 23 31 00 – HVAC Ducts and Casings, of ductwork where damper is installed.
- C. Use only factory-fabricated dampers with mechanically captured replaceable resilient blade seals, stainless steel jamb seals and with entire assembly suitable for maximum temperature and air velocities encountered in system.
- D. Construct dampers in aluminum ductwork of stainless steel or aluminum.
- E. Construct dampers in galvanized ductwork of galvanized steel and aluminum.
- F. Dampers, unless otherwise specified, to be rated at a minimum of 180 degrees F working temperature.
- G. Leakage testing shall be certified to be based on latest edition of AMCA Standard 500-D as follows:

<u>Damper Class</u>	<u>Differential Pressure</u>	<u>Leakage</u>
Class IA	1-inch w.g.	≤3 CFM/ft ²
Class I	4-inch w.g.	≤8 CFM/ft ²
Class I	8-inch w.g.	≤11 CFM/ft ²
Class I	12-inch w.g.	≤14 CFM/ft ²

- H. Leakage rate dampers for differential pressures that they will encounter at maximum system design pressures.
- I. Steel Framed Dampers:
 1. Manufacturers:
 - a. Nailor Models 2010 and 2020.
 - b. Greenheck Models VCD-33 and VCD-42.

- c. Johnson Controls Model V-1330.
 - d. Ruskin Models CD60 and CD40.
 - e. Substitutions: In accordance with Division 01 Section 23 05 00.
- J. Aluminum Frame and Blade Dampers:
- 1. Manufacturers:
 - a. Nailor Models 2010EAF and 202EAF.
 - b. Greenheck Model VCD-43.
 - c. Ruskin Model CD50.
 - d. Arrow Model AFD-20.
 - e. Substitutions: In accordance with Division 01 Section 23 05 00.
- K. Dampers used for directed mixing of air-streams to be parallel blade type, sized for air velocity of 1800 to 2000 fpm.
- L. Dampers used for throttling or modulating applications other than air stream mixing to be opposed blade type.
- M. Two position dampers may be parallel or opposed blade type.
- N. Dampers used for isolation on discharge of centrifugal fans shall have damper blades perpendicular to fan shaft to minimize system effect.
- O. Design dampers mounted with blades vertically for vertical blade orientation.
- P. Dampers for applications other than fume exhaust to have frames of not less than 16-gauge galvanized steel or 12-gauge extruded aluminum.
 - 1. Blades shall be two-ply steel airfoil of not less than 2 x 20-gauge galvanized steel (14-gauge equivalent) or extruded aluminum airfoil, with stainless steel, acetal, Celcon, bronze, or nylon bearings.
 - 2. Maximum allowable blade width is 8 inches. Use plated steel linkage hardware.
- Q. Dampers used for laboratory fume exhaust systems shall have not less than 8-inch wide x 14-gauge frames and not less than 16-gauge two-ply airfoil blades.
 - 1. Frames, blades, and axels to be constructed of Type 304 stainless steel.
 - 2. Select dampers for a minimum rating of 10-inch water gauge at velocity of 4000 FPM and rated at minimum of 250 degrees F.
- R. Damper:
 - 1. Blade bearings to be constructed of stainless steel or Teflon.
 - 2. Blade seals to be silicone.
 - 3. Certify leakage testing is based on latest edition of AMCA Standard 500-D and laboratory fume exhaust dampers shall have leakage ratings as follows:

<u>Damper Class</u>	<u>Differential Pressure</u>	<u>Leakage</u>
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Class I	1-inch w.g.	≤ 4 CFM/ft ²
Class I	4-inch w.g.	≤ 8 CFM/ft ²
Class I	8-inch w.g.	≤ 11 CFM/ft ²
Class I	12-inch w.g.	≤ 14 CFM/ft ²

- S. Maximum damper width is 48 inches; where required width exceeds 48 inches, use multiple damper sections. Inside frame free area shall be minimum of 90 percent of total inside duct area.
- T. Multiple width damper sections shall utilize jackshaft linkages unless noted below.
- U. Sections over 144 inches wide shall be actuated from two locations on jackshaft.
- V. Double width damper sections for two-position operation may be actuated without jackshafts if each damper section is actuated separately.
- W. Dampers that have multiple width and multiple vertical sections shall have jackshaft for each vertically stacked set of dampers and be provided with crossover linkages between jackshafts to transfer uneven loading.
- X. Extend jackshafts outside of ductwork for external actuator mounting.
- Y. Provide bearings on point of exit for support of damper shafts to prevent wear on shaft and ductwork.
- Z. If locating actuators out of air stream is impossible, obtain mounting location approval from Engineer/ Architect unless Contract Documents indicate in air stream mounting is acceptable.
- AA. In no cases shall damper actuators for fume exhaust systems be located in air stream or require entering air stream to service an actuator.
- BB. Provide weatherproof stainless steel enclosures or NEMA 4 watertight actuator housing to prevent actuator failure or freeze-up when mounting in locations exposed to harsh environments or outdoor locations.
- CC. Size operators for smooth and positive operation of devices served, and with sufficient torque capacity to provide tight shutoff against system temperatures and pressure encountered.
- DD. For pneumatic actuation, use rolling diaphragm, piston type operators with adjustable stops. For electric modulating actuation, use fully proportional actuators with 0-10 VDC inputs and zero and span adjustments.
- EE. For two-position electric actuation use 24 VAC for DDC controlled actuators, 120 VAC actuators may be used for hardwire interlocking.

- FF. Actuator stroke times shall match requirements of DDC controllers provided under Section 23 09 23 - Direct Digital Control System for HVAC and specific system requirements for proper operation.
- GG. Electric actuators shall be provided with overload protection to prevent motor from damage when stall condition is encountered.
- HH. Provide operators with spring return for applications involving fire, freeze protection, moisture protection, or specified normally open/closed operation.
- II. Provide damper end switches with form "C" contacts where control sequences require damper position indication.
- JJ. This Contractor shall provide all power required for electric actuation if it is not able to be directly provided from DDC controller.
- KK. Provide operators with linkages and brackets for mounting on device served.

2.3 CONTROL VALVES

- A.
- A. Provide control valves as indicated on Drawings and details and as required to perform functions specified. Spring ranges must be selected to prevent overlap of operation and simultaneous heating and cooling.
- B. Size operators to allow smooth and positive operation of devices served and to provide sufficient torque capacity for tight shutoff against system temperatures and pressure encountered.
- C. For electric modulating actuation, use fully proportional actuators with 0-10 VDC inputs and zero and span adjustments unless specified otherwise in chart below.
- D. If TriState with feedback is specified, feed valve position back to controller and controller shall position valve based on this feedback.
- E. For two-position electric actuation use 24 VAC for DDC controlled actuators, 120 VAC actuators may be used for hardwire interlocking.
- F. For applications other than terminal units provide electric actuators with manual override capability.
- G. Provide electric actuators with a visible position indicator.
- H. This Contractor shall provide power required for electric actuation if it is not able to be directly provided from DDC controller.

- I. Equip operators that are full proportioning or two-position, as required for specified sequence of operation.
- J. Provide spring-return for applications involving fire, freeze protection, moisture protection or specified normally open/closed operation.
- K. Valves shall move to their fail positions on loss of electrical power or air pressure to actuator.
- L. Size two-position shut-off valves for maximum pressure drop of 2 PSI at design flow with minimum size same as line size.
- M. Provide operators with linkages and brackets for mounting on device served.
- N. Valves, unless specifically noted on Drawings, or indicated below shall be globe style valves.

VALVE SERVING	TYPE	SIGNAL	SPRING RETURN REQUIRED	FAIL POSITION
	Globe Butterfly (BF) Ball or Press Independent Ball (PI Ball)	0-10 VDC TriState (24 VAC) 2-Position Electric Pneumatic (Pneumatic)	Yes / No	Open (thru Coil) Closed (bypass Coil) Last Position
Fan Coil Heating	Globe or Ball	0-10 VDC	No	Last Position
AHU Heating Coil	Globe	0-10 VDC	Yes	Open
Humidifier Shutoff	Globe	2-Pos Elect	Yes	Closed
HW Heat Exchanger	Globe	0-10 VDC	Yes	Open
Process HW HX	Globe	0-10 VDC	Yes	Open

See plan details, notes, and schedules for where two-way and three-way valves should be used.

- O. Water Systems:
 - 1. Use equal percentage valves for two-way control valves; size for pressure drop not less than 4 psi or more than 6 psi.
 - 2. Use three-way valves sized for maximum pressure drop of 5 psi that have linear characteristics so that valve pressure drop remains constant regardless of valve position.
 - 3. Globe Valves 2-Inch and Smaller (Terminal Unit Control):
 - a. Manufacturers:
 - 1) Siemens Powermite 599 VF Series (599 VE Series Zone Valves are not acceptable).
 - 2) Invensys VB7200 Series.
 - 3) Johnson Controls VG7000 Series.
 - 4) Honeywell V5011/V5013 Series.
 - 5) Substitutions: In accordance with Division 01.
 - b. Minimum size for globe valves shall be 1.5 Cv.

- c. Cast bronze or forged brass body, brass plug and brass or stainless steel seat, stainless steel stem, screwed ends, suitable for use on water systems at 150 psig and 240 degrees F.
 - d. Seat leakage with actuator supplied will meet FCI class IV leakage (0.01 percent).
 - 4. Globe Valves 2 1/2-Inch and Larger:
 - a. Iron body, brass plug and seat, stainless steel stem, spring loaded Teflon or EPDM packing, flanged ends, suitable for use on water systems at 150 psig and 240 degrees F.
 - 5. Butterfly Valves:
 - a. Iron body, stainless steel shaft, bronze bearings, and resilient seat.
 - b. Disc to be aluminum-bronze, nickel-plated ductile iron, cast iron with welded nickel edge, or stainless steel.
 - c. Valve assembly to be bubble tight, suitable for use on water systems at 150 psig and 240 degrees F.
 - d. When butterfly valves are used in modulating applications, detail entering and leaving pipe sizes and required transition distances on control valve submittals.
 - e. Control Contractor shall be responsible for coordinating proper pipe sizes and transitions with Mechanical Contractor to provide correct Cv at 70-degrees open position.
 - 6. Characterized Ball Valves:
 - a. Manufacturers:
 - 1) Honeywell.
 - 2) Belimo.
 - 3) Johnson Controls.
 - 4) KMC Controls.
 - 5) Yamatake.
 - 6) Substitutions: In accordance with Division 01.
 - b. For use on terminal units only where specified above.
 - c. Forged brass or bronze body, stainless steel shaft and ball, reinforced Teflon or PTFE ball seals, double O-ring stem seals, characterized disk, maximum of FCI Class IV (0.01 percent) leakage, suitable for use on water systems at 150 psig and 212 degrees F.
 - d. Minimum size for ball valves shall be 1.0 Cv.
 - 7. Pressure Independent Characterized Ball Valves:
 - a. Manufacturers:
 - 1) Belimo Model PICCV.
 - 2) Griswold Controls PIC-V.
 - 3) Substitutions: In accordance with Division 01.
 - b. For use on terminal units only where specified above.
 - c. Forged brass or bronze body, reinforced Teflon or PTFE ball seals, double O-ring stem seals, characterized disk, maximum of FCI Class IV (0.01

percent) leakage, suitable for use on water systems at 150 psig and 212 degrees F.

- d. Vary flow by actuator position and at any given position flow through valve shall not vary more that plus or minus 5 percent due to system pressure fluctuations across valve in selected operating range.
- e. Valves shall be pressure independent between a system differential pressure of 8 and 50 PSID. Minimum size for ball valves shall be 1.0 Cv.

2.4 CONTROL SYSTEM INSTRUMENTATION

A. Duct Thermometers:

- 1. 3-1/2-inch Dial Type with Swivel Mount.
- 2. Maximum scale graduations of 2 degrees F.
- 3. Provide averaging type, liquid filled capillary sensing element.

B. Pipe Thermometers:

- 1. 9-inch Stem Type with an Adjustable Swivel Mount.
- 2. Scale graduations of 2 degrees F and mid-range accuracy of ± 1 degree F.
- 3. Install thermometers in separable brass wells filled with conductive fluid.

C. Remote Bulb Thermometers:

- 1. 3-1/2-inch dial type with recalibration screw on face.
- 2. Accuracy within 1 percent of scale range.
- 3. Thermometers with sensing elements in air ducts with area of above 4 square feet to have averaging elements.
- 4. Provide separable wells for all pipeline applications.

2.5 ELECTRIC/ELECTRONIC THERMOSTATS

A. Electric Thermostats:

- 1. For single setpoint applications, provide line or low voltage electric type suitable for heating or heating and cooling as required.
- 2. Provide required number of heating and cooling stages required for application.
- 3. For line voltage ventilation applications utilizing fans and where otherwise specified in sequence of operations, provide integral manual On/Off/Auto selector switch.
- 4. Minimum contact rating shall be equal to electrical load of device being controlled.

B. Low Limit Thermostats (Freezestats):

- 1. Electric two-position type with temperature sensing element and manual reset.
- 2. Unit to be capable of opening control circuit if any one-foot length of sensing element is subject to temperature below setpoint.
- 3. Length of sensing element to be not less than one lineal foot per square foot of coil surface areas.
- 4. Unless otherwise indicated, set low limit controls at 36 degrees F.

- C. Aquastats:
 - 1. Line voltage type with single pole, double throw switch of adequate rating for applied load.
- D. Immersion Type Thermostat Sensors:
 - 1. Rod and tube type with linear output.
 - 2. Provide separable wells with heat conductive fluid for installation in pipeline.
 - 3. Units shall be factory calibrated.
- E. Firestats: UL labeled, manual reset, line voltage type with 135 degree F setpoint.

2.6 DUCT SMOKE DETECTOR AND FIRE ALARM INTERFACE MODULES

- A. Detectors with auxiliary contacts or fire alarm control modules will be provided by others.
- B. Provide wiring, conduit, and necessary interface with fire alarm system to perform specified sequence of operation.

2.7 TEMPERATURE CONTROL PANELS

- A. Constructed of steel or extruded aluminum, with hinged door, keyed lock, and baked enamel finish.
- B. Install controls, relays, transducers and automatic switches inside panels.
- C. Label devices with permanent printed labels and provide as-built wiring and piping diagram within enclosure.
- D. Provide raceways for wiring and poly within panel for neat appearance and to separate high and low voltage wiring.
- E. Provide termination blocks and resettable circuit breaker for 120 VAC power wiring.
- F. Label panel with panel number corresponding to as-built control drawings and building system(s) served.
- G. Provide service shutdown toggle switch for each air handling unit system located inside temperature control panel that will initiate logical shutdown of handling unit system.
- H. Label switch so it is clear which position is shutdown and which is auto.
- I. Flush mount manual switches including damper "minimum-off" positioning switches, "summer-winter switches", "manual-automatic switches", dial thermometers, pressure gauges, and receiver indicating gauges in front door of panel.
- J. Clearly identify each item with engraved nameplates.

2.8 TEMPERATURE SENSORS

- A. Manufacturers (Thermistor Temperature Sensor):
 - 1. PreCon.
 - 2. BAPI.
 - 3. ACI.
 - 4. Substitutions: In accordance with Division 01.
- B. Use thermistor or RTD type temperature sensing elements constructed so accuracy and life expectancy is not affected by moisture, physical vibration, or other conditions that exist in each application.
- C. RTD's shall be of nickel or platinum construction and have base resistance of 1000 ohms at 70 degrees F and 77 degrees F respectively.
- D. 100-ohm platinum RTD's are acceptable if used with temperature transmitters.
- E. Temperature sensing device used must be compatible with DDC controllers used on project.
- F. RTD:
 - 1. Accuracy (Room or Probe): Minimum ± 0.65 degrees F.
 - 2. Accuracy (Averaging): Minimum ± 1.2 degrees F.
 - 3. Range: minimum -40 to 220 degrees F.
- G. Thermistor:
 - 1. Accuracy (All): Minimum ± 0.36 degrees F.
 - 2. Range: Minimum -30 to 230 degrees F.
 - 3. Heat Dissipation Constant: Minimum 2.7 mW/degree C.
- H. Temperature Transmitter:
 - 1. Accuracy: Minimum ± 0.1 degree F or ± 0.2 percent of span.
 - 2. Output: 4-20 mA.
- I. Provide limited range or extended range sensors if required to sense range expected for respective point.
- J. Use RTD type sensors for extended ranges beyond -30 to 230 degrees F.
- K. If RTD's are incompatible with DDC controller direct temperature input use temperature transmitters in conjunction with RTD's.
- L. Use wire size appropriate to limit temperature offset due to wire resistance to 1.0 degree F.
- M. If offset is greater than 1.0 degree F due to wire resistance, use temperature transmitter.

- N. If feature is available in DDC controller, compensate for wire resistance in software input definition.
- O. Provide sensors in occupied spaces with brushed aluminum or brushed nickel covers unless otherwise noted or features specified will not allow for this.
- P. Use averaging elements on duct sensors when ductwork is four square feet or larger.
- Q. In piping systems use temperature sensors with separable wells designed to be used with temperature element.

2.9 CURRENT STATUS SWITCHES

- A. Provide current sensor with adjustable threshold and digital output with LED display.
 - 1. Provide Veris Model H-708/H-904 or approved equal.
- B. Threshold adjustment must be by multi-turn potentiometer or set by multiprocessor that will automatically compensate for frequency and amperage changes associated with variable frequency drives.
- C. When used on variable speed motor applications, use current sensor that will not change state due to varying speeds.

2.10 POWER SUPPLIES

- A. Provide all required power supplies for transducers, sensors, transmitters and relays. All low voltage transformers shall have resettable secondary circuit breaker.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install system with trained mechanics and electricians employed by control equipment manufacturer or an authorized representative of manufacturer.
- B. Where installing Contractor is authorized representative of control manufacturer, such authorization shall have been in effect for period of no less than three years.
- C. Install control equipment, accessories, wiring, and piping in a neat and workmanlike manner.
- D. Control devices must be installed in accessible locations.
- E. Contractor shall verify that all control devices furnished under this Section are functional and operating mechanical equipment as specified in Section 23 09 93 – Sequence of Operations for HVAC Controls.

- F. Supply and install cables to electronic input/output devices, sensors, relays and interlocking wiring, under this section of specification and extend interface with Direct Digital Control System into Section 23 09 24 - Direct Digital Control System for HVAC (Informational purposes only).
- G. DDC panel with minimum of 5 feet of cable to allow for termination by DDC Contractor.
- H. Contractor shall provide technician to inspect and validate all tubing, wiring, and field devices associated with DDC interface in coordination with and under direction of DDC Contractor.
- I. DDC Contractor to ensure that each device is operating per control sequences as specified in Section 23 09 93 – Sequence of Operations for HVAC Controls.
- J. Label control devices with exception of dampers, valves, and terminal unit devices with permanent printed labels that correspond to control drawings.
- K. Identify temperature control junction and pullboxes by using spray painted green covers.
- L. Other electrical system identification shall follow Division 26 – Electrical.
- M. Mount control devices and electrical boxes mounted on insulated ductwork over insulation.
- N. Provide mounting stand-offs where necessary for adequate support.
- O. Cutting and removal of insulation to mount devices directly on ductwork is not acceptable.
- P. This Contractor shall coordinate with insulation contractor to provide for continuous insulation of ductwork.
- Q. Protect mounting of electrical or electronic devices from weather if building is not completely enclosed.
- R. This Contractor shall be solely responsible for replacing any equipment that is damaged by water that infiltrates building if equipment is installed prior to building being enclosed.
- S. Provide electrical relays and wiring, line and low voltage, for control systems, devices, and components.
- T. Install high voltage and low voltage wiring, including low voltage cable, in metal conduit, Electrical Non-metallic Tubing (ENT), or Electrical Metallic Tubing (EMT), as scheduled below and hereafter referred to generically as conduit.
- U. Reference Wire Conduit Installation Schedule below for specific conduit or tubing to be used.

- V. Conduit shall be installed in accordance with Division 26 of this specification and National Electrical Code.
- W. Conduit shall be minimum of 1/2-inch for low voltage control provided pipe fill does not exceed 40 percent.
- X. Minimum low voltage wiring gauge to be 18 AWG for outputs and 20 AWG for inputs. Low voltage wiring to be stranded.
- Y. Low voltage wiring can be run without conduit above accessible lay-in tile ceilings.
- Z. Wiring in mechanical rooms, above inaccessible hard ceilings, exterior locations, and in any exposed areas, and in other locations shall be in conduit.
- AA. Wire for wall sensors must be run in conduit.
- BB. Where wiring is installed free-air, installation shall be as follows:
 - 1. Wiring shall utilize cable tray wherever possible.
 - 2. Wiring shall run at right angles and be kept clear of other trades work.
 - 3. Support wiring using "J" or "Bridal-type" steel mounting rings anchored to ceiling concrete, piping supports, walls above ceiling or structural steel beams.
 - 4. Mounting rings shall be of open design (not a closed loop) to allow additional wire to be strung without being threaded through ring.
 - 5. For mounting rings that do not completely surround wire, attach wire to mounting ring with a strap.
 - 6. Space supports at maximum 4-foot interval unless limited by building construction. If wiring "sag" at mid-span exceeds 6 inches; provide additional support.
 - 7. Wiring shall never be laid directly on ceiling grid or attached in any manner to ceiling grid wires.
 - 8. Sleeve wall penetrations.
 - 9. Do not attach wiring to existing cabling, existing tubing, plumbing or steam piping, ductwork, ceiling supports, or electrical or communications conduit.
- CC. Control panels serving equipment fed by emergency power shall also be served by emergency power.
- DD. This Contractor shall be responsible for 120 VAC power, not provided in Division 26 specifications, required for equipment provided under this section.
 - 1. Section 23 09 23 - Direct Digital Control System for HVAC and Section 23 09 14 – Variable Frequency Drives Contractors may utilize power shown for temperature control panels on Drawings.
- EE. Provide communication trunk wiring to integrated devices including VFD's, Flow Meters, Chillers, Lighting Panels, and Electrical Meters, specified to be connected to building automation system.

- FF. Provide communication trunk required by equipment specified under Section 23 09 23 - Direct Digital Control System for HVAC and route to DDC panel designated for that equipment as shown on Drawings or closest DDC panel if not designated.
- GG. If communication trunks required daisy chained style wiring, provide two communication cables.
- HH. Install "hand/off/auto" selector switches on systems where automatic interlock controls are specified and "hand/off/auto" selector switches are not supplied with equipment controlled.
- II. Control panel power will not be required for "hand" switch to operate.
- JJ. When switch is in "hand" position, allow manual operation of selected device without operating interlocked motors but allowing all unit safety devices to stay in circuit.
- KK. Pneumatic tubing and electrical wiring are to be permanently tagged or labeled within one inch of terminal strip with a numbering system to correspond with Record Drawings.
- LL. After completion of installation, test and adjust control equipment.
- MM. Submit data showing set points and final adjustments of controls.

3.2 WIRE PIPING CONDUIT AND TUBING INSTALLATION SCHEDULE

- A. Following conduit schedule shall apply to both polyethylene tubing and wire in conduit where conduit is specified for air tubing or wiring.
- B. Conduit and tubing referenced below shall meet specifications in Division 26 - Electrical and as defined below.
- C. Conduit other than that specified below for specific applications shall not be used. Comply with following schedule:
 1. Underground Installations within 5 Feet of Foundation Wall: Rigid steel conduit.
 2. Underground Installations More than 5 Feet from Foundation Wall: Rigid steel conduit.
 3. Under Slab on Grade Installations: Schedule 40 PVC conduit.
 4. Exposed Outdoor Locations: Rigid steel conduit.
 5. Concealed in Concrete and Block Walls: Electrical Nonmetallic Tubing (ENT).
 6. Within Concrete Slab: Rigid steel conduit.
 7. Wet Interior Locations: Rigid steel conduit.
 8. Concealed Dry Interior Locations: Electrical metallic tubing.
 9. Exposed Dry Interior Locations: Electrical metallic tubing.

3.3 CONTROL DAMPERS

- A. Control dampers furnished by control manufacturer are to be installed by Mechanical Contractor under coordinating control and supervision of Control Contractor in locations shown on Drawings or where required to provide specified sequence of control.
- B. Coordinate installation with sheet metal installer to obtain smooth duct transitions where damper size is different than duct size. Blank off plates will not be accepted.
- C. Each operator shall serve maximum damper area of 36 square feet. Where larger dampers are used, provide multiple operators.

3.4 CONTROL VALVES

- A. Temperature control valves furnished by control manufacturer are to be installed by Mechanical Contractor under coordinating control and supervision of Control Contractor in locations shown on Drawings or where required to provide specified sequence of control.
- B. Provide pilot positioners on all valves where more than one pneumatic operator is controlled in sequence, for all valves 3-inch and larger, or where required to provide sufficient power.
- C. Where two or more valves are operated in sequence, pilot positioners shall have adjustable start point (2-12 psig) and span (5-13 psig).

3.5 CONTROL SYSTEM INSTRUMENTATION

- A. For pneumatically actuated systems install pressure gauges as follows:
 - 1. Indication of supply air pressure in each temperature control panel.
 - 2. Output of pneumatic/electric transducers.
 - 3. Output of each pneumatic controller.
 - 4. Output of each solenoid air valve.
 - 5. Input of each PE switch.
 - 6. At each modulated damper and valve except terminal devices.
 - 7. Other points where visible indication of air pressure is required for operating and maintenance purposes.
- B. On dampers and valves with pilot positioners, locate gauge in output of positioner to controlled device.
- C. Mount gauges so they are visible when looking at monitored device.
- D. At each receiver controller input port, install a 1-1/2-inch diameter dial indicator with scale to match input range (in degrees F., percent RH, in. WC, etc.).
- E. Equip control air output line with a 1-1/2-inch diameter air pressure gauge.

- F. Install thermometers at each point of temperature transmission (sensors) and control, except reheat coils, unless Drawings indicate thermometer is to be installed by piping or sheet metal installer.
- G. Install thermometers to permit easy reading from floor or operating platform.
- H. Provide remote mounting or swiveled mounting as required for easy reading.
- I. Flush mounting where not easily read is not acceptable.

3.6 ROOM THERMOSTATS AND TEMPERATURE SENSORS

- A. Check and verify location of thermostats, humidistats, and other exposed control sensors with Drawings and room details before installation.
- B. Locate room thermostats and sensors 48 inches above floor.
- C. Align with light switches and humidistats.
- D. For drywall installations, thermostat mounting shall use back-box attached to a wall stud. Drywall anchors are not acceptable.
- E. Mount any room thermostats or sensors mounted on exterior wall on thermally insulated sub-base. Subbase to provide minimum of one half inch of insulation.
- F. Where thermostats or sensors are mounted on exterior walls or in any location where air transfer will affect measured temperature or humidity seal conduit and any other opening that will effect measurement.
- G. Provide guards on thermostats in entrance hallways, other public areas, or in locations where thermostat is subject to physical damage.

3.7 LOW LIMIT THERMOSTATS (FREEZESTATS)

- A. Install low limit controls where indicated on Drawings or as specified.
- B. Unless otherwise indicated, install sensing element on downstream side of heating coils.
- C. Mount units using flanges and element holders.
- D. Provide duct collars or bushings where sensing capillary passes through sheet metal housings or ductwork; seal this penetration to eliminate air leakage.
- E. Mount units in an accessible location as to allow for resetting after low limit trips while still meeting manufacturer's installation requirements for proper function.

- F. Distribute (serpentine) sensing element horizontally across coil to cover every square foot of coil; on larger coils this may require more than one instrument.
- G. Install controls at accessible location with mounting brackets and element duct collars where required.
- H. For integral face and bypass coils elements are to be run vertically on face of heating coil inside damper enclosure. This shall require drilling frame to run element around by-pass.

3.8 TEMPERATURE CONTROL PANELS

- A. Mount control panels adjacent to associated equipment on vibration-free walls or freestanding angle iron supports.
- B. One cabinet may accommodate more than one system in same equipment room.
- C. Provide permanent printed labeling for instruments and controls inside cabinet and engraved plastic nameplates on cabinet face.
- D. Provide control Record Drawings of all systems served by each local panel in location adjacent to or inside of panel cover. Provide protective cover or envelope for drawings.

3.9 CURRENT STATUS SWITCHES

- A. Provide for each fan or pump specified, or shown on point list.
- B. Set threshold adjustment to indicate belt or coupling loss.
- C. Readjust threshold for proper operation after final balancing is completed.
- D. Use variable frequency drive (VFD) integrated relay output for motor status, if provided on VFD, in lieu of a discrete current switch.
- E. Wire separate current switch provided under this Section in parallel with VFD motor status relay when bypass starter is provided on VFD to prove motor status in bypass mode.

END OF SECTION

SECTION 23 09 23

DIRECT DIGITAL CONTROL SYSTEM FOR HVAC

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes
 - 1. Local Control Panels.
 - 2. Direct Digital Controls (DDC).
 - 3. Networking/Communications.
 - 4. Supervisory Controllers.
 - 5. System Software.
 - 6. Programmable Controllers.
 - 7. Application Specific Controllers – HVAC.

- B. Related Sections
 - 1. Applicable provisions of Division 01 shall govern all work under this Section.
 - 2. Section 23 05 00 - Basic HVAC Requirements.
 - 3. Section 23 05 93 - Testing, Adjusting, and Balancing for HVAC – Coordination.
 - 4. Section 23 09 14 - Pneumatic and Electric Instrumentation and Control Devices for HVAC.
 - 5. Section 23 09 93 - Sequence of Operations for HVAC Controls.

1.2 REFERENCES

- A. Federal Communication Commission (FCC)
 - 1. FCC Part 15, Subpart J, Class A - Digital Electronic Equipment to Radio Communication Interference

1.3 WORK NOT INCLUDED

- A. Section 23 09 14 – Pneumatic and Electrical Instrumentation and Control Devices for HVAC work includes furnishing and installing all field devices, including electronic sensors for DDC of this section, equipment, and all related field wiring, interlocking control wiring between equipment, pneumatic tubing, and sensor mounting, that is covered in that section.

- B. Motorized control dampers and actuators, thermowells (temperature sensing wells), automatic control valves, and their actuators are also covered in Section 23 09 14 – Pneumatic and Electrical Instrumentation and Control Devices for HVAC.

1.4 QUALITY ASSURANCE

- A. Manufacturer: Firm regularly engaged in manufacture of DDC control equipment similar to specified equipment and has been in satisfactory similar service for not less than 8 years.
- B. Installer:
 - 1. Firm specializing and experienced in DDC control system installation for no less than 3 years.
 - 2. Work shall be done by qualified mechanics in direct employ of this manufacturer, or of n Authorized Representative of that manufacturer that provides engineering and commissioning of manufacturer's control equipment.
 - 3. Where installing contractor is authorized representative of control equipment manufacturer, submit written confirmation of such authorization.
 - 4. Indicate in letter of authorization that installing contractor has successfully completed necessary training required for engineering, installation, and commissioning of equipment and systems to be provided for project, and that such authorization has been in effect for period of not less than three years.
- C. Response Time: During warrantee period: Four (4) hours or less 24-hours/day 7 days/week.
- D. Electrical Standards: Provide electrical products, which have been tested, listed and labeled by Underwriters' Laboratories (UL) and comply with NEMA standards.

1.5 SUBMITTALS

- A. Division 01 – General Requirements: Shop drawings, product data and samples.
- B. Product Data:
 - 1. Submit manufacturer's specifications for each control device furnished, including installation instructions and startup instructions.
 - 2. General catalog sheets showing a series of same device is not acceptable unless specific model is clearly marked.
 - 3. Annotated software program documentation shall be submitted for system sequences, along with descriptive narratives of sequence of operation of entire system involved.
 - 4. Submit wiring diagram for each electrical control device along with other details required to demonstrate that system has been coordinated and will function as a system.
- C. DDC manufacturer shall provide written proof with shop drawings that equipment being provided is in compliance with FCC rules governing control of interference caused by Digital Electronic Equipment to Radio Communications (Part 15, Subpart J, Class A).
- D. Maintenance Data: Submit maintenance data and spare parts lists for each control device. Include this data in maintenance manual.
- E. Record Drawings: Prior to request for final payment, provide complete composite Record Drawings to incorporate DDC and Pneumatic/Electric field work.

1.6 TRAINING

- A. Provide minimum of 8 hours of training to Owner's personnel, concerning proper operation and maintenance of control system provided. Conduct training sessions during normal business hours after system start-up and acceptance by Owner.
- B. Submit operating and maintenance manuals to Owner a minimum of five (5) working days prior to training session. Use these manuals as basis for instruction at all training sessions.
 - 1. Provide two follow-up visits for troubleshooting and instruction, one six months after substantial completion and other at end of warranty period.
 - 2. Length of each visit to be not less than 2 hours or time necessary to provide required information and complete troubleshooting and inspection activity for controls installed under Section 23 09 23 - Sequence of Operations for HVAC Controls and Section 23 09 14 - Pneumatic and Electric Instrumentation and Control Devices for HVAC.
 - 3. Coordinate visit with Owner and provide an inspection report to Owner of any deficiencies found.

1.7 MATERIAL DELIVERY AND STORAGE

- A. Provide factory shipping cartons for each piece of equipment and control device. Contractor is responsible for storage of equipment and materials inside and protected from weather.

PART 2 PRODUCTS

2.1 DIRECT DIGITAL CONTROL SYSTEM

- A. Manufacturers:
 - 1. Johnson Controls, Inc.
 - 2. Automated Logic.
 - 3. Carrier.
 - 4. Siemens.
 - 5. Honeywell.
 - 6. Substitutions: In accordance with Division 01 – General Requirements.

2.2 SYSTEM REQUIREMENTS

- A. Provide DDC control products in sizes and of capacities as required, conforming to manufacturer's standard materials and components as published in their product information, designed and constructed as recommended by manufacturer and as required for application indicate.
- B. System shall be capable of operating with 120 VAC power supply, fully protected with shutdown-restart circuit, and associated hardware and software.

2.3 LOCAL CONTROL PANELS

- A. Use control panels with suitable mounting brackets for each supply fan system. Locate panel adjacent to system served.
- B. Fabricate panels of 14-gauge furniture grade steel or 6063-T5 extruded aluminum alloy, totally enclosed on six sides, hinged door and keyed lock, with manufacturer's standard shop painted finish and color.
- C. Provide UL listed cabinets for use with line voltage devices.
- D. Plastic control enclosures will be approved provided all conduits are bonded and grounded.
- E. Provide control panels for DDC Controllers, ASC's, and associated function modules. Controls to be in panels except for terminal unit controllers mounted within terminal unit equipment enclosure or VAV box controllers designed to be directly mounted on air terminals.
- F. Permanently label controls; tag all control wiring.

2.4 DIRECT DIGITAL CONTROLS

- A. System to be capable of integrating multiple building functions, including equipment supervision and control, alarm management, energy management, and trend data collection.
- B. DDC to consist of Supervisory Controllers, Programmable Controllers, stand-alone Application Specific Controllers (ASC's), Operator Terminals, Operator Workstations, DDC system servers, and other operator interface devices.
- C. System shall be modular in nature, and shall permit expansion of both capacity and functionality through addition of sensors, actuators, ASC's, and operator devices.
- D. Failure of any single component or network connection shall not interrupt execution of control strategies at other operational devices.

2.5 NETWORKING AND COMMUNICATIONS

- A. Design of DDC shall be networked.
- B. Inherent in system's design shall be ability to expand or modify network either by local network, auto-dial telephone line modem connections, or combination of these two schemes.
- C. DDC communications network shall be capable of direct connection to and communication with high-speed local area network (LAN) such as ARCNET or Ethernet.

- D. Supervisory controller shall directly oversee local network such that communications may be executed directly to and between programmable controllers and ASC's.
- E. Operator devices, either network resident or connected via dial-up modems, shall have ability to access points and application reports on network.
- F. Provide RS-232 ports on all ASC's for operator's terminal communications with DDC Controller from any ASC on network.
- G. Do not restrict access to system data by hardware configuration of DDC system.
- H. Global data sharing or global point broadcasting shall allow point data to be shared between programmable controllers and ASC's when it would be impractical to locate multiple sensors.
- I. Network design shall include the following provisions:
 - 1. Data transfer rates for alarm reporting and quick point status from multiple programmable controllers and ASC's. Minimum baud rate shall be 9600 baud.
 - 2. Support of any combination of programmable controllers and ASC's. A minimum of 32 programmable controllers and ASC's shall be supported on a single local network. Buss shall be addressable for up to 32 ASC's.
 - 3. Detection of single or multiple failures of ASC's or network media.
 - 4. Error detection, correction, and re-transmission to guarantee data integrity.
 - 5. Use commonly available, multiple-sourced, networking components.
 - 6. Use of an industry standard communication transport, such as, ARCNET, Ethernet, or RS-485 communications interface.

2.6 SUPERVISORY CONTROLLERS

- A. Supervisory controllers shall be microprocessor-based, multi-tasking, multi-user, and digital control processors.
- B. Provide each supervisory controller sufficient memory to support its own operating system and databases including:
 - 1. Control processes.
 - 2. Energy management application.
 - 3. Alarm management.
 - 4. Trend data.
 - 5. Maintenance support applications.
 - 6. Operator I/O.
 - 7. Dial-up communications.
 - 8. Manual override monitoring.
- C. System shall be modular in nature, and shall permit easy expansion through addition of field controllers, sensors, and actuators.

- D. Supervisory controllers shall provide at least two RS-232C or USB serial communication ports or Ethernet ports for simultaneous operation of multiple operator I/O devices, such as laptop computers, personal computers, and video display terminals.
- E. Supervisory controllers shall monitor status of all overrides and include this information in logs and summaries to inform operator that automatic control has been inhibited.
- F. Each supervisory controller shall continuously perform self-diagnostics, communications diagnostics, and diagnostics of all subsidiary equipment.
- G. Supervisory controllers shall provide both local and remote annunciation of any detected component failures, or repeated failure to establish communication.
- H. Provide indication of diagnostic results at each supervisory controller.
- I. Provide isolation at all network terminations, as well as field point terminations, to suppress induced voltage transients.
- J. Isolation levels shall be sufficiently high to allow all signal wiring to be run in same conduit as high voltage wiring acceptable by electrical code.
- K. In event of loss of normal power, there shall be orderly shutdown of supervisory controller to prevent loss of database or operating system software.
- L. Incorporate non-volatile memory for critical controller configuration data, and provide battery backup to support real-time clock and all volatile memory for minimum of 72 hours.
- M. Upon restoration of normal power, supervisory controller shall automatically resume full operation without manual intervention.
- N. Should supervisory controller memory be lost for any reason, supervisory controller shall have capability of reloading it's programming via high speed local area network from control system archive workstation or server, local RS-232C port, or telephone line dial-in.

2.7 SYSTEM SOFTWARE FEATURES

- A. Provide necessary software to form complete operating system, as described in this specification, as integral part of supervisory controller, and not be dependent upon higher level computer for execution.
- B. Control software shall include provision for limiting number of times that each piece of equipment may be cycled within any one-hour period.
- C. System shall provide protection against excessive demand situations during start-up periods by automatically introducing time delays between successive start commands to heavy electrical loads.

- D. Supervisory controllers shall have ability to perform any or all of the following energy management routines:
 - 1. Time of day scheduling
 - 2. Calendar based scheduling.
 - 3. Holiday scheduling.
 - 4. Optimal start.
 - 5. Optimal stop.
 - 6. Demand limiting.
 - 7. Load rolling.
 - 8. Heating/cooling interlock.

- E. Programs shall be executed automatically without need for operator intervention, and be flexible enough to allow user customization.

- F. Apply programs to building equipment described in Section 23 09 93 – Sequence of Operations for HVAC Controls, of this specification.

- G. Supervisory controllers shall be able to execute configured processes defined by user to automatically perform calculations and control routines.

- H. It shall be possible to use any of the following in configured process:
 - 1. Any system-measured point data or status.
 - 2. Any calculated data.
 - 3. Any results from other processes.
 - 4. Boolean logic operators (and, or).

- I. Configured processes may be triggered based on any combination of the following:
 - 1. Time of day.
 - 2. Calendar date.
 - 3. Other processes.
 - 4. Events (point alarms).

- J. Single process shall be able to incorporate measured or calculated data from any and all other ASC's.

- K. Single process shall be able to issue commands to points in any and all other programmable controllers and ASC's on local network.

- L. Provide alarm management to monitor, buffer, and direct alarm reports to operator devices and memory files.

- M. Each supervisory controller shall perform distributed; independent alarm analysis and filtering to minimize network traffic and prevent alarms from being lost.

- N. At no time shall ability of supervisory controllers to report alarms be affected by either operator activity at local I/O device or communications with other ASC's on network.
- O. Alarm or point change reports shall include English language description of each point and time and date of occurrence.
- P. User shall be able to define specific system reaction for each point.
- Q. Prioritize alarms to minimize nuisance reporting and to speed operator response to critical alarms.
- R. Provide minimum of three priority levels. Provide user ability to manually inhibit alarm reporting for each point.
- S. User shall also be able to define conditions under which point changes need to be acknowledged by operator and logged for analysis at later date.
- T. Direct alarms reports and messages to an operator device.
- U. In addition to point's descriptor and time and date, user shall be able to print, display, or store 60-character alarm message more fully describing alarm condition or directing operator response.
- V. Provide each supervisory controller with capability of storing library of at least 100 messages. Each message may be assignable to any number of points in panel.
- W. Provide data collection utility to automatically sample, store, and display system data.
- X. Measured and calculated analog and binary data shall be assignable to user definable trends for purpose of collecting operator specified performance data over extended periods of time.
- Y. Provide sample intervals of 1 minute to 24 hours, in one minute or one hour intervals.
- Z. Provide each supervisory controller with a dedicated buffer for trend data and ability to store 16 trend logs.
- AA. Each trend log shall have up to four points trended at 48 data samples each.
- BB. Store data at supervisory controller and up-load to DDC system server when archiving is desired.
- CC. Supervisory controllers shall automatically accumulate and store runtime hours for binary input and output points specified in Section 23 09 14 – Pneumatic and Electrical Instrumentation and Control Devices for HVAC, of this specification.

- DD. Supervisory controllers shall automatically sample, calculate, and store consumption totals on daily, weekly, or monthly basis, user defined, for user-selected analog and binary pulse input type points.
- EE. Totalization shall provide calculation and storage accumulations of up to 9,999,999 units (e.g., KWH, gallons KBTU, tons, etc.).
- FF. Totalization routine shall have sampling resolution of one minute.
- GG. Provide user ability to define warning limit. Generate unique, user specified messages when limit is reached.
- HH. Information available from pulse totalization shall include, but not be limited to, the following:
 - 1. Peak demand, with date and time stamp.
 - 2. 24-hour demand log.
 - 3. Accumulated KWH for day.
 - 4. Sunday through Saturday KWH usage.
 - 5. Demand KW annual history for past 12 periods.
 - 6. KWH annual history for past periods.
- II. Provide supervisory controller's ability to count events, such as number of times pump or fan system is cycled on and off.
- JJ. Provide event totalization feature ability to store records associated with minimum of 9,999,999 events before reset.

2.8 PROGRAMMABLE CONTROLLERS

- A. Provide programmable controllers with software program that allows user to design flexible software algorithms for control sequences as described in Sections 23 09 14 – Pneumatic and Electrical Instrumentation and Control Devices for HVAC and 23 09 93 of this specification.
- B. Programmable controllers shall support all necessary point inputs and outputs to perform specified control sequence in totally stand-alone fashion.
- C. Each programmable controller shall perform its' own limit and status monitoring and analysis to maximize network performance by reducing unnecessary communications.
- D. Each programmable controller shall support use of locally mounted status and adjust panel interface to allow for local adjustment of all setpoints, temporary override of any input or output points, and status of all points directly at controller. Capabilities of locally mounted status and adjust panel shall include, but not be limited to, the following information for programmable controllers to which:
 - 1. Display temperatures.

2. Display status.
 3. Display setpoints.
 4. Display control parameters.
 5. Override binary output control.
 6. Override analog setpoints.
 7. Modification of gain and offset constants.
- E. Store all system setpoints, proportional bands, control algorithms, and any other programmable parameters such that power failure of any duration does not necessitate reprogramming programmable controller.
- F. Programmable controllers shall support, but not be limited to, the following configurations of systems to address current requirements as described in Sections 23 09 14 - Sequence of Operations for HVAC Controls and 23 09 93 – Sequence of Operations for HVAC Controls, portions of this specification, and for future expansion of air handling units:
1. Mixed air handling units.
 2. 100 percent outside air handling units.
 3. Boiler or chiller plants with pump logic.
 4. Hot water heat exchangers.
 5. Cooling towers.
 6. Zone pressurization of labs.
 7. Smoke control systems.
 8. Generic system interlocking through hardware.

2.9 APPLICATION SPECIFIC CONTROLLERS - HVAC APPLICATIONS

- A. Each supervisory controller shall be able to extend its monitoring and control through use of stand-alone application specific controllers (ASC's).
- B. Each ASC shall operate as stand-alone controller capable of performing its specified control responsibilities independently of other controllers in network. Each ASC shall be microprocessor based, multi-tasking, real-time digital control processor.
- C. Each ASC shall have sufficient memory to support its own operating system and databases including:
1. Control processes.
 2. Energy management applications.
 3. Operator I/O (portable service terminal).
- D. Operator interface to any ASC point or program shall be through supervisory controller connection to any ASC on network.
- E. ASC's shall directly support temporary use of portable service terminal that can be connected to ASC via zone temperature or directly at controller. Capabilities of portable service terminal shall include, but not be limited to, the following information:

1. Display temperatures.
 2. Display status.
 3. Display setpoints.
 4. Display control parameters.
 5. Override binary output control.
 6. Override analog setpoints.
 7. Modification of gain and offset constants.
- F. Store system setpoints, proportional bands, control algorithms, and any other programmable parameters such that power failure of any duration does not necessitate reprogramming ASC.
- G. ASC's shall support, but not be limited to, the following configurations of systems to address current requirements as described in Sections 23 09 14 - Sequence of Operations for HVAC Controls and 23 09 93 – Sequence of Operations for HVAC Controls, of this specification, and for future expansion of air handling units:
1. Variable air volume terminals.
 2. Reheat terminals.
 3. Fan coils.
 4. Unit ventilators.
 5. Packaged air handling units.

2.10 OPERATOR INTERFACE REQUIREMENTS

- A. Command Entry and Menu Selection Process: Operator interface software shall minimize operator training through use of English language prompting and point identification.
- B. Text-Based Displays:
1. Operator interface shall provide consistent text-based displays of all system point and application data described in this specification.
 2. Point identification, engineering units, status indication, and application naming conventions shall be same at all operator devices.
- C. Graphic-Based Displays:
1. Operator interface shall provide graphic based displays of each system.
 2. Point data associated with each system shall dynamically update at minimum of every 30 seconds.
 3. Link graphic displays to each other to provide “drill down” capability from main graphic displays to more specific system based displays.
 4. Provide building level graphic display that links to system graphics.
 5. For systems that have ASC controlled terminal unit controls, provide building floor plan with dynamic temperatures shown on graphic that can be drilled into for more specific terminal information.

- D. Password Protection: Provide multiple-level password access protection to allow user/manager to limit control, display, and data base manipulation capabilities as he deems appropriate for each user, based upon assigned password.
- E. Use exact same password for all operator devices.
- F. Support minimum of three levels of access:
 - 1. Level 1: Data access and display.
 - 2. Level 2 = Level 1 + operator overrides and commands.
 - 3. Level 3 = Level 2 + database generation and modification.
- G. Support minimum of 4 passwords at each supervisory controller.
- H. Operators to be able to perform only those commands available for their respective passwords.
- I. Limit menu selections displayed at any operator device to only those items defined for access level of password used to log-on.
- J. Provide user definable, automatic log-off timers of from 1 to 60 minutes to prevent operators from inadvertently leaving devices on-line.
- K. Operator Commands: Operator interface shall allow operator to perform commands including, but not limited to, the following:
 - 1. Start-up or shutdown selected equipment.
 - 2. Adjust setpoints.
 - 3. Add/modify/delete time programming.
 - 4. Enable/disable process execution.
 - 5. Lock/unlock alarm reporting for each point.
 - 6. Enable/disable totalization for each point.
 - 7. Enable/disable trending.
 - 8. Enter temporary override schedules.
 - 9. Define holiday schedules.
 - 10. Change time/date.
 - 11. Enter/modify analog alarm limits.
 - 12. Enable/disable analog alarm limits.
 - 13. Enable/disable demand limiting.
 - 14. Enable/disable duty cycle.
- L. Logs and Summaries: Manually generate reports and direct to displays. As minimum, system shall allow user to easily obtain general listing of all points in system including, but not limited to:
 - 1. Points currently in alarm.
 - 2. Off-line points.
 - 3. Points currently in override status.

4. Points in weekly schedules.
 5. Holiday programming.
- M. Provide summaries for specific points, for logical point group, for user-selected group of groups, or for entire facility without restriction due to hardware configuration on facility management system.
- N. Under no conditions shall operator need to specify address of hardware controller to obtain system information.
- O. System Configuration and Definition:
1. Temperature and equipment control strategies and energy management routines shall be definable by operator.
 2. System definition and modification procedures shall not interfere with normal system operation and control.
- P. Provide complete system with equipment, software, and documentation necessary to allow operator to independently perform the following functions:
1. Add/delete/modify application specific controllers.
 2. Add/delete/modify points of any type, and all associated point parameters, and tuning constants.
 3. Add/delete/modify alarm reporting definition for each point.
 4. Add/delete/modify energy management applications.
 5. Add/delete/modify time and calendar-based programming.
 6. Add/delete/modify totalization for every point.
 7. Add/delete/modify historical data trending for every point.
 8. Add/delete/modify configured control processes.
 9. Add/delete/modify dial-up telecommunication definition.
 10. Add/delete/modify all operator passwords.
 11. Add/delete/modify alarm messages.
- Q. Programming Description:
1. Perform definition of operator device characteristics, ASC's, and individual points through fill-in-the-blank templates.
- R. Network-wide Strategy Development:
1. Do not restrict inputs and outputs for any process to single ASC, but allow ability to include data from any and other ASC's to develop network-wide control strategies.
- S. System Definition and Control Sequence Documentation:
1. Portions of system definition shall be self-documenting and capable of providing hardcopy printouts of configuration and application data.
- T. Database Save and Restore Backup:

1. Store backup copies of all programmable controller, ASC, and supervisory controller databases in at least one personal computer or laptop.
2. Users shall also have ability to manually execute downloading of programmable controller, ASC, or supervisory controller database.

2.11 OPERATOR WORK STATION AND DDC SYSTEM SERVER

- A. Provide personal computer (PC) operator workstation and DDC system server software for command entry, information management, network alarm management, database management and archiving functions.
- B. Functions of operator workstation and DDC system server may reside on single personal computer.
- C. Provide separate DDC system server PC if required to perform specified requirements.
- D. Functions specified under entire Operator Interface section of this specification shall be satisfied.
- E. Real-time control functions shall be resident in stand-alone supervisory controllers to facilitate greater fault tolerance and reliability.
- F. Workstation shall be general purpose, commercially available, personal computers with dual-core processor with minimum speed of 2 GHz, minimum of 2 GB of RAM, minimum hard drive size of 200 GB, and R/W DVD/CD drive.
- G. Provide more memory and faster processor if necessary to perform all functions described in this specification.
- H. Provide sufficient storage to accommodate fully configured point databases, application databases, graphics databases, user-defined reports, and historical data archived as described in this specification.
- I. Provide display for system operation with diagonal screen measurement of no less than 17 inches and minimum display resolution of no less than 1024 x 1280 pixels.
- J. Provide separate controls for color, contrast, and brightness.
- K. Printer shall be current production model.
- L. Provide software, including but not limited to functions such as:
 1. Grouping point data by systems or types.
 2. Displaying trends in textual and graphical format.
 3. Application software for programming all DDC controllers specified herein.
 4. Graphics definition and development.

5. Managing archive data and programs.

2.12 WEB BASED HTML BROWSER INTERFACE

- A. Provide HTML based browser interface (Web Server) for accessing DDC system. Include hardware and software to provide Ethernet twisted pair connection to Owner's local or wide area network (LAN or WAN) that can be used to access DDC system through standard internet browser.
- B. Provide information to Owner's IT staff to facilitate connection through Owner's LAN/WAN.
- C. At minimum, this interface shall be capable of all functions described under Operator Interface section, and Password Protection, Operator Commands, and Logs and Summary subsections of this specification.

2.13 THIRD-PARTY INTERFACES

- A. DDC Contractor shall integrate real-time data from systems supplied by other trades as required in Part 3.
- B. DDC system shall include necessary DDC hardware equipment and software to allow data communications between DDC system and systems supplied by other trades.
- C. Trade Contractor supplying other systems will provide their necessary hardware and software and will cooperate fully with DDC Contractor in timely manner at their cost to ensure complete data integration.

PART 3 EXECUTION

3.1 GENERAL

- A. Electronic work required as integral part of Direct Digital Control system work is responsibility of this section unless specifically indicated otherwise in this section, Section 23 09 14 - Pneumatic and Electrical Instrumentation and Control Devices for HVAC, or in Division 26 - Electrical.
- B. This Contractor shall provide all labor, materials, engineering, software, permits, tools, checkout, and certificates required to install complete Direct Digital Control system as specified.
- C. Group any and all points added with this project for display purposes into system such that all points associated with new or existing DDC system can appear together on CRT display or printed log.
- D. Assignment of points to group shall not be restricted by hardware configuration of points of direct digital control. It shall be possible to assign point to appear in more than one system.

- E. English descriptor and alpha and numeric identifier shall identify each system.
- F. Direct Digital Control system as specified shall be fully integrated and completely installed by this section.
- G. Include required computer CPU software and hardware.
- H. Include engineering, installation, supervision, calibration, software programming, and checkout necessary for fully operational system.

3.2 INSTALLATION

- A. Work and materials are to conform in every detail to rules and requirements of National Electrical Code and present manufacturing standards.
- B. Wiring and cable installation shall conform with wiring installation as specified in Section of Section 23 09 14 - Pneumatic and Electrical Instrumentation and Control Devices for HVAC.
- C. Material shall be UL approved.
- D. Install system and materials in accordance with manufacturer's instructions, rough-in drawings and details on Drawings.
- E. Control panels serving equipment fed by emergency power shall also be served by emergency power.
- F. Provide uninterruptable power supplies where necessary to provide proper startup of equipment or to accomplish power restart control sequences specified.
- G. Mount control panels adjacent to associated equipment on vibration-free walls or free-standing angle iron supports.
- H. One cabinet may accommodate more than one system in same equipment room.
- I. Provide engraved plastic nameplates for instruments and controls inside cabinet and on cabinet face.
- J. Provide as-built control drawings of all systems served by each local panel in location adjacent to or inside of panel cover. Provide protective cover or envelope for drawings.
- K. Cable tray routing of communication trunks is acceptable.
- L. Provide input for service shutdown toggle switch for each air handling unit system provided inside temperature control panel that will initiate logical shutdown of air handling unit system.

- M. Permanently tag all tubing, cable and individual wiring with numbers corresponding with "Record Drawings". Label spares as "Spare".
- N. Provide technician to work with air balancing Contractor and/or provide balancing Contractor with necessary hardware to over-ride DDC controllers for air balancing.
- O. Provide documentation to demonstrate that all points, input and output have been checked out and verified operational, note any points not operating properly with notation of reason.

END OF SECTION

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SECTION 23 09 93
SEQUENCE OF OPERATION FOR HVAC CONTROLS

PART 1 GENERAL

1.1 SUMMARY

- A. This section includes control sequences for HVAC equipment as well as equipment furnished by others that may need monitoring or control. Included are the following control sequences:
 - 1. General Control.
 - 2. Exhaust fan control.
 - 3. Heat exchanger control.
 - 4. Heating water pump control.
 - 5. Terminal unit control – DDC and electric.
 - 6. Variable volume mixed air handling unit control.

- B. Related Sections
 - 1. Applicable provisions of Division 01 govern work under this Section.
 - 2. Section 23 05 93 - Testing, Adjusting, and Balancing for HVAC.
 - 3. Section 23 09 14 - Pneumatic and Electric Instrumentation and Control Devices for HVAC.
 - 4. Section 23 09 23 – Direct Digital Control System for HVAC: Direct Digital Controls (DDC).
 - 5. Division 23 - HVAC - Equipment provided to be controlled or monitored
 - 6. Division 26 - Electrical – Electrical characteristics and wiring connections.
 - 7. Division 28 - Electronic Safety and Security

1.2 QUALITY ASSURANCE

- A. Section 23 09 14 - Pneumatic and Electric Instrumentation and Control Devices for HVAC:
 - 1. Work includes furnishing and installing all field devices, including electronic sensors for DDC of this section, equipment, and all related field wiring, interlocking control wiring between equipment, pneumatic tubing, sensor mounting, which is covered in that section.
 - 2. Motorized control dampers and actuators, thermowells (temperature sensing wells), automatic control valves and their actuators are also covered in Section 23 09 14 - Pneumatic and Electric Instrumentation and Control Devices for HVAC.

1.3 DESCRIPTION OF WORK

- A. Control sequences are hereby defined as manner and method by which automatic controls function. Requirements for each type of operation are specified in this section.

- B. Operation equipment, devices and system components required for automatic control systems are specified in other Division 23 control sections of these specifications.
- C. All temperature, humidity, and pressure sensing, and all other control signal transportation for control sequences shall be furnished under Section 23 09 14 - Pneumatic and Electric Instrumentation and Control Devices for HVAC.
- D. All electronic, and electric input/output signals shall be extended under Section 23 09 14 - Pneumatic and Electric Instrumentation and Control Devices for HVAC, with adequate lead length for termination within appropriate control panel being provided under Section 23 09 23.
- E. Sequences for equipment controlled by Direct Digital Controls (DDC) as specified are accomplished by hardware and software provided under Section 23 09 23. Sequences for equipment controlled by pneumatic or electric self-contained controls are accomplished by hardware provided under Section 23 09 14 - Pneumatic and Electric Instrumentation and Control Devices for HVAC.

1.4 SUBMITTALS

- A. Division 01 and Sections 23 09 23 and 23 09 14 - Pneumatic and Electric Instrumentation and Control Devices for HVAC for descriptions of what should be included in submittals.
- B. Shop drawings shall be provided by contractor(s) providing equipment under Sections 23 09 23 and 23 09 14 - Pneumatic and Electric Instrumentation and Control Devices for HVAC.
- C. Contractor providing DDC equipment shall provide complete narrative of sequence of operations for equipment that is controlled through DDC system.
- D. Contractor providing Section 23 09 14 - Pneumatic and Electric Instrumentation and Control Devices for HVAC equipment shall provide complete narrative of sequence of operation for equipment that is controlled directly from that equipment (without control logic through DDC system).
- E. Narrative of sequence of operation shall not be verbatim copy of sequences contained within these specifications, but shall reflect actual operation as applied by Contractor.
- F. All submittals are to comply with submission and content requirements specified in specification Division 01.

1.5 OPERATION AND MAINTENANCE DATA

- A. All operations and maintenance data shall comply with submission and content requirements specified under section General Requirements and specification Division 01.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.1 GENERAL CONTROL

A. Setpoints:

1. All setpoints indicated in control specification are to be adjustable.
2. Setpoints shall be readily available to be modified in mechanical system software system summary (either textual or graphic based) and under same software level as hardware points.
3. Some less used setpoints may be provided on lower software level, if requested by user for clarity.
4. Setpoints indicated are only specified as calculated starting point (or initial system operation). It is expected that setpoint adjustments and control loop tuning shall be required to provide optimum system operation based on requirements of building.
5. Control contractor shall work with balancing contractor and Owner's Representative to provide final system setpoint adjustments and control loop tuning after system is in operation and building is in use.
6. Document all final setpoints on record drawings. Any questions regarding intended operation of HVAC equipment and control systems shall be referred to HVAC design engineer through appropriate construction communication process.
7. The following setpoints should be used as initial setpoints unless otherwise specified in individual control sequences:
 - a. Occupied Space Terminal Unit Heating: 68 degrees F
 - b. Occupied Space Terminal Unit Cooling: 76 degrees F
 - c. Entry Way Heating: 60 degrees F
 - d. Mechanical or Unoccupied Space Ventilation: 82degrees F
 - e. Mechanical or Unoccupied Space Heating: 60 degrees F

B. Anti-cycling:

1. When HVAC equipment or sequence is specified to be started and stopped by temperature, humidity, pressure setpoint or any other controlled variable, there shall be adjustable differential setpoint that shall be set to prevent short cycling of systems and equipment due to minor changes in controlled variable.
2. Temperature differential setpoints shall be set at 2 degrees F and non-temperature setpoints shall be set at 10 percent of controlled range unless otherwise specified.
3. Setpoints shall indicate at when process should be turned on.
4. Cooling differentials shall be set for below setpoint and heating differentials shall be set above setpoint and will be used to turn process off.
5. For example, economizer sequence called to switch at 68 degrees F would turn on at

68 degrees F and off at 70 degrees F since it is cooling function.

6. Heating lockout setpoint of 50 degrees F would turn on heating control at 50 degrees F and off at 52 degrees F Non-temperature differentials shall be set above setpoint if setpoint is indicating minimum value or below setpoint if setpoint is indicating maximum value.
7. Provide minimum runtime timers for loads that are cycled to prevent over-cycling.
8. Timers shall be set as specified or as needed to prevent damage or excessive wear to equipment.
9. Unless otherwise specified in individual control sequences, fans and pumps shall have minimum runtime on timers of 15 minutes (adjusted) and off timers of 5 minutes (adjusted). Safeties shall override runtime timers.

C. Deadbands:

1. Provide deadbands for all DDC control loops to prevent constant hunting of output signals to controlled devices.
2. Deadbands shall be set to provide adequate control around setpoint as follows unless otherwise specified in the individual control sequences:
 - a. Temperature Control: ± 0.5 degrees F
 - b. Humidity Control: ± 1 percent RH
 - c. Airflow Control: ± 2 percent of total flow
 - d. AHU Static Pressure Control: ± 0.01 in. W.C.

D. Alarms:

1. Provide all alarmed points with adjustable time delays to prevent nuisance tripping under normal operation and on equipment start-up.
2. Provide alarms on all points as indicated on point charts. For existing campus automations systems, add or delete what is called on point charts for after consultation with Owner's Representative to provide consistent alarming throughout automation system.

E. Equipment Start/Stop Failure States:

1. All start/stop points for equipment shall utilize normally open contacts unless called out specifically in individual control sequences.

F. Lead/Lag Sequencing:

1. For sequences that call for lead/lag of equipment connected to building automation systems, lead device shall be able to be chosen through selectable day of week and time of day through building automation system.
2. Coordinate with Owner's Representative for scheduling switchover and frequency.
3. Unless otherwise directed, switchover shall occur at 10AM Tuesday and shall rotate lead device on weekly cycle rotating through all devices sequentially.
4. For standalone lead/lag sequence controllers (non-DDC), lead device shall be selected by switch on panel face.

- G. Variable frequency Drive (VFD) Motor Run Status:
1. Use VFD programmable relay dry contact output specified to be provided with VFD under Section 23 05 14 to prove motor run status and detect belt loss or coupling break.
 2. If bypass contactor is provided with VFD, provide adjustable current switch and wire it in parallel with VFD output for proving motor status.
- H. VFD Minimum Speed:
1. VFD start-up technician shall work with Temperature Control Contractor determine minimum speed required for motor controlled by VFD to provide cooling of motor as installed to prevent heat related problems.
 2. This minimum speed shall be set in VFD controller.
- I. Current Switch Setup:
1. When current switches are used for proving fan or pump status, they shall be set up so that they will detect belt or coupling loss by reduction in current draw on loss of coupled load.
 2. Current switch set up shall be redone by Section 23 09 14 contractor after balancer is complete.
- J. Damper Interlocks for Fans with Starters:
1. For fan systems with magnetic starters and shutoff dampers specified with end switches, damper interlock shall be hardwired in such way that damper shall open if fan starter Hand / Off / Auto switch is in hand or in auto position and being called to start.
 2. After damper end switch has proven damper open, hardwire interlock from end switch to starter holding coil for fan shall cause fan to start.
 3. For fan systems that are ducted in parallel, see specific sequence for fan system on interlock requirements.
- K. Damper Interlocks for Fans with VFD's:
1. For fan systems with VFD's and shutoff dampers specified with end switches, damper end switches shall be hardwire interlocked to safety circuit(s) of VFD to prevent fan from starting until damper is proven open.
 2. This interlock shall prevent fan from running in VFD or bypass (if provided) mode.
 3. For fan systems that are ducted in parallel, see specific sequence for fan system on interlock requirements.
- L. Fan Interlocking:
1. Provide interlocks between supply and return or exhaust fan systems as scheduled on plans or called out in individual control sequences.
 2. If DDC controlled, interlocks shall be done through DDC start/stop points unless otherwise specified in individual control sequences.

3. If not DDC controlled, interlocks shall be accomplished via hardwire interlocks between fan starters or VFD's.

M. Thermostats and Sensors:

1. All devices and equipment including terminal units, specified to be controlled in control sequence by thermostat or sensor, shall be provided with thermostat or sensor, whether or not device is indicated on Drawings.
2. Consult HVAC Design Engineer for thermostat or sensor location.

3.2 EXHAUST FAN CONTROL

A. Electrical equipment room exhaust fan EF-5, 6, 7, 8

1. Exhaust fan shall be controlled from wall mounted reverse acting thermostat. Exhaust fan shall cycle on/off to maintain setpoint temperature (80 degrees F).
2. Interlock two-position motorized air intake damper with exhaust fan such that air intake damper opens fully when exhaust fan is operating.
3. EF-5 shall operate continuously anytime building is occupied.

B. Summer ventilation exhaust fans EF-1 thru 4.

1. Summer ventilation fans shall be controlled from manual wall-mounted starter switches and reverse acting thermostat mounted at ceiling..
2. Interlock air intake dampers to open with respective ventilation fan.
3. Provide outside lock-out controls to prevent fan operation whenever outside air temperature is less than 50 degrees F.
4. Summer ventilation fans shall also be interlocked with gas monitoring and detection system to provide purge exhaust cycle that shall operate all fans continuously for minimum of 15 minutes, and until alarm is no longer present from gas monitoring system.

3.3 HEAT EXCHANGER CONTROL

A. Water-to-Water Heat Exchanger (HX-1 thru 3):

1. Install temperature sensors in heating water supply and return piping near inlet and outlet of heat exchanger.
2. Whenever Pump (PP-1) or Pump (PP-2) is running, as determined by DDC system, temperature of heating water supply shall be controlled to maintain setpoint.
3. Setpoint shall be 180 degrees F (adjusted).
4. Three-way electronic temperature control valves in engine jacket water circuits of each engine shall be modulated in sequence to maintain heating water supply temperature.
5. When hot water supply temperature is below setpoint, all three-way temperature control valves shall modulate open equally. Sequence shall be adjustable from DDC system.

6. Provide electronic two position valves in return branch of each heat exchanger to hydronic loop piping to open when associated engine generator is running.
7. Reverse shall occur when hot water supply temperature is above setpoint.
8. Whenever Pump (PP-1) and Pump (PP-2) are not running, three-way control valves shall be fully closed to heat exchanger.
9. Provide high limit temperature sensor aquastat located on hot water supply set at 210 degrees F and with 5 degrees F differential.
10. Temperature sensor shall override DDC system control and cause heat exchanger three-way valves to close if setpoint is exceeded.
11. Provide separate 10VDC signal powered separately from DDC controller and DDC controller transformer that will be switched through aquastat to provide backup high limit control.
12. Alarm shall be sent through DDC system if hot water supply temperature exceeds 200 degrees F or below 160 degrees F.
13. Provide low limit temperature sensor that shall alarm DDC system when primary pumps are active and water temperature is below 160 degrees F.

3.4 HEATING WATER PUMP CONTROL

A. Pump (PP-1) and Pump (PP-2) Control:

1. Start/Stop: DDC system shall start lead pump. Lag pump shall normally remain off. Hot water pump start/stop relays shall utilize normally closed contacts so upon failure of relay or DDC controller pump will fail on.
2. Lead/Lag Control: Current status switches, either integral to VFD and/or discreet devices, shall prove lead and lag pump operation. If lead pump is called to run and current status switch indicates that lead pump is not operating for 30 seconds (adjusted), alarm shall be sent to operator interface and DDC system shall start lag pump. Upon sensing lead pump is operating, lag pump shall be stopped. DDC system shall index lag pump to become lead pump through weekly scheduling feature of building automation system.
3. Flow Control: Install differential pressure sensor across supply and return piping at point in system with highest pressure drop as indicated on plans. DDC system shall control modulating two-way valve to maintain initial setpoint of 10 psig (adjusted) at differential pressure sensor. Final setpoint shall be optimized by Balancing Contractor.
4. Pump shall be called to run when outside air temperature is below 45 degrees F (adjusted).

3.5 TERMINAL UNIT CONTROL – DDC AND ELECTRIC:

- A. Reference valve chart in Section 23 09 14 – Pneumatic and Electrical Instrumentation and Control Devices for HVAC for requirements for type of valve, signal required, spring return requirements, and fail positions.

- B. Valve requirements specified in Section 23 09 14 – Pneumatic and Electrical Instrumentation and Control Devices for HVAC valve chart shall supersede what is called out in terminal unit sequences.
- C. Make-Up Air Unit Heating Coil Control:
 - 1. Provide DDC discharge air temperature sensor to control modulating electronic hot water valve to maintain space temperature. Provide adjustable space sensor to provide override cycle of elevated setpoint (adjusted).
 - 2. When space temperature is below setpoint modulate hot water valve open.
 - 3. Reverse shall occur when space temperature is above setpoint. Provide discharge air temperature sensor for monitoring purposes.
- D. Unit Heater Control:
 - 1. Provide electric space thermostat to control the control valve to maintain space temperature.
 - 2. Provide strap on aquastat mounted on hot water return line set at 100 degrees F to control unit fan when hot water temperature is above setpoint.
- E. Fan Coil Heating / Cooling Electric Control:
 - 1. Provide electric space thermostat to control modulating control valve for hot water and for DX compressor/condenser to maintain space temperature.
 - 2. When space temperature is below setpoint, thermostat shall de-energize air cooled compressor/condenser valve.
 - 3. Hot water valve shall open to maintain setpoint.
 - 4. When space temperature is above setpoint, thermostat shall close hot water valve.
 - 5. When hot water valve is fully closed, the compressor/condenser shall energize to maintain setpoint.
 - 6. Provide temperature sensor mounted on hot water return line.
 - 7. Set hot water aquastat at 100 degrees F to start unit fan when hot water is above setpoint.
 - 8. Interlock energy recovery ventilator with fan coil, so when building is occupied fan coil and energy recovery ventilator is energized.

3.6 AIR HANDLING UNIT CONTROL (AHU-X)

- A. Air Handling unit is variable air volume, indoor air unit.
- B. Air Handling unit is controlled by direct digital controller (DDC).
- C. Air Handling unit is equipped with the following:
 - 1. Supply fan with VFD.
 - 2. Exhaust fan with VFD, explosion proof construction.
 - 3. Outside air damper.

4. Exhaust air damper.
 5. Hydronic run around coils for heat recovery.
- D. Fan Control:
1. Start/Stop:
 - a. DDC system shall start supply and exhaust fan via VFD.
 2. Current Status Switch:
 - a. Provide as specified, VFD Motor Run Status, in this Section for supply and exhaust fans.
 3. Supply Fan Speed Control:
 - a. Purpose of supply fan control is to maintain negative space pressure in product area.
 - b. Install differential pressure sensing probe between product area and break room. Maintain 0.05" negative pressure in product area.
 - c. DDC system shall modulate supply fan VFD to maintain pressure setpoint.
 - d. Final differential pressure setpoint shall be determined by Balancing Contractor.
 4. Exhaust Fan Speed Control:
 - a. Exhaust fan shall ramp up to scheduled value and operate continuously at that point.
- E. Filters:
1. Install differential static pressure sensor across each filter bank. Ensure that static probes do not impede filter removal.
 2. For pre-filter bank, provide alarm to operator interface when differential static pressure exceeds 0.5" W.C. (adjusted).
- F. Discharge Air Temperature Control:
1. Install temperature sensor in supply duct downstream of the supply fan and all water coils and humidifiers.
 2. Discharge Air Temperature Setpoint: Heating discharge air temperature setpoint shall be 75 degree F (adjusted).
 3. Discharge Air Temperature Control:
 - a. Heating coil shall be controlled in sequence to maintain discharge air setpoint temperature.
 - b. Whenever discharge air temperature is above setpoint heating coil valve shall be closed.
 4. Pumped Hot Water Heating Coil Control:
 - a. Modulate hot water/glycol control valve as sequenced under discharge air control.
 - b. Start hot water/glycol pump whenever entering air temperature is below 60 degrees F (adjusted).

- c. Stop hot water pump whenever entering air temperature is above 60 degrees F (adjusted).

G. Safeties:

1. All safeties shall be hard wired to supply and return fan starters or VFD safety circuits. Starters shall not function in “Hand” or “Auto” and VFD’s shall be disabled if they are indexed to “Auto” or “Hand” position in VFD or bypass modes.
2. Freezestat:
 - a. Install electric freezestat, reference to specification Section 23 09 14 for location information, to shut down unit, reference Unit Shutdown for additional information) if temperature downstream of heating coil drops below 35 degrees F (adjusted).
 - b. Electric freezestat shall act independently of DDC system via hardware interlock and shall override DDC system control signal to open heating coil control valves.
 - c. Freezestat trip shall notify DDC system that shall send alarm to operator interface.
3. Fire Alarm Shutdown:
 - a. Upon Fire Alarm System alarm, fire alarm control module provided by electrical contractor at temperature control panel shall change state of its contacts.
 - b. This shall cause unit to be shut down, reference Unit Shutdown for additional information, and all fire/smoke and smoke dampers within this system shall close.
 - c. Auxiliary contact shall be provided to notify DDC system of fire alarm shutdown.

H. Unit Shutdown:

1. Whenever make-up air unit is indexed off, supply and exhaust fans shall stop. If exhaust fan fails off, supply fan shall be indexed off.
2. On failure of supply or exhaust fan, alarm will be sent through DDC system.
3. Whenever supply and exhaust fans are off for any reason the following shall occur:
 - a. Outside air dampers and exhaust air dampers shall close.
 - b. Heating coil control valves shall remain under control from entering air sensor to maintain 75 degrees F (adjusted). Freezestat shall override heating control valves open.
 - c. Alarm shall be sent to operators alerting that ventilation air for building is not active.

I. Heat Recovery Pumped Coil Control:

1. Heat recovery coil pump shall continue to run continuously when outdoor air temperature is below 60 degrees F (adjustable) and above 80 degrees F (adjustable).

2. Provide hand-off-auto switch for manual override of pump control near pump.
- J. Radiant Floor Manifold And Circulation Pump Control:
1. Start radiant floor zone pump when outside air temperature falls below 50 degrees F (adjustable) and run pump continuously.
 2. When outdoor air rises above 50 degrees F (adjustable) reverse procedure.
 3. Modulate three-way mixing valve based upon temperature sensor in water supply main to supply header to maintain 140 degrees F (adjustable).
 4. Provide four slab temperature sensors (as indicated on mechanical drawings) to provide temperature reset to maintain slab temperature at 55 degrees F (adjustable).
 5. Provide outdoor air reset control logic for resetting water temperature in hydronic loops based upon outside air temperature.
- K. Back-up Electric Boiler Control:
1. When DDC low temperature alarm is indicated on main hydronic loop, energize circulation pump, energize boiler and modulate three-way valve to maintain 180 degrees F hydronic loop temperature.
 2. Utilize boiler staging of electric elements.
 3. Indicate alarm in DDC panel when boiler is energized.
 4. When hydronic loop temperature exceeds 180 degrees F, reverse procedure.
 5. Boiler to operate only upon failure of engines.
 6. Provide software start/stop switch.

END OF SECTION

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SECTION 23 21 13

HYDRONIC PIPING

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes
 - 1. Hydronic pipe and fittings.
 - 2. Vents and relief valve pipe and fittings.
 - 3. Cooling coil condensate pipe and fittings
 - 4. Condenser water pipe and fittings.

- B. Related Sections
 - 1. Applicable provisions of Division 01 shall govern Work under this Section.
 - 2. Section 23 05 00 - Basic HVAC Requirements.
 - 3. Section 23 05 15 - Piping Specialties.
 - 4. Section 23 05 23 - General-Duty Valves for HVAC Piping.
 - 5. Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.
 - 6. Section 23 05 48 – Vibration and Seismic Controls.
 - 7. Section 23 07 00 - HVAC Insulation.
 - 8. Section 23 25 00 - HVAC Water Treatment.

1.2 REFERENCES

- A. American Society of Mechanical Engineers (ASME):
 - 1. ASME B16.1 – Cast Iron Pipe Flanges And Flanged Fittings
 - 2. ASME B16.3 - Malleable Iron Threaded Fittings.
 - 3. ASME B16.4 - Cast Iron Threaded Fittings.
 - 4. ASME B16.5 - Pipe Flanges and Flanged Fittings.
 - 5. ASME B16.9 - Factory-Made Wrought Buttwelding Fittings.
 - 6. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings.
 - 7. ASME B16.22 - Wrought Copper and Wrought Copper Alloy Solder Joint Pressure Fittings.
 - 8. ASME B16.23 - Cast Copper Alloy Solder Joint Drainage Fittings: DWV.
 - 9. ASME B16.29 – Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings-DWV.
 - 10. ASME B31.9 - Building Services Piping.
 - 11. ASME BPVC Section IX - Welding and Brazing Qualifications.

- B. ASTM International:
 - 1. ASTM A47 – Specification for Ferritic Malleable Iron Castings.
 - 2. ASTM A53 – Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless.

3. ASTM A105 - Specification for Forgings, Carbon Steel, for Piping Components.
4. ASTM A106 - Specification for Seamless Carbon Steel Pipe for High-Temperature Service.
5. ASTM A126 - Specification for Gray Cast Iron Castings for Valves, Flanges, and Pipe Fittings
6. ASTM A181 - Specification for Forgings, Carbon Steel for General Purpose Piping.
7. ASTM A182 – Specification for Forged or Rolled Alloy and Stainless Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service.
8. ASTM A197 - Specification for Cupola Malleable Iron.
9. ASTM A234 - Specification for Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures.
10. ASTM A312 – Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes.
11. ASTM A376 – Specification for Seamless Austenitic Steel Pipe for High-Temperature Central-Station Service.
12. ASTM A403 – Specification for Wrought Austenitic Stainless Steel Piping Fittings.
13. ASTM B75 - Specification for Seamless Copper Tube.
14. ASTM B88 - Specification for Seamless Copper Water Tube.

1.3 SUBMITTALS

- A. Division 01 - Submittal Procedures: Shop Drawings, product data and samples.
- B. Contractor shall submit schedule indicating ASTM designation of proposed pipe along with its type and grade and sufficient information to indicate type and rating of fittings for each service.
- C. Type F Steel Pipe: Statement from manufacturer on his letterhead that pipe furnished meets ASTM specification contained in this section.
- D. Type E or S Steel Pipe:
 1. Mill certification papers, also known as material test reports, for pipe furnished for this project, in English.
 2. Heat numbers on these papers to match heat numbers stenciled on pipe.
 3. Chemical analysis indicated on mill certification papers to meet or exceed requirements of referenced ASTM specification.
- E. Copper Tube: Statement from manufacturer on his letterhead that pipe furnished meets ASTM specification contained in this section.
- F. Welder Qualifications
 1. Before any metallic welding is performed, Contractor shall submit his Standard Welding Procedure Specifications, Procedure Qualification Records and Qualification Test Records for each Welder along with associated continuity records to demonstrate compliance with ASME Section IX, paragraph QW-322.

2. Contractor shall maintain complete set of welder qualification documents at jobsite, including Test Records and Continuity Records for each welder.
3. Engineer/Architect reserves right to test Work of any welder employed on Project, at Owner's expense.
4. Testing will include visual examination of pipe and weld and may include radiography of any suspect welds.
5. If Work of welder is unsatisfactory, prevent welder from doing further welding on Project.
6. Repair any welds deemed unacceptable at Contractor's expense.

1.4 QUALITY ASSURANCE

- A. Order Type E and Type S steel pipe with heat numbers rolled, stamped, or stenciled to each length or each bundle, depending on size of pipe, and in accordance with appropriate ASTM specification.
- B. Contractor must replace any installed material not meeting specification requirements with material that meets these specifications without additional cost to Owner.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Promptly inspect shipments to insure that material is undamaged and complies with specifications.
- B. Cover pipe to eliminate rust and corrosion while allowing sufficient ventilation to avoid condensation.
- C. Do not store materials directly on grade.
- D. Protect pipe, tube, and fitting ends from damage. Take precautions to keep provided or specified end caps in place.
- E. Protect fittings, flanges, and unions by storage inside or by durable, waterproof, above ground packaging.
- F. Offsite storage agreements will not relieve Contractor from using proper storage techniques.
- G. Storage and protection methods must allow inspection to verify products.

1.6 DESIGN CRITERIA

- A. Use only new material, free of defects, rust, and scale, meeting latest revision of ASTM specifications as listed in this Section.
- B. Construct piping for highest pressures and temperatures in respective system in accordance with ASME B31.9, but not less than 125 psig unless specifically indicated otherwise.

- C. Where weld fittings or mechanical grooved fittings are used, use only long radius elbows having a centerline radius of 1.5 pipe diameters.
- D. Where ASTM A53 Type F pipe is specified, Contractor may substitute ASTM A53 Grade A Type E or S, or ASTM A53 Grade B Type E or S at Contractor's option.
- E. Where ASTM A53 grade A pipe is specified, Contractor may substitute ASTM A53 Grade B pipe at Contractor's option.
- F. Where grade or type is not specified, Contractor may choose from those commercially available.
- G. Where ASTM B88, Type L hard temper copper tubing is specified, Contractor may substitute ASTM B88, Type K hard temper copper tubing.
- H. Non-metallic piping is acceptable only for the services indicated.
- I. It is not acceptable in occupied spaces and ventilation plenum spaces, including plenum ceilings except for venting of sealed combustion, condensing gas fired appliances.
- J. When used in ceiling plenums, PVC piping and the piping installation shall conform with applicable codes and standards for installation of PVC piping within ceiling plenum.

PART 2 PRODUCTS

2.1 HEATING HOT WATER PIPE AND FITTINGS

- A. 2-Inch and Smaller: ASTM A53, Type F, Schedule 40, black steel pipe with ASTM A126/ASME B16.4, class 125, standard weight cast iron threaded fittings.
- B. 2-1/2-Inch and Larger: ASTM A53, Schedule 40, black steel pipe with ASTM A234 grade WPB/ASME B16.9 standard weight, seamless, carbon steel weld fittings.
- C. Contractor may use ASTM B88 seamless, Type L, hard temper copper tube with ASME B16.22 wrought copper solder-joint fittings in lieu of steel pipe for all sizes. Mechanically formed tee fittings may be used in lieu of wrought copper solder-joint tee fittings for branch takeoff up to one-half (1/2) diameter of main.
- D. Mechanical Formed Fittings: "Pro-press" mechanical formed fittings may be used for pipe sizes 2" and smaller at Contractor's option.
- E. Under floor: ASTM B88 seamless, Type K, soft copper tube with no joints underground.

2.2 MAKEUP WATER PIPE AND FITTINGS

- A. Extend from where left by Plumbing Contractor with same materials.

2.3 CHEMICAL TREATMENT PIPE AND FITTINGS

- A. Use pipe and pipe fittings as specified for system to which chemical treatment piping is connected. Plastic pipe furnished with chemical treatment materials may be used if its pressure and temperature ratings are acceptable for service.

2.4 VENT AND RELIEF VALVE PIPE AND FITTINGS

- A. Use pipe and fittings specified for system to which relief valve or vent is connected.

2.5 COOLING COIL CONDENSATE PIPE AND FITTINGS

- A. ASTM B88, Type L Hard Temper copper tubing with ASTM B145/ASME B16.23 cast red bronze or ASTM B75/ASME B16.29 wrought solder-type drainage fittings.

2.6 UNIONS AND FLANGES

- A. 2-Inch and Smaller:
 - 1. ASTM A197/ASME B16.3 malleable iron unions with brass seats.
 - 2. Use black malleable iron on black steel piping and galvanized malleable iron on galvanized steel piping.
 - 3. Use ASME B16.18 cast copper alloy unions on copper piping.
 - 4. Use unions of pressure class equal to or higher than that specified for fittings of respective piping service but not less than 250 psi.
- B. 2-1/2-Inch and Larger:
 - 1. ASTM A181 or A105, Grade 1 hot forged steel flanges or threaded, welding and pressure class compatible with that specified for valves, piping specialties, and fittings of respective piping service.
 - 2. Flanges smaller than 2-1/2-inch may be used as needed for connecting to equipment and piping specialties.
 - 3. Use raised face flanges ASME B16.5 for mating with other raised face flanges on equipment with flat ring or full face gaskets.
 - 4. Use ASME B16.1 flat face flanges with full face gaskets for mating with other flat face flanges on equipment.

2.7 GASKETS

- A. Manufacturers:
 - 1. Klingersil C4401
 - 2. Garlock 3000.
 - 3. JM Clipper 978.
 - 4. Or approved equal.
- B. Water and Glycol Systems: Branded, compressed, non-asbestos sheet gaskets.

PART 3 EXECUTION

3.1 ERECTION

- A. Carefully inspect pipe, fittings, valves, equipment, and accessories before installation.
- B. Reject any items that are unsuitable, cracked, or otherwise defective and remove from jobsite immediately.
- C. Excluding minor surface rust, piping that exhibits significant oxidation or corrosion will be rejected.
- D. Exercise care at every stage of storage, handling, laying, and erecting to prevent entry of foreign matter into piping, fittings, valves, equipment, and accessories.
- E. Do not erect or install any item that is not clean.
- F. Remove loose dirt, scale, oil, chips, burrs, and other foreign material from internal and external surfaces of pipe and piping components prior to assembly, including debris associated with cutting, threading, and welding.
- G. During fabrication and assembly, remove slag and weld spatter from internal pipe surfaces at joints by peening, chipping, and wire brushing.
- H. During construction, until system is fully operational, keep openings in piping and equipment closed except when performing actual work on that item of system. Use plugs, caps, blind flanges, or other items designed for this purpose.
- I. Furnish and install flanges, caps, bypasses, drains, and valves required to facilitate flushing and draining heating and cooling system piping.
- J. Install piping parallel to building walls and ceilings and at heights not obstructing any portion of a window, doorway, stairway, or passageway.
- K. Where interferences develop in field, offset or reroute piping as required to clear such interferences.
- L. In all cases, consult Drawings for exact location of pipe spaces, ceiling heights, door and window openings, or other architectural details before installing piping.
- M. Provide anchors, expansion joints, swing joints, and expansion loops to allow piping to expand and contract without damage to itself, equipment, or building.
- N. Mitered ells, notched tees, and orange peel reducers are not acceptable. On threaded piping, bushings are not acceptable.

- O. "Weldolets" and "Threadolets" may be used for branch takeoffs up to one-half (1/2) diameter of main.
- P. Install drains throughout systems to permit complete drainage.
- Q. Do not route piping through transformer vaults or above transformers, panelboards, or switchboards, including required service space for this equipment, unless piping is serving this equipment
- R. Install valves, control valves, and piping specialties, including items furnished by others, as specified and detailed.
- S. Make connections to equipment installed by others where that equipment requires piping services indicated in this section.

3.2 PIPE JOINTS AND CONNECTIONS

- A. Welded Pipe Joints
 - 1. Make welded joints by fusion welding in accordance with ASME B31.9, and State and local codes where applicable.
 - 2. Qualified welders shall complete pipe welding in accordance with Contractor's Procedure Specifications.
 - 3. Contractor shall ensure these steps are followed where joining pipe sections by welding:
 - a. Cleaning: Welding surfaces shall be clean and free of defects.
 - b. Alignment: Align inside diameter of piping components as accurately as possible. Internal misalignment shall not exceed 1/16-inch.
 - c. Spacing: Space pipe sections to allow deposition of weld filler material through entire weld joint thickness.
 - d. Girth Butt Welds:
 - 1) Girth butt welds shall be complete penetration welds.
 - 2) Concavity shall not exceed 1/32-inch.
 - 3) Under cuts shall not exceed 1/32-inch.
 - 4) As welded surfaces are permitted however, surfaces shall be free from coarse ripples, grooves, abrupt ridges, and valleys.
 - 4. Electrodes shall be Lincoln, or approved equal, with coating and diameter as recommended by manufacturer for type and thickness of this work.
- B. Threaded Pipe Joints
 - 1. Use Teflon based thread lubricant or Teflon tape when making joints. Hard setting pipe thread cement or caulking shall not be permitted.
- C. Copper Pipe Joints:
 - 1. Remove slivers and burrs remaining from cutting operation by reaming and filing both pipe surfaces.

2. Clean fitting and tube with emery cloth or sandpaper.
3. Remove residue from cleaning operation, apply flux, and assemble joint.
4. Use 95-5 solder or brazing to secure joint as specified for specific piping service.
5. Where mechanically formed tee fittings are permitted, form mechanically extracted collars in continuous operation, consisting of drilling pilot hole and drawing out tube surface to form collar having height of not less than three times thickness of tube wall.
6. Use adjustable collaring device.
7. Notch and dimple branch tube.
8. Braze joint, applying heat properly so that pipe and tee do not distort; remove distorted connections.

D. Mechanical Press Formed Fittings:

1. Install fittings in strict accordance with manufacturer's installation instructions.
2. Use manufacturer approved press tools.

3.3 WATER SYSTEM PIPING

- A. Run water mains level or pitch horizontal mains up 1-inch in 40 feet in direction of flow.
- B. Install manual air vents at high points where air may collect.
- C. If vent is not in an accessible location, extend air vent piping to nearest code acceptable drain location with vent valve located at drain.
- D. Main branches and runouts to terminal equipment may be made at top, side, or bottom of main provided that there are drain valves suitably located for complete system drainage and manual air vents are located as described above.
- E. Use top connection to main for upfeed risers and bottom connection to main for downfeed risers. Make connections at main with a tee and 45-degree elbow.
- F. Use minimum of two elbows in each pipe line to piece of terminal equipment to provide flexibility for expansion and contraction of piping systems.
- G. Offset pipe connections at equipment to allow for service, such as removal of terminal device.
- H. Use eccentric fittings for changes in horizontal pipe sizes with fittings installed for proper air venting. Concentric fittings may be used for changes in vertical pipe sizes.

3.4 MAKEUP WATER PIPING

- A. Install where shown and specified, including valves, piping specialties, and dielectric unions required for a functional system.

3.5 CHEMICAL TREATMENT PIPING

- A. Install chemical treatment piping as indicated on Drawings, as detailed, and as recommended by supplier of chemical treatment equipment.

3.6 VENT AND RELIEF VALVE PIPING

- A. Install vent and relief valve discharge piping as indicated on Drawings, as detailed, and as specified for each specific valve or piping specialty item.
- B. In no event is a relief termination to occur less than six feet above a roof line.

3.7 COOLING COIL CONDENSATE PIPING

- A. Trap each cooling coil drain pan connection with trap seal of sufficient depth to prevent conditioned air from moving through piping.
- B. Extend drain piping to nearest code approved drain location.
- C. Construct trap with plugged tee for cleanout purposes as detailed.

3.8 UNIONS AND FLANGES

- A. Install union or flange, as required, at each automatic control valve and at each piping specialty or piece of equipment which may require removal for maintenance, repair, or replacement.
- B. Where valve is located at piece of equipment, locate flange or union connection on equipment side of valve.
- C. Concealed unions or flanges are not acceptable.

3.9 GASKETS

- A. Store horizontally in cool, dry location and protect from sunlight, water, and chemicals.
- B. Inspect flange surfaces for warping, radial scoring, or heavy tool marks.
- C. Inspect fasteners, nuts, and washers for burrs or cracks. Replace defective materials.
- D. Align flanges parallel and perpendicular with bolt holes centered without using excessive force. Center gasket in opening.
- E. Lubricate fastener threads, nuts, and washers with lubricant formulated for application.

- F. Draw flanges together evenly to avoid pinching gasket. Tighten fasteners in cross pattern sequence (12 – 6 o'clock, 3 – 9 o'clock), one pass by hand and four passes by torque wrench at 30 percent full torque, 60 percent full torque, and two passes at full torque per ASME B16.5.

3.10 PIPING SYSTEM LEAK TESTS

- A. Verify that piping system being tested is fully connected to components and that equipment is properly installed, wired, and ready for operation.
- B. If required for additional pressure load under test, provide temporary restraints at expansion joints or isolate them during test.
- C. Verify that hangers can withstand any additional weight load imposed by test.
- D. Provide piping, fittings, blind flanges, and equipment to perform testing.
- E. Conduct pressure test with test medium of air or water unless specifically indicated.
- F. Minimum test time is indicated in table below; additional time may be necessary to conduct an examination for leakage.
- G. Owner's Representative must witness each test. If leaks are found, repair area with new materials and repeat test. Caulking will not be acceptable.
- H. Do not insulate pipe until it is successfully tested.
- I. For hydrostatic tests, use clean water and remove air from piping being tested by means of air vents or loosening of flanges and unions.
- J. Measure and record test pressure at high point in system.
- K. For air tests, gradually increase pressure to not more than one-half of test pressure; then increase pressure in steps of approximately one-tenth of test pressure until reaching required test pressure. Examine joints and connections with a soap bubble solution or equivalent method.
- L. Piping system, exclusive of possible localized instances at pump or valve packing, shall show no evidence of leaking.
- M. After testing is complete, slowly release pressure in a safe manner.

<u>System</u>	<u>Medium</u>	<u>Pressure</u>	<u>Duration</u>
Heating hot water with glycol	Water	100 psig	8 hours

- N. Pressure tests are to be documented on a form included in this specification.

- O. On piping that cannot be tested because of connection to active line, provide temporary blind flanges and hydrostatically test new section of piping.
- P. After completion of test, remove temporary flanges and make final connections to piping.
- Q. Die penetrate test pass weld or x-ray piping that was not hydrostatically tested up to active system.

3.11 HYDRONIC PIPING SYSTEM FLUSHING

- A. Thoroughly flush new and heating hot water system piping before putting systems in to operation.
- B. Subsequent to executing chemical cleaning processes specified in Section 23 25 00 – HVAC Water Treatment, and prior to adding scale and corrosion inhibitors, flush piping and components with clean source of water until discharge from system is clean.
- C. Discharge at drains provided at low points in piping, ends of headers, and as otherwise necessary to flush and drain entire system.
- D. Establish project specific procedures prior to flushing.
- E. Before beginning flushing operations, submit proposed flushing procedures to Owner's Representative for review and approval.
- F. Provide minimum 72 hours notice to Owner's Representative to allow observation of flushing operations.
- G. Tap clean water source into system downstream of main circulation pump(s).
- H. Provide minimum 2-inch connection between water source and hot water/chilled water systems including taps with ball valves, or line size tap and ball valve for piping systems smaller than 2-inch.
- I. Provide minimum 2-inch, or line size if mains are smaller than 2-inch, taps at ends of headers, low pint of each main on each floor, and as otherwise necessary to flush and drain entire system.
- J. Contractor shall identify proposed clean water source along with method/location of drain discharge and review with Engineer prior to installing flushing connections to water source and drain outlets.
- K. Provide code required temporary backflow prevention for clean water source if needed.
- L. Provide temporary taps, valves, piping, bypasses, and hoses as needed to accomplish flushing procedures.

- M. Flush piping systems using the following procedure:
1. Flushing sequence for hot water and chilled water systems is as follows:
 - a. Close isolation valves at coils and wall fin.
 - b. Open temporary bypasses that connect ends of supply and return mains.
 - c. Flush mains by turning on flushing water source and sequentially opening drains on mains on each floor until discharge is clean. This will flush mains without forcing water or debris into branches and run out pipes.
 - d. Close isolation valves located downstream of coils and wall fin.
 - e. Open isolation valves located upstream of coils and wall fin.
 - f. Open individual drain valves upstream of coil and /wall fin until discharge is clean. This will flush supply branch and run out lines between mains and coils/wall fin without running water or debris through TCV or coils and wall fin.
 - g. Close individual drain valves upstream of coils and wall fin.
 - h. Open drain valves at low points in return piping mains.
 - i. Open individual isolation valves located downstream of coils and wall fin. This will flush return branch and run out lines located between coils and wall fin and mains back into mains and out drains on return mains. Water going through coils and wall fin should already be clean since this section was flushed previously.
 - j. Repeat steps 1-3 to clean debris from mains.
- N. Isolate coils while flushing risers and mains.
- O. Flush mains on each floor individually, starting at top of building and working down towards basement level.
- P. After risers and mains have been flushed clean, individually open drain valves in each branch circuit to discharge any debris that may have accumulated in branch piping.
- Q. Contractor is required to open drain valves at selected locations in system to verify effectiveness of flushing procedures as directed by Owner's Representative.
- R. If sediment or debris is identified in system, flush system again and re-inspect at no expense to Owner.
- S. After flushing operations are complete, drain and blow out any residual water, clean or replace strainers, and add scale and corrosion inhibitors as specified in Section 23 25 00 – HVAC Water Treatment. Leave flushing connections and valves in place and cap.
- T. Document flushing procedures by completing and submitting report form included at end of this Section.

3.12 INITIAL FILL AND VENT

- A. Fill hydronic systems with appropriate working fluids as specified.
- B. Chemically treat system fluids as specified in Section 23 25 00 – HVAC Water Treatment.
- C. For closed piping systems, relieve air trapped at high points through manual air vents prior to notifying Owner's Representative that systems are ready to testing and balancing.

END OF SECTION

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SECTION 23 21 23

HYDRONIC PUMPS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes
 - 1. Base Mounted Centrifugal Pumps.
 - 2. In-Line Centrifugal Pumps.
- B. Related Sections
 - 1. Applicable provisions of Division 01 shall govern all work under this Section.
 - 2. Section 23 05 00 – Basic HVAC Requirements.
 - 3. Section 23 05 13 - Common Motor Requirements for HVAC Equipment.
 - 4. Section 23 05 15 – Piping Specialties.
 - 5. Section 23 21 13 – Hydronic Piping.

1.2 SUBMITTALS

- A. Division 01 - Submittal Procedures: Shop Drawings, product data, and samples.
- B. Submit data including dimensions, capacities, materials of construction, ratings, weights, pump curves with net positive suction head requirements, manufacturer's installation requirements, manufacturer's performance limitations, and appropriate identification.
- C. Pump curves shall identify design point of operation.

1.3 DESIGN CRITERIA

- A. Provide pump sizes, capacities, pressures, and operating characteristics as scheduled.
- B. Pumps shall meet or exceed operating efficiencies scheduled.
- C. Provide pumps with motors, impellers, drive assemblies, bearings, coupling guard, and other accessories specified. Statically and dynamically balance rotating parts.
- D. Provide flanged connections on pumps unless specified otherwise.
- E. Service or repair of base mounted pumps shall not require breaking piping connections or removal of motor.
- F. Where a pump is specified for parallel operation, scheduled conditions are for that pump with both pumps operating; total system flow rate is twice that scheduled for a single pump.

- G. When only one parallel pump is operating, operating point of that pump must fall within manufacturer's recommended operating range.
- H. Provide pump with a motor sized for non-overloading over entire pump curve. Motors to be 1750 rpm unless specified otherwise.
- I. Furnish each pump and motor with a nameplate giving manufacturer's name, serial number of pump, capacity in GPM and head in feet at design condition, horsepower, voltage, frequency, speed, and full load current.
- J. Test, clean, and paint pumps before shipment. Manufacturer shall certify pump ratings.
- K. Pumps to operate without excessive noise or vibration.
- L. After completion of balancing, provide replacement impellers, or trim impellers to provide specified flow at actual pumping head, as installed.
- M. Furnish one spare seal and casing gasket for each pump.

PART 2 PRODUCTS

2.1 BASE MOUNTED CENTRIFUGAL PUMPS

- A. Manufacturers:
 - 1. Bell and Gossett.
 - 2. Taco.
 - 3. Allis Chalmers.
 - 4. Armstrong.
 - 5. Aurora.
 - 6. Or approved equal.
- B. Type: Horizontal shaft, single stage, single or double suction, split casing, 175 psig working pressure at operating temperature of 225 degrees F continuous, 250 degrees F intermittent.
- C. Casing: Cast iron with suction and discharge gauge ports, renewable bronze wear rings, vent and drain plugs, and flanged suction and discharge connections.
- D. Impeller: Bronze, hydraulically and dynamically balanced, keyed and locked to pump shaft, and protected by a replaceable bronze shaft sleeve.
- E. Bearings: Oil or grease lubricated ball or roller bearings.
- F. Shaft: Alloy steel with copper, bronze, or stainless steel shaft sleeve.
- G. Seal: Carbon rotating against a stationary ceramic seat, 225 degrees F maximum continuous operating temperature.

- H. Drive: Flexible spacer type coupling or coupling with extended hub to allow for pump service. Provide guard for shaft/coupling assembly.
- I. Baseplate: Cast iron or fabricated steel with integral drain rim.

2.2 IN-LINE CENTRIFUGAL PUMPS

- A. Manufacturers:
 - 1. Bell and Gossett.
 - 2. Taco.
 - 3. Armstrong.
 - 4. Aurora.
 - 5. Grundfos.
 - 6. Or approved equal.
- B. Type: Single stage, direct connected, resiliently mounted motor for in-line mounting, oil lubricated, 175 psig maximum working pressure at operating temperature of 225 degrees F. continuous, 250 degrees F. intermittent.
- C. Casing: Cast iron or stainless steel; flanged suction and discharge connection; with plugged taps for vent, drain, and suction and discharge gauges.
- D. Impeller: Brass or bronze, keyed to the shaft, single suction enclosed type, hydraulically and dynamically balanced.
- E. Bearings: Two, oil lubricated bronze sleeves or ball bearings capable of being greased.
- F. Shaft: Stainless steel or carbon steel with stainless steel or bronze sleeve, integral thrust collar.
- G. Seal: Mechanical type, carbon rotating against a stationary ceramic seat, 225 degrees F maximum continuous operating temperature.
- H. Drive: Close coupled.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install pumps in strict accordance with manufacturer's instructions.
- B. Access and service space around pumps shall not be less than minimum space recommended by pump manufacturer.
- C. Support piping adjacent to pump such that no weight is carried on pump casings.

- D. Decrease from line size at pump connections with suction diffusers, where specified, long radius reducing elbows, or concentric reducers in vertical piping, and eccentric reducers or increasers for horizontal piping. Install eccentric reducers with top of pipe level
- E. Valves and piping specialties shall be full line size as indicated on Drawings
- F. Lubricate pumps before startup.
- G. Install a full line size spring loaded check valve and balancing valve in pump discharge piping.
- H. At Contractor's option, combination shut-off, check, balancing valve may be substituted instead of separate valves. Reference Section 23 05 23 – General Duty Valves for HVAC Piping.

3.2 BASE MOUNTED PUMPS

- A. Set base mounted pumps on concrete bases, or concrete inertia base, level and bolt down prior to grouting. Fill entire base with non-shrink grout when required by manufacturer's installation instructions.
- B. Align flexible coupled base-mounted pumps in accordance with manufacturer's instructions.
- C. Provide supports for elbows on pump suction and discharge piping 4-inch and larger.
- D. Provide air vent and drain valve on horizontal pump casings.
- E. Provide drains for bases and seals, piped to discharge to floor drains.

END OF SECTION

SECTION 23 22 16
UNDERGROUND HEATING PIPING

PART 1 GENERAL

1.1 SUMMARY

- A. Sections Include:
 - 1. This section contains specifications for all hydronic heating & steam utility distribution systems for this project. Included are the following topics:

- B. Related Sections:
 - 1. Applicable provisions of Division 01 shall govern all work under this section.
 - 2. Division 07 – Thermal and Moisture Protection - Elastomeric Sheet Waterproofing
 - 3. Division 23 – Heating, Ventilating and Air Conditioning
 - 4. Division 31 - Earthwork

- C. Applicable provisions of Division 01 govern work under this section.

1.2 REFERENCES

1.3 SUBMITTALS

- A. Division 01 – General Requirements: Requirements for Submittals.

- B. Contractor shall submit information on factory supplied steam and condensate conduit systems and accessories, including but not limited to;
 - 1. Conduit coating.
 - 2. Conduit material specifications.
 - 3. Support assemblies.
 - 4. Guide assemblies.
 - 5. Anchor assemblies.
 - 6. End seals.
 - 7. Gland seals.
 - 8. Cathodic protection.

- C. Contractor shall also submit information related to installation and maintenance instructions.

- D. Contractor shall submit information on factory supplied direct-buried hydronic heating systems and accessories, including but not limited to;
 - 1. Carrier pipe.
 - 2. Insulation material.
 - 3. Jacketing material.
 - 4. Anchors.

5. End seals.
- E. Contractor to submit information related to materials specified in other associated sections, including but not limited to;
 1. Piping material.
 2. Welding specifications and certifications.
 3. Waterproofing.
 4. Paint.
 5. Concrete.
 6. Insulation.
 - F. Contractor shall provide pipe-stress and system-expansion calculations for each expansion compensation elbow using a finite element computer generated three-dimensional analysis.
 - G. Contractor shall provide calculations which shall demonstrate that pipe stresses from temperature changes are within the allowable requirements in ASME B31.1 and the anchors and the guides will withstand the resultant forces.
 - H. Submitted detailed design layout drawings including the location of all anchors and guides.
 - I. Layout shall also include all analysis node points.
 - J. As a minimum, the computer analysis results include node stresses, forces, moments and displacements.
 - K. Calculation shall be approved, certified, stamped and signed by a registered Professional Engineer in the employment of the piping system manufacturer.

1.4 QUALITY ASSURANCE

- A. Any installed material not meeting the specification requirements must be replaced with material that meets these specifications without additional cost to the Owner.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Promptly inspect shipments to insure that the material is undamaged and complies with specifications.
- B. Cover pipe and conduit or insulation/jacketing system to eliminate rust and corrosion while allowing sufficient ventilation to avoid condensation. Do not store materials directly on grade. Protect pipe, and conduit ends so they are not damaged. Where end caps are provided or specified, take precautions so the caps remain in place. Protect fittings and closure materials by storage inside or by durable, waterproof, above ground packaging.

- C. Unload all underground conduit and direct-buried systems using manufacturer's approved methods and rigging materials which may include exclusive use of fabric slings. Store so that all conduit and direct-buried systems can be visually inspected.
- D. Offsite storage agreements will not relieve the contractor from using proper storage techniques.
- E. Storage and protection methods must allow inspection to verify products.

1.6 DESIGN CRITERIA

- A. Use only new material, free of defects, rust and scale, and meeting the latest revision of ASTM specifications as listed in this specification.
- B. Install all piping for the highest pressures and temperatures in the respective system in accordance with ANSI B31, but not less than 125 psig unless specifically indicated otherwise.
- C. Use only long radius pipe fitting elbows having a centerline radius of 1.5 pipe diameters.
- D. See Division 23 – Heating, Ventilating and Air Conditioning for other piping requirements.

1.7 WELDER QUALIFICATIONS

- A. Welding procedures, welders, and welding operators for all building service piping and steam piping less than or equal to 15 psig to be in accordance with certified welding procedures of the National Certified Pipe Welding Bureau.
- B. Before any polyethylene fusion welding is performed, Contractor to submit certification that the welders to be used on this project have successfully demonstrated proper welding procedures in accordance with the Code of Federal Regulations, Title 49, Part 192, Section 192.285.
- C. Owner reserves the right to test the work of any welder employed on the project, at Contractor's expense.
- D. If the work of the welder is found to be unsatisfactory, the welder shall be prevented from doing further welding on the project.

PART 2 PRODUCTS

2.1 DIRECT BURIED UNDERGROUND HEATING CONDUIT

- A. Manufacturers:
 - 1. Perma-Pipe/Ricwil
 - 2. Rovanco.

3. Thermacor.
 4. As approved equal.
- B. Conduit:
1. Conduit shall be 10 gauge smooth wall steel having all outside surfaces of the conduit coated with 30 mils of spray applied urethane coating.
 2. Interior surface shall be sandblasted to remove all foreign material and then coated with a minimum 6 mil thickness of red oxide primer.
 3. System shall be rated for a continuous operating temperature of 350 degrees Fahrenheit without cracking or blistering.
 4. Exterior coating system shall have an impact resistance of at least 160 psi per ASTM G14.
 5. Urethane coating system for field patches shall be held to the same thickness requirements and temperature performance requirements.
- C. Carrier Pipe: As specified in Division 23 – Heating, Ventilating and Air Conditioning for the associated system.
- D. Supports: Corrosion protected steel spaced at intervals not greater than 10 feet in the conduit, permitting the pipe to expand and contract freely without stress or wear on the pipe or insulation as well as provide for drainage and free air circulation. Insulation to be continuous through the supports.
- E. Carrier Pipe Insulation: Preformed mineral fiber, minimum 8 lbs/ft³ density, thickness as specified in Section Division 23 – Heating, Ventilating and Air Conditioning.
- F. Expansion Loops or Z-Bends: Installed in conduit sized to handle indicated pipe movement. Conduit fittings and straight sections to be large enough to allow expansion and contraction of the system without having the insulation touch the outer conduit.
- G. Carrier pipe alignment guides shall be factory-installed to direct movement from expansion within conduit to aforementioned expansion loops or Z-bends.
- H. Anchors:
1. Prefabricated plate anchors where shown on plans, consisting of a steel plate welded to pipe and conduit.
 2. Steel plate shall be sized as recommended by the manufacturer, suitable for anchoring in a poured concrete block.
 3. Anchor plates are not to limit the free venting and drainage of the conduit.
- I. End And Gland Seals:
1. Terminal ends of conduit inside manholes, pits, or building walls to be equipped with end seals consisting of a steel bulkhead plate welded to the pipe and conduit.

2. Where there is no anchor within five feet of a terminal end, equip conduit end with gland seal consisting of a packed stuffing box and gland follower mounted on a steel plate welded to end of conduit.
 3. End seals or gland seals to be equipped with drain and vent openings located diametrically opposite on the vertical center line of the mounting plate and shall be shipped to the job site with plugs in place.
 4. Terminate all conduits 2 inches beyond the inside face of manhole or building walls to protect any exposed piping insulation from damp-wall condensation.
- J. Wall Penetration Seal:
1. Provide link seal within building wall or pit wall penetration to act as a moisture barrier.
 2. Provide anchor plates as indicated on Drawings.
 3. Anchor location is preferably within associated building or steam pit.
 4. If preferred anchor location is not possible, locate factory provided anchor plate within 5 feet outside the wall.
- K. In lieu of link seal, leakplates to be furnished within wall penetration. Leak plate to consist of a steel plate flange 4 inches larger in outside diameter than the conduit, welded to the conduit only, and located in the wall approximately 6 inches from the end of the conduit.

TABLE 1
MINIMUM PIPE INSULATION THICKNESS (INCHES)
For Heating Piping

Nominal Pipe Diameter (Inches)	Minimum Mineral Wool Thickness (Inches)	Maximum Heat Loss (BTU / Ft ² – HR)
1.0	1.0	41
2.0	1.0	41
3.0	1.5	50
4.0	1.5	56
6.0	2.0	71
8.0	2.0	77

PART 3 EXECUTION

3.1 PREPARATION

- A. Remove all foreign material from exterior of conduit straight lengths and fittings.
- B. Welded Conduit Joints:
 1. Make all welded joints by fusion welding in accordance with ASME Codes and State Codes where applicable.
 2. Electrodes shall be Lincoln, or approved equal, with coating and diameter as

recommended by the manufacturer for the type and thickness of work being done.

C. Direct Buried Underground Heating Conduit:

1. Install conduit where indicated and according to manufacturer's instructions.
2. Dig trench, shore as needed and provide dewatering control per Division 31.
3. Handle all conduit with fabric slings. Do not use chains or steel cables to handle conduits.
4. Fill bottom of excavation with washed pea gravel or controlled backfill per manufacturer's specifications. Set conduits on sandbags during fabrication so that the conduits do not sag or droop. Backfill material to consist of fine earth without rocks taken from the trench, fine limestone screenings, or sand; do not use frozen fill, sod, cinders, stone, or rocks. Hand tamp beneath conduits
5. Hand tamp beneath conduits after joint work is complete.
6. Weld carrier pipe and perform hydrotesting before proceeding with conduit closure work.
7. Install closures at points of field joints between straight units or fabricated fittings by welding them centrally over conduit ends between such adjacent units.
8. After welding, conduct a 25 psig air pressure test on the outer casing and examine for leaks with a soap solution.
9. Repair any leaks and retest until the system is airtight at 25 psig air pressure for a two hour period.
10. Clean closures of all welding slag, burned coating, and mud by wire brushing.
11. Finish coat in accordance with the system manufacturer's instructions, using materials supplied.
12. Final outside coating to be subjected to a spark test and be capable of maintaining dielectric strength at 5,000 volts.
13. Contractor to furnish all necessary equipment and labor to perform the spark test and the air test, including air compressor, gauges, conduit caps, temporary pipe and connections, and complete the tests to the satisfaction of the Owner Representative Engineer.
14. Manufacturer's representative to supervise and approve the installation and test of the system.
15. Approval to be in the form of a manufacturer's certificate indicating that the installation has been made in accordance with their recommendations; include certificates in the Operating and Maintenance manuals.
16. Cast a concrete block over anchor plates and conduit at each change in direction and at each building entrance so that the block rests on undisturbed trench sidewalls and/or bottom. The concrete block to be at least x" in length and extend a minimum of x" beyond the top and bottom of anchor plate.

D. Hydronic Piping Hydrostatic Testing:

1. Reference Division 23 – Heating, Ventilating and Air Conditioning for requirements

- of hydro-testing of all hydronic heating system piping.
2. Do not begin to insulate pipe at joints nor perform any field joint closure work until carrier piping systems have been successfully hydro-tested.

END OF SECTION

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SECTION 23 31 00

HVAC DUCTS AND CASINGS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Low pressure ductwork.
 - 2. Fume exhaust duct.
 - 3. Duct sealant.
 - 4. Gaskets.

- B. Related Sections:
 - 1. Applicable provisions of Division 01 shall govern all work under this Section.
 - 2. Section 23 01 30 – HVAC Air Duct Cleaning.
 - 3. Section 23 05 00 - Basic HVAC Requirements.
 - 4. Section 23 05 93 - Testing, Adjusting, and Balancing for HVAC.
 - 5. Section 23 07 00 – HVAC Insulation.
 - 6. Section 23 33 00 – Air Duct Accessories.

1.2 REFERENCES

- A. American National Standards Institute (ANSI)
 - 1. ANSI SS-EN 485-2 - Aluminum and Aluminum Alloys-Sheet, Strip and Plate-Part 2: Mechanical Properties.

- B. ASTM International
 - 1. ASTM A90 - Test Method for Weight of Coating on Zinc-Coated (Galvanized) Iron or Steel Articles.
 - 2. ASTM A167 - Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
 - 3. ASTM A527 - Specification for General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Lock-Forming Quality.
 - 4. ASTM A653 - Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process.
 - 5. ASTM A924 - Specification for General Requirements for Sheet Steel, Metallic-Coated by the Hot-Dip Method.
 - 6. ASTM B209 - Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
 - 7. ASTM C411 - Test Method for Hot Surface Performance of High Temperature Thermal Insulation.
 - 8. ASTM C916 - Specification for Adhesives for Duct Thermal Insulation.
 - 9. ASTM C1071 - Specification for Fibrous Glass Duct Lining Insulation.

10. ASTM C1338 - Test Method for Determining Fungal Resistance of Insulation Materials and Facings.
 11. ASTM E84 - Test Method for Surface Burning Characteristics of Building Materials.
 12. ASTM G21 - Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.
- C. National Fire Protection Association (NFPA)
1. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems.
 2. NFPA 96 - Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.
- D. North American Insulation Manufacturers Association (NAIMA)
1. NAIMA - Fibrous Glass Duct Liner Standard.
- E. Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)
- F. Underwriters Laboratories, Inc. (UL)
1. UL 181 - Standard for Safety for Factory Made Air Ducts and Air Connectors.

1.3 SUBMITTALS

- A. Division 01 - Submittal Procedures: Shop drawings, product data and samples.
- B. Submit manufacturer's data and Contractor data for the following:
1. Fabrication and installation drawings.
 2. Schedule of duct systems including material of construction, gauge, pressure class, system class, method of reinforcement, joint construction, fitting construction, and support methods, with details as appropriate.
 3. Duct sealant and gasket material.
 4. Duct liner including data on thermal conductivity, air friction correction factor, and limitation on temperature and velocity.

1.4 DESIGN CRITERIA

- A. Construct ductwork to be free from vibration, chatter, objectionable pulsations, and leakage under specified operating conditions.
- B. Use material, weight, thickness, gauge, and construction and installation methods as outlined in the following Sheet Metal and Air Conditioning Contractors' National Association (SMACNA) publications, unless noted otherwise:
1. HVAC Duct Construction Standards, Metal and Flexible, Latest Edition.
 2. HVAC Air Duct Leakage Test Manual, Latest Edition.
 3. HVAC Systems - Duct Design, Latest Edition.
 4. Rectangular Industrial Duct Construction Standard, Latest Edition.

5. Round Industrial Duct Construction Standards, Latest Edition.
 6. Thermoplastic Duct (PVC) Construction Manual, Latest Edition.
 7. Round Industrial Duct Construction Standards, Latest Edition.
 8. Rectangular Industrial Duct Construction Standards, Latest Edition.
- C. Use products which conform to NFPA 90A, possessing a flame spread rating of not over 25 and a smoke developed rating no higher than 50.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Promptly inspect shipments to ensure that ductwork is undamaged and complies with specification.
- B. Protect ductwork against damage.
- C. Protect ductwork by storing inside or by durable, waterproof, above ground packaging.
- D. Do not store material on grade. Protect ductwork from dirt, dust, construction debris, and foreign material.
- E. Where end caps or packaging are provided, take precautions so caps or packaging remain in place and free from damage.
- F. Offsite storage agreements do not relieve Contractor from using proper storage techniques.
- G. Storage and protection methods must allow inspection to verify products.

PART 2 PRODUCTS

2.1 GENERAL

- A. Sheet metal used for construction of duct shall be 24-gauge or heavier except for round and spiral ductwork and spiral duct take-offs 12-inch and below may be 26-gauge where allowed in SMACNA HVAC Duct Construction Standards, Metal and Flexible, latest edition.
- B. Duct sizes indicated on Drawings are net inside dimensions. Where duct liner is specified, dimensions are net, inside of liner.

2.2 DUCTWORK PRESSURE CLASS

- A. Minimum acceptable duct pressure class, for ductwork except transfer ductwork, is 2-inch W.G. positive or negative, depending on application.
- B. Transfer ductwork minimum acceptable duct pressure class is 1-inch W.G. positive or negative, depending on application.

- C. Duct system pressure classes not indicated on Drawings to be as follows:

<u>Duct System</u>	<u>Pressure Class</u>
Supply duct	2 inch pressure class
Transfer ducts	1 inch pressure class
Exhaust ducts	2 inch pressure class
Return ducts	2 inch pressure class

2.3 MATERIALS

- A. Stainless Steel Sheet: Use ASTM A167, Type 304 or 316 stainless steel sheet as specified, 316L if welded ductwork, with No. 2B finish for concealed work and No. 3 finish for exposed work.
- B. Aluminum Sheet: Use ASTM B209 aluminum sheet, Alloy 3003H-14, capable of double seaming without fracture.

2.4 LOW PRESSURE DUCTWORK (MAXIMUM 3-INCH PRESSURE CLASS)

- A. Fabricate and install ductwork in sizes indicated on Drawings and in accordance with SMACNA recommendations, except as modified below.
- B. Construct so that interior surfaces are smooth.
- C. Use slip and drive or flanged and bolted construction when fabricating rectangular ductwork.
- D. Use spiral lock seam construction when fabricating round spiral ductwork.
- E. Sheet metal screws may be used on duct hangers, transverse joints and other SMACNA approved locations if screw does not extend more than 1/2-inch into duct.
- F. Use elbows and tees with centerline radius to width or diameter ratio of 1.5 wherever space permits.
- G. When a shorter radius must be used due to limited space, install single wall sheet metal splitter vanes in accordance with SMACNA, Type RE 3.
- H. Where space will not allow and C value of radius elbow, as given by SMACNA, exceeds 0.31, use rectangular elbows with turning vanes as specified in Section 23 33 00 – Air Duct Accessories.
- I. Square throat-radius heel elbows shall not be acceptable. Straight taps or bullhead tees are also not permitted.

- J. Where rectangular elbows are used, provide turning vanes in accordance with Section 23 33 00 – Air Duct Accessories.
- K. Provide expanded take-offs or 45-degree entry fittings for branch duct connections with branch ductwork airflow velocities greater than 700 fpm. Square edge 90-degree take-off fittings or straight taps are unacceptable.
- L. Button punch snaplock construction will not be accepted on aluminum ductwork.
- M. Contractor may substitute round ducts for rectangular ducts if sized in accordance with ASHRAE table of equivalent rectangular and round ducts. No variation of duct configuration or sizes permitted except by written permission of Engineer.
- N. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible. Divergence upstream of equipment shall not exceed 30 degrees; convergence downstream shall not exceed 45 degrees.

2.5 FUME EXHAUST DUCT CONSTRUCTION

- A. Use PVC coated steel (internally coated) or stainless steel duct and fittings. Use stainless steel for exposed installations below suspended ceilings.
- B. Use 316 stainless steel for flanged gasketed connections.
- C. Use 18-gauge or heavier 316L stainless steel sheet for externally welded ductwork. Grind and polish joints and seams to a number 3 finish, minimum.

2.6 DUCT SEALANT

- A. Manufacturers:
 1. 3M 800.
 2. 3M 900.
 3. H.B. Fuller/Foster.
 4. Hardcast.
 5. Hardcast Peal & Seal.
 6. Lockformer Cold Sealant.
 7. Mon-Eco Industries.
 8. United Sheet Metal.
 9. Or approved equal.
- B. Silicone sealants will not be allowed in any type of ductwork installation.
- C. Install sealants in strict accordance with manufacturer's recommendations, paying special attention to temperature limitations.

- D. Allow sealant to fully cure before pressure testing of ductwork or startup of air handling systems.

2.7 GASKETS

- A. Two-Inch Pressure Class and Lower: Soft neoprene or butyl gaskets in combination with duct sealant for flanged joints.
- B. Three-Inch Pressure Class and Higher: Butyl gaskets.
- C. Fume Hood Exhaust: Butyl gaskets.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Verify dimensions at site, making field measurements and drawings necessary for fabrication and erection.
- B. Check Drawings showing work of other trades and consult with Engineer in event of any interference.
- C. Make allowances for beams, pipes, or other obstructions in building construction and for work of other contractors.
- D. Transform, divide or offset ducts as required, in accordance with SMACNA HVAC Duct Construction Standards, Figure 2-7, except do not reduce duct to less than 6 inches in any dimension and do not exceed an 8:1 aspect ratio.
- E. Where it is necessary to take pipes or similar obstructions through ducts, construct easement as indicated in SMACNA HVAC Duct Construction Standards, Figure 2-8, Fig. E.
- F. In all cases, seal to prevent air leakage. Pipes or similar obstructions may not pass through high pressure or fume exhaust ductwork.
- G. Test openings for test and balance work will be provided under Section 23 05 93 - Testing, Adjusting, and Balancing for HVAC.
- H. Provide frames constructed of angles or channels for coils, filters, dampers, or other devices installed in duct systems, and make connections to such equipment including equipment furnished by others. Secure frames with gaskets and screws or nut, bolts, and washers.
- I. Install duct to pitch toward outside air intakes and drain to outside of building. Solder or seal seams to form watertight joints.

- J. Where two different metal ducts meet, install joint in such manner that metal ducts do not contact each other by using proper seal or compound.
- K. Install motor operated dampers and connect to or install equipment furnished by others. Blank off unused portions of louvers, as indicated on Drawings, with 1-1/2-inch board insulation with galvanized sheet metal backing on both sides.
- L. Do not install ductwork through dedicated electrical rooms or spaces unless ductwork is serving this room or space.
- M. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.
- N. Provide adequate access to ductwork for cleaning purposes.
- O. Provide temporary capping of ductwork openings to prevent entry of dirt, dust, and foreign material.
- P. Protect diffusers, registers, and grilles with plastic wrap or some other approved form of protection to maintain dirt and dust free and to prevent entry of dirt, dust, and foreign material into ductwork.
- Q. Install prefabricated grease ductwork assemblies in accordance with manufacturer requirements and NFPA 96.
- R. During construction provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.
- S. Provide duct access doors or cleanout doors on all exhaust ductwork and return air ductwork at 20 foot intervals for healthcare applications.

3.2 DUCTWORK SUPPORT

- A. Support ductwork in accordance with SMACNA HVAC Duct Construction Standards, Figure 4-4, except supporting ductwork with secure wire method is not allowed.
- B. Support with 3/32-inch, 7-inch x 7-inch, stainless steel air-craft cable, with matching fastener rated for 150 percent of actual load, will be allowed on round ductwork under 12 inches if installed as detailed, with cable double looped on duct and at point of support.

3.3 LOW PRESSURE DUCT (MAXIMUM 3-INCH PRESSURE CLASS)

- A. Seal ducts, with exception of transfer ducts, in accordance with SMACNA seal class "A"; sealing transverse and longitudinal seams, joints, and penetrations.

- B. Install manual-balancing damper in each branch duct and for each diffuser or grille. Use of splitter dampers, extractors, or grille face dampers will not be accepted for balancing dampers.
- C. Hangers must be wrapped around bottom edge of duct and securely fastened to duct with sheet metal screws or pop rivets. Trapeze hangers may be used at Contractor's option.

3.4 CLEANING

- A. Remove dirt and foreign matter from entire duct system and clean diffusers, registers, grilles, and inside of air-handling units before operating fans.
- B. Clean duct systems with high power vacuum machines where systems have been used for temporary heat, air-conditioning, or ventilation purposes during construction.
- C. Protect equipment that may be harmed by excessive dirt with filters, or bypass during cleaning.

3.5 LEAKAGE TEST

- A. Test ductwork in accordance with test methods described in Section 5 of SMACNA HVAC Air Duct Leakage Test Manual.
- B. Do not insulate ductwork until it has been successfully tested. Test pressure shall be equal to duct pressure class.
- C. If excessive air leakage is found locate leaks, repair duct in area of leak, seal duct, and retest.
- D. Leakage rate shall not exceed more than 5 percent of system air quantity for low-pressure ductwork, determined in accordance with Appendix C of SMACNA HVAC Air Duct Leakage Test Manual.
- E. Leakage rate shall not exceed more than 1 percent of system air quantity for high-pressure ductwork, determined in accordance with Appendix C of SMACNA HVAC Air Duct Leakage Test Manual.
- F. Contractor may omit leakage test for ductwork downstream of air terminal devices but will not relieve Contractor from duct sealing requirements.
- G. Submit a signed report to Engineer/Architect indicating test apparatus used, results of leakage test, and any remedial work required to bring duct systems into compliance with specified leakage rates.

3.6 STRUCTURAL TEST

- A. Random test ductwork per Engineer/Architect's direction. Do not insulate ductwork until it has been successfully tested. Test pressure shall be equal to duct pressure class.
- B. Deflection limits shall not exceed those listed in accordance with Chapter 7 of SMACNA HVAC Duct Construction Standards, 3.0 Performance Requirements.
- C. Submit signed report to Engineer/Architect indicating test apparatus used, results of structural test, and any remedial work required.

END OF SECTION

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SECTION 23 33 00

AIR DUCT ACCESSORIES

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes.
 - 1. Manual volume dampers.
 - 2. Turning vanes.
 - 3. Fire dampers.
 - 4. Access doors.
 - 5. Flashings.
 - 6. Intake and exhaust hoods.
 - 7. Louvers.

- B. Related Sections
 - 1. Applicable provisions of Division 01 shall govern work under this Section.
 - 2. Section 23 05 00 – Basic HVAC Requirements.
 - 3. Section 23 05 29 – Hanger and Supports for HVAC Piping and Equipment.
 - 4. Section 23 09 14 – Pneumatic and Electrical Instrumentation and Control Devices for HVAC.
 - 5. Section 23 09 93 – Sequence of Operations for HVAC Controls.
 - 6. Section 23 31 00 – HVAC Ducts and Casings.

1.2 REFERENCES

- A. Air Movement & Control Association International, Inc. (AMCA)
 - 1. AMCA 500-L - Laboratory Methods of Testing Louvers for Rating.

- B. ASTM International
 - 1. ASTM C411 – Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
 - 2. ASTM C916 - Specification for Adhesives for Duct Thermal Insulation.
 - 3. ASTM C1071 – Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material).
 - 4. ASTM C1338 – Test Method for Determining Fungi Resistance of Insulation Materials and Facings.
 - 5. ASTM E84 – Test Method for Surface Burning Characteristics of Building Materials.
 - 6. ASTM G21 - Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.

- C. National Fire Protection Association (NFPA)

1. NFPA 90A - Standard for Installation of Air Conditioning and Ventilating Systems.
- D. Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)
1. SMACNA - HVAC Duct Construction Standards - Metal and Flexible, Latest Edition.
- E. Underwriters Laboratories, Inc. (UL)
1. UL 181 – Standard for Factory-Made Air Ducts and Air Connectors
 2. UL 214 - Test for Flame-Propagation of Fabrics and Films.
 3. UL 555 - Standard for Fire Dampers and Ceiling Dampers.
 4. UL 555S - Leakage Rated Dampers for Use in Smoke Control Systems.

1.3 SUBMITTALS

- A. Division 01 - Submittal Procedures: Shop Drawings, product data and samples.
- B. Submittals for accessories shall include dimensions, capacities, ratings, installation instructions, and appropriate identification.
- C. Include certified test data on dynamic insertion loss, self-noise power levels, and aerodynamic performance of sound attenuators.
- D. Fire damper and smoke damper submittals shall include free area data, certified pressure drop data and leakage data for sizes used.
- E. Include performance data for air blenders.
- F. Submit manufacturer's color charts where finish color is to be selected by Engineer/Architect.

PART 2 PRODUCTS

2.1 MANUAL VOLUME DAMPERS

- A. Manufacturers:
 1. Ruskin
 2. Vent Products
 3. Air Balance
 4. Or approved equal.
- B. Construct dampers in accordance with SMACNA Fig. 2-12, Fig. 2-13, and notes relating to these figures, except as modified below.
- C. Reinforce blades to prevent vibration, flutter, or other noise.
- D. Construct dampers in multiple sections with mullions where width is over 48 inches.

- E. Use rivets or tack welds to secure individual components; sheet metal screws are unacceptable.
- F. Provide operators with locking devices and damper position indicators for each damper; use an elevated platform on insulated ducts.
- G. Provide end bearings or bushings for volume damper rods penetrating ductwork constructed to a 3-inch water column pressure class or above.

2.2 TURNING VANES

- A. Manufacturers:
 - 1. Aero Dyne
 - 2. Anemostat
 - 3. Barber-Colman
 - 4. Hart & Cooley
 - 5. Or approved equal.
- B. Construct turning vanes and runners for square elbows in accordance with SMACNA Fig. 2-3 and Fig. 2-4, except use only airfoil type vanes.
- C. Construct turning vanes for short radius elbows and elbows where one dimension changes in turn in accordance with SMACNA Fig. 2-5 and Fig. 2-6.

2.3 FIRE DAMPERS

- A. Manufacturers:
 - 1. Air Balance
 - 2. Advanced Air
 - 3. American Warming and Ventilating
 - 4. Prefco
 - 5. Ruskin
 - 6. Safe-Air
 - 7. Vent Products
 - 8. Or approved equal.

2.4 STATIC FIRE DAMPERS

- A. Static fire damper assemblies must be UL 555 listed and labeled for static applications, where air systems do not operate during a fire and meet requirements of NFPA 90A.
- B. Damper must be type B curtain type with blades out of air stream; dampers with blades in air stream are unacceptable. Damper blades in air stream may be used in transfer ducts.

- C. Damper fire rating to be compatible with rating of building assembly in which damper is used.

2.5 CONTROL DAMPERS

- A. Control dampers are specified in Section 23 09 14 - Pneumatic and Electrical Instrumentation and Control Devices for HVAC.

2.6 SMOKE DETECTORS

- A. Electrical Contractor shall furnish and install smoke detectors.

2.7 ACCESS DOORS

- A. Manufacturers:
 - 1. Ruskin.
 - 2. Air.
 - 3. Balance.
 - 4. Advanced Air.
 - 5. Arrow.
 - 6. Vent Products Co., Inc.
 - 7. Greenheck.
 - 8. Or approved equal.
- B. Design and construct access door for pressure class of duct receiving door installation.
- C. Doors in exposed areas shall be hinged type with cam sash lock.
- D. Hinges shall be steel full-length continuous piano type.
- E. Secure doors in concealed spaces with cam sash latches.
- F. For both hinged and non-hinged doors provide sufficient number of cam sash latches to provide airtight seal when door is closed.
- G. Do not use hinged doors in concealed spaces if this will restrict access.
- H. Use minimum 1-inch deep 24-gauge galvanized steel double wall access doors with minimum 24-gauge galvanized steel frames.
- I. For non-galvanized ductwork, use minimum 1-inch deep double wall access door with frame using materials of construction identical to adjacent ductwork.
- J. Provide double neoprene gasket that seals from frame to door and frame to duct.

- K. When access doors are installed in insulated ductwork or equipment provide insulated doors with insulation equivalent to what is provided for adjacent ductwork or equipment.
- L. Use insulated, 1-1/2-hour, UL 555 listed and labeled access doors in kitchen exhaust ducts.

2.8 FLASHINGS

- A. Provide flashing to completely weatherproof connection of ductwork to louvers. Construct flashing of material similar to louver material.
- B. Flashing and counterflashing for roof curbs will be provided by others.
- C. Flashing and curbs for duct and pipe penetrations of roof assemblies in accordance with details.

2.9 HOODS FOR INTAKE AND EXHAUST

- A. Manufacturers:
 - 1. Acme.
 - 2. Ammerman.
 - 3. Carnes.
 - 4. Cook.
 - 5. Greenheck.
 - 6. Louvers and Dampers.
 - 7. Penn.
 - 8. Or approved equal.
- B. Use low silhouette type hoods.
- C. Construct hoods of aluminum.
- D. Provide bird screen and motor operated damper for each hood.

2.10 LOUVERS

- A. Manufacturers:
 - 1. Airolite K6776.
 - 2. Industrial Louvers 658.
 - 3. American Warming and Ventilating LE-31.
 - 4. Carnes FPCB.
 - 5. Vent Products co., Inc. 4650
 - 6. Or approved equal.
- B. Extruded aluminum alloy not less than 12-gauge, drainable blades, all-welded assembly, 35-degree or 45-degree blades with water baffle, 6 inches thick.

- C. Provide with bird screen of 1/2 x 1/2-inch mesh aluminum in 12-gauge aluminum frame and an aluminum sill.
- D. Locate bird screen inside of louver unless noted otherwise.
- E. Louver to bear AMCA certified ratings seal for both air performance and water penetration, having free area not less than 50 percent based on a 48 x 48-inch section, water penetration less than 0.1 oz/square foot under AMCA 500-L test at 1000 feet per minute, and intake pressure drop less than 0.20 inches of water at 1000 feet per minute.
- F. Finish to be anodized or Kynar 500 in a custom color to be selected by Engineer/Architect.
- G. Furnish sufficient paint in same color as louver to paint outer surface of panels over unused portions of louvers and to paint interior portion of ductwork visible through louvers.

2.11 AIR FLOW STATIONS

- A. Air flow stations are specified in section 23 09 14 – Pneumatic and Electrical Instrumentation and Control Devices for HVAC.

PART 3 EXECUTION

3.1 MANUAL VOLUME DAMPERS

- A. Install manual volume dampers in each branch duct and each grille, register, or diffuser as far away from outlet as possible while still maintaining accessibility to damper.
- B. Install so there is no flutter or vibration of damper blades.
- C. Splitter dampers shall not be used in place out volume dampers.

3.2 TURNING VANES

- A. Install turning vanes in rectangular, mitered elbows in accordance with SMACNA standards and manufacturer's recommendations.
- B. Install double wall, airfoil, 2-inch radius vanes in ducts with vane runner length 18 inches or greater and air velocity less than 2000 fpm.
- C. Install double wall, airfoil, 4-1/2-inch radius vanes in ducts with vane runner length greater than 18 inches and air velocity 2000 fpm or greater.
- D. If duct size changes in a mitered elbow, use single wall type vanes with a trailing edge extension.

- E. If duct size changes in a radius elbow or if short radius elbows must be used, install sheet metal turning vanes in accordance with SMACNA Figure 2-5 and Figure 2-6.

3.3 FIRE DAMPERS

- A. Install dampers in strict accordance with manufacturer's installation instructions.
- B. Install damper sleeves with retaining angles on both sides of rated partition.
- C. Connect ductwork to fire damper assemblies as specified in installation instructions.
- D. Where it is necessary to set dampers out from rated wall, install a sleeve extension encased in two-hour rated fire proofing insulation.
- E. Install an access door at each fire damper, located to permit resetting damper and replacing fusible link.
- F. Manually test each fire damper for proper operation by removing fusible link. Repair or replace any fire damper that does not close completely. Re-install fusible link after test.
- G. Label all fire dampers per Section 23 05 00 – Basic HVAC Requirements.

3.4 CONTROL DAMPERS

- A. Install dampers in locations indicated on Drawings, as detailed, and according to manufacturer's instructions.
- B. Install blank-off plates or transitions where required for proper mixing of airstreams in mixing plenums.
- C. Provide adequate operating clearance and access to operator. Install an access door adjacent to each control damper for inspection and maintenance.

3.5 SMOKE DETECTORS

- A. Electrical Contractor shall install and wire detectors. Install an access door at each detector location as indicated on electrical drawings.

3.6 ACCESS DOORS

- A. Install access doors where specified, indicated on Drawings, and in locations where maintenance, service, cleaning, or inspection is required.
- B. Examples include, but are not limited to, motorized dampers, fire and smoke dampers, smoke detectors, fan bearings, heating and cooling coils, filters, valves, and control devices needing periodic maintenance.

- C. Size and numbers of duct access doors to be sufficient to perform intended service.
- D. Minimum access door size shall be 8 x 8-inch size for hand access, 18 x 18-inch size for shoulder access, or other size as indicated.
- E. Install access doors on inlet side of reheat coils and other duct-mounted coils.

3.7 FLASHINGS

- A. Flashing for roof curbs, equipment supports, or rails located on roof, will be installed by others.

3.8 HOODS FOR INTAKE AND EXHAUST

- A. Install in locations indicated on Drawings, coordinating roof opening location with Contractor. Curbs are specified in Section 23 05 29 -.Hangers and Supports for HVAC Piping and Equipment.

3.9 LOUVERS

- A. Furnish louvers to General Contractor for mounting in exterior walls. Connect outside air intake duct to louver, sealing connections airtight and watertight.
- B. Provide bird screen on inside of active louver area where none is provided with louver. Where louvers are equipped with inside bird screen, remove screen at locations where duct connections are not made.
- C. Install insulated metal panel on unused portion of louver. Seal panels weather tight to louver assembly with flashing as required for proper drainage to outside of building.
- D. Paint outside surface of panel to match louver prior to installation.
- E. Where ductwork is visible through louver when viewed from outside building, paint inside of duct to match louver color.

END OF SECTION

SECTION 23 34 00

HVAC FANS

PART 1 GENERAL

- A. SUMMARY
- B. Section Includes
 - 1. Centrifugal fans.
 - 2. Power roof exhaust fans.
 - 3. Sidewall centrifugal fans.
 - 4. Ceiling exhaust fans.
- C. Related Sections
 - 1. Applicable provisions of Division 01 shall govern Work under this Section.
 - 2. Section 23 05 00 – Basic HVAC Requirements.
 - 3. Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.
 - 4. Section 23 05 13 - Motor Requirements for HVAC Equipment.
 - 5. Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment.

1.2 REFERENCES

- A. Air Movement and Control Association (AMCA)
 - 1. AMCA 203 - AMCA Fan Application Manual - Troubleshooting
 - 2. AMCA 210 - Laboratory Method of Testing Fans for Rating
 - 3. AMCA 300 - Reverberant Room Method for Sound Testing of Fans
- B. National Fire Protection Association (NFPA)
 - 1. NFPA 90A - Standard for the Installation of Air Conditioning and Ventilating Systems

1.3 SUBMITTALS

- A. Division 01 - Submittal Procedures: Shop Drawings, product data and samples.
- B. Submit dimensions, capacities, fan curves, materials of construction, ratings, weights, motors and drives, sound power levels, appropriate identification, and vibration isolation for equipment. Sound power levels to be based on tests performed in accordance with AMCA Standard 300.
- C. Submit color selection charts for equipment where applicable.
- D. Fan curves shall indicate relationship of CFM to static or total pressure for various fan speeds.
- E. Indicate brake horsepower, recommended selection range, and limits of operation on curves.

- F. Indicate operating point on fan curves at design air quantity and indicate manufacturer's recommended drive loss factor for specific application.
- G. Tabular fan performance data is not acceptable.
- H. For variable air volume application, include data indicating effect of capacity control devices, such as inlet vanes, on performance.

1.4 DESIGN CRITERIA

- A. Tested and certify fans in accordance with applicable AMCA test code.
- B. Each fan and motor combination shall be capable of delivering 110 percent of scheduled air quantity at scheduled static pressure.
- C. Motor furnished with fan shall not operate into motor service factor when operating under these conditions.
- D. Consider drive efficiency in motor selection according to manufacturer's published recommendation or according to AMCA Publication 203, Appendix L.
- E. Where inlet and outlet ductwork at any fan is changed from that shown on Drawings, provide any motor, drive, and wiring changes required due to increased static pressure or baffling necessary to prevent uneven airflow or improve mixing.
- F. All internal insulation and other components exposed to air stream are to meet flame spread and smoke ratings contained in NFPA 90A.
- G. Provide all roof mounted equipment with curbs or equipment stands in accordance with specification in Section 23 05 29 – Hangers and Supports for HVAC Piping and Equipment.

PART 2 PRODUCTS

2.1 GENERAL

- A. Use fan size, class, type, arrangement, and capacity as scheduled.
- B. Furnish complete with motors, wheels, drive assemblies, bearings, vibration isolation devices, and accessories required for specified performance and proper operation. Single phase motors to have inherent thermal overload protection.
- C. Reference Section 23 05 13 – Motor Requirements for HVAC Equipment for motor requirements.

- D. Provide variable pitch sheaves for drives 3 hp and smaller and fixed pitch sheaves for drives 5 hp and larger. Design drives for 150 percent of motor rating.
- E. Use OSHA approved belt guards that totally enclose entire drive. Construct guards of expanded metal to allow for ventilation; provide tachometer openings at shaft locations.
- F. Statically and dynamically balance fans so they operate without objectionable noise or vibration.
- G. Use AMCA Type A spark resistant construction for fans handling flammable or combustible vapors from hazardous locations.

2.2 CENTRIFUGAL FANS

- A. Manufacturers:
 1. Greenheck Fan Corporation.
 2. Loren Cook Company.
 3. New York Blower Company.
 4. PennBarry.
 5. Johnson Controls Inc.
 6. Twin City Fan & Blower.
 7. Or approved equal.
- B. Centrifugal Fan Assembly:
 1. Construct housing of welded steel with angle iron frame.
 2. Use spun or die formed inlet cones to provide streamlined flow into wheel.
 3. Use airfoil blades welded to spun wheel cones unless otherwise indicated.
 4. Bearings to be self-aligning grease packed pillow block type with grease seal and external grease fittings. Bearings rated for 200,000 hours average life.
 5. Provide each fan housing with capped drain connection and bolted and gasketed access door for inspection of fan wheel.
 6. Unless special coating is scheduled, paint fans with a prime coat after metal cleaning and surface preparation; apply second coat of paint to exterior surfaces.
 7. Provide fan assembly with spring vibration isolators.
 8. Provide 1-inch galvanized mesh inlet screens for fans without inlet ductwork.
 9. For fans serving hazardous air streams, provide spark proof wheel, aluminum rubbing, and explosion proof motor and device enclosure for devices mounted in air stream.

2.3 POWER ROOF EXHAUST FANS

- A. Manufacturers:
 1. Greenheck Fan Corporation.
 2. JencoFan.
 3. Loren Cook Company.

4. Or approved equal.
- B. Power Roof Exhaust Fan Assembly:
1. Provide upblast or downblast units, as scheduled, with aluminum housing, non-overloading type centrifugal wheel, inlet cone, factory mounted and wired motor and disconnect switch, and bird screen.
 2. Manufacturer will provide disconnect switches and thermal overload protection for units with three phase motors.
 3. Upblast units to have motor, bearings, and drives completely enclosed and isolated from exhaust air stream with ventilation provided by outside air. Units handling grease laden vapors to be UL listed for conveying such vapors, operating continuously at 300 degrees F.
 4. For direct drive units, furnish solid state, variable speed controller for each fan. Speed controller to be used for final air balancing of fan or with variable frequency drive matched to motor characteristics.

2.4 SIDEWALL PROPELLER FANS

- A. Manufacturers:
1. Greenheck Fan Corporation.
 2. Loren Cook Company.
 3. Or approved equal.
- B. Sidewall Propeller Fan Assembly:
1. Constructed of steel with angle iron reinforcing and motor support frame, die formed propeller blades with welded reinforcing gusset on backside for added rigidity, belt or drive as scheduled, 24 volt electrically operated control damper with blade edge and jamb seals, damper operator, birdscreen, and screened inlet/fan guard.
 2. Unless special coating is scheduled, paint fans with prime coat after metal cleaning and surface preparation; apply second coat of paint to exterior surfaces.
 3. Provide factory fabricated wall sleeves and hoods

2.5 CEILING EXHAUST FANS

- A. Manufacturers:
1. Acme Engineering & Manufacturing Corporation.
 2. Broan.
 3. Greenheck Fan Corporation.
 4. Jenco Fan.
 5. Loren Cook Company.
 6. Or approved equal.
- B. Ceiling Exhaust Fan Assembly:
1. Centrifugal blower wheel, steel housing with acoustical lining, integral exhaust grille, adjustable mounting brackets to allow for any ceiling thickness, permanently

lubricated motor, integral junction box with permanently lubricated and thermally protected motor factory wired, 24 volt electrically operated control damper with blade edge and jamb seals, and damper operator.

2. Provide wall, eave, or roof discharge assembly, as indicated on Drawings.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install as shown on Drawings, as detailed, and according to manufacturer's installation instructions. On units provided with drain connection, reduce drain connection down to 1/2-inch fitting and leave open.
- B. Install thrust restraints in accordance with requirements of Section 23 05 48 – Vibration and Seismic Controls for HVAC.
- C. Fan drive sheaves on belt driven units shall be adjusted or replaced by Contractor to provide design air volumes.
- D. Roof mounted exhaust fans and utility sets shall be securely anchored to their roof mounting curb/rails by installing corrosion resistant lag screws around side of curb cap into curb top nailer.
- E. Furnish wall and roof opening locations and dimensions to other sections of work requiring opening information.
- F. For direct drive fans furnished with variable fan speed controllers, Electrical Contractor will wire and install fan speed controllers on fans.

3.2 POWER ROOF VENTILATORS

- A. Install motorized dampers in fan curb. Wire damper motor to fan power supply and install required transformers. Damper shall be interlocked to fan power supply so that damper opens when fan is energized.
- B. Horizontal exhaust duct under bottom of roof shall have 2 inch deep drip pan centered under roof opening below roof exhaust fan throat. Seams in bottom pan shall be soldered or caulked watertight.

3.3 SIDEWALL PROPELLER FANS

- A. Install discharge shutter, backdraft dampers and other accessories requiring field installation. Wire wall shutter and backdraft damper motors to fan power supply and install required transformers. Shutter and dampers shall be interlocked to fan power supply so that shutter or damper opens when fan is energized.

3.4 CEILING EXHAUST FANS

- A. Installation of fan speed controllers is provided by Electrical Contractor.

END OF SECTION

SECTION 23 37 13

DIFFUSERS, REGISTERS, AND GRILLES

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Ceiling diffusers.
 - 2. Side-wall registers and grilles.
 - 3. Door grilles.

- B. Related Sections:
 - 1. Applicable provisions of Division 01 shall govern Work under this Section.
 - 2. Section 23 05 00 – Basic HVAC Requirements.
 - 3. Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
 - 4. Section 23 31 00 - HVAC Ducts and Casings.
 - 5. Section 23 33 00 - Air Duct Accessories.

1.2 REFERENCES

- A. Air-Conditioning and Refrigeration Institute (ARI)
 - 1. ARI-ADC Standard 880.

- B. ASTM International
 - 1. ASTM D6386 - Practice for Preparation of Zinc (Hot-Dip Galvanized) Coated Iron and Steel Product and Hardware Surfaces for Painting.

- C. National Fire Protection Association (NFPA)
 - 1. NFPA 90A - Installation of Air Conditioning and Ventilation Systems.

- D. Underwriters Laboratories, Inc. (UL)
 - 1. UL 181 - Factory-Made Air Ducts and Connectors.

1.3 SUBMITTALS

- A. Division 01 - Submittal Procedures: Shop drawings, product data and samples.

- B. Furnish submittal information including, but not limited to, the following:
 - 1. Manufacturer's name and model number.
 - 2. Identification as referenced in documents.
 - 3. Capacities/ratings.
 - 4. Materials of construction.
 - 5. Sound ratings.

6. Dimensions.
7. Finish.
8. Color selection charts where applicable.
9. Manufacturer's installation instructions.
10. Frame and border for each application.

1.4 DESIGN CRITERIA

- A. Basel performance data on tests conducted in accordance with Air Diffusion Council (ADC) Test Code 1062 GRD 84.

PART 2 PRODUCTS

2.1 SQUARE CEILING DIFFUSERS - HIGH PERFORMANCE

- A. Manufacturers:
 1. Titus: Model TMS.
 2. Carne: Series SF.
 3. Price Industries: Model SCD.
 4. MetalAire Series 5800.
 5. Krueger Series 1400.
 6. Or approved equal.
- B. Square Ceiling Diffusers – HP Assembly:
 1. Diffusers to be aluminum unless otherwise indicated, louvered face furnished with frame type appropriate to installation.
 2. Diffuser shall have throw characteristics of a round diffuser having a 360-degree horizontal blow pattern.
 3. High performance type diffuser incorporating short throws and low NC levels. Louver cones shall be one-piece construction with no corner joints.
 4. Unless otherwise indicated, diffuser shall have baked enamel finish with color selected by Architect.

2.2 SIDE-WALL REGISTERS AND GRILLES

- A. Manufacturers:
 1. Titus: Series 300 (Supply) and Series 350 (Return/Exhaust).
 2. Carnes: Model R Series.
 3. Price Industries: Model NM22S/T or C22S/3.
 4. MetalAire: Series V4000 or H4000.
 5. Krueger: Series 880.
 6. Or approved equal.
- B. Side-Wall Registers And Grille Assembly:
 1. Aluminum unless otherwise indicated, with frame type appropriate to installation.

2. Double deflection type blade supply registers and supply grilles allow deflection adjustment in all directions.
3. Opposed blade volume control damper supply registers, operable from face.
4. Fixed blade 45-degree core return and exhaust registers and grilles.
5. Opposed blade volume control damper return registers, operable from face.
6. Register and grille sizes as shown on Drawings and as scheduled. Unless noted otherwise, baked enamel finish with color selected by Architect.
7. Screw holes on surface counter sunk to accept recessed type screws.

2.3 EGGCRATE GRILLES

A. Manufacturers:

1. Titus: Model 50.
2. Carnes: Model RAE or RAT.
3. Price Industries: Model C80.
4. MetalAire: Model CC.
5. Krueger: Model EGC.
6. Or approved equal.

B. Eggcrate Grille Assembly:

1. Aluminum construction with frame type appropriate to installation.
2. Grille face 1/2 x 1/2-inch or 1 x 1-inch grid pattern 1-inch deep with a minimum of 85 percent free area.
3. Grille sizes and finishes as shown on Drawings and as scheduled. Unless noted otherwise, baked enamel finish with color selected by Architect.
4. Screw holes on surface counter sunk to accept recessed type screws.

2.4 DOOR GRILLES

A. Manufacturers:

1. Titus Series 700.
2. Carnes Series RF or RG.
3. MetalAire Series DG.
4. Or approved equal.

B. Door Grille Assembly:

1. Aluminum. Sight tight.
2. Grille sizes, frame types, and finishes as shown on Drawings and as scheduled. Unless noted otherwise, baked enamel finish with color selected by Architect.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install grilles, registers, and diffusers as shown on Drawings and according to manufacturer's instructions.
- B. Furnish diffusers with equalizing grids where it is not possible to maintain minimum 2 duct diameter straight duct into diffuser.
- C. Equalizing grids shall consist of individually adjustable vanes designed for equalizing air flow into diffuser neck and providing directional control of air flow.
- D. Unless otherwise indicated, size ductwork drops to diffusers or grilles to match unit collar size.
- E. Seal connections between ductwork drops and diffusers/grilles airtight. The use of duct tape or insulating tape is not acceptable.
- F. Blank off unused portion of linear slot diffusers and linear bar diffusers and grilles.
- G. Where diffusers, registers, and grilles cannot be installed to avoid seeing inside duct, paint inside of duct with flat black paint to reduce visibility.
- H. Coordinate door grille sizes, locations, and installation with work of other trades.
- I. Grilles and registers shall be securely and neatly attached to the building construction or sheet metal flanges.
- J. Adjust front and rear blades for draft free air pattern.

END OF SECTION

SECTION 23 41 00

PARTICULATE AIR FILTRATION

PART 1 GENERAL

1.1 SUMMARY

- A. Selection Includes:
 - 1. Panel Filters.
 - 2. MERV 8 Filters.
 - 3. Filter Holding Frames.
 - 4. Filter Gauges.

- B. RELATED SECTIONS
 - 1. Applicable provisions of Division 01 shall govern all work under this section.
 - 2. Division 01 Section 01 91 00 – Commissioning.
 - 3. Section 23 05 00 - Basic HVAC Requirements.
 - 4. Section 23 07 00 - HVAC Insulation.
 - 5. Section 23 72 00 - Air-to-Air Energy Recovery Equipment.
 - 6. Section 23 73 13 - Modular Indoor Central-Station Air-Handling Units.
 - 7. Section 23 73 23 - Built-Up Air Handling Units.
 - 8. Section 23 74 13 - Packaged Rooftop Heating and Cooling Units.

1.2 REFERENCES

- A. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE)
 - 1. ASHRAE Standard 52.2, Current Standard.

- B. Underwriters Laboratories, Inc. (UL)
 - 1. UL 181 – Standard for Factory-Made Air Ducts and Air Connectors.
 - 2. UL 586 – Standard for High Efficiency Particulate Air Filter Units.
 - 3. UL 900 – Standard for Air Filter Units.

1.3 SUBMITTALS

- A. Division 01 – Submittal Procedures: Shop Drawings, product data, and samples.

- B. Include data concerning dimensions, materials, efficiencies, installation instructions and appropriate identification.

- C. Independent test reports verifying filter performance, test procedures, and ratings.

1.4 OPERATION AND MAINTENANCE DATA

- A. Operations and maintenance data shall comply with submission and content requirements

specified under Division 01 – Operation and Maintenance Data.

1.5 DESIGN CRITERIA

- A. Use UL Class 1 or Class 2 filters unless noted otherwise. (Reference applicable UL standard referenced).
- B. Efficiencies indicated in this section are based on ASHRAE Standard 52.2, Current Edition.
- C. Fan motors have been selected to operate against resistance of dirty filters as specified in this section.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Filtration Equipment and Accessories;
 - 1. American Air Filter.
 - 2. Cambridge.
 - 3. Continental.
 - 4. Eco-Air.
 - 5. Flanders.
 - 6. Camfil-Farr.
 - 7. Purifil (Odor Control) Purolator.
 - 8. Or approved equal.

2.2 PANEL FILTERS

- A. Use 1-inch, or as scheduled, thick fiberglass blanket enclosed in a cardboard frame and reinforced with a perforated metal retainer on air leaving side, coat media with flameproof, non- volatile adhesive.
- B. Media nominal rating to be 500 FPM face velocity, 0.15-inch WG initial resistance, 0.30-inch WG recommended final resistance.
- C. Average resistance of filter media shall be 80 percent. Provide filter holding frame.

2.3 MERV 8 FILTERS

- A. Use 2-inch thick, pleated panels, 100 percent synthetic, self supported media fully bonded and sealed in cardboard frame.
- B. Media nominal rating to be 500 FPM face velocity, 0.20-inch WG initial resistance, 1.0-inch WG recommended final resistance. Average arrestance of filter media shall be 90-92 percent. Minimum 4.6 sq.ft. of media per sq.ft. of filter face area.

- C. Furnish side access housing or holding frame as scheduled.
- D. Construct filter tracks to provide a minimum clearance of 2 inches between pre-filter and final filter media to facilitate installation of static pressure tips.

2.4 SIDE ACCESS FILTER HOUSINGS

- A. Galvanized steel housing with aluminum or galvanized steel filter mounting tracks.
- B. Standard filter sections provided by air handling unit manufacturers may be used for MERV 8 filters but will not be accepted for HEPA filters or activated carbon filters.

2.5 FILTER GAUGES

- A. Manufacturers:
 - 1. Dwyer.
 - 2. Or approved equal.
- B. Direct reading, 3-1/2 inch dial type, diaphragm actuated, in a metal case.
- C. Lettering shall be black figures on white background.
- D. Provide front re-calibration adjustment.
- E. Provide gauges with following ranges:

Filter Type	Scale Range (inch W.G.)
MERV 7	0.0 to 1.0
MERV 11	0.0 to 2.0
MERV 14	0.0 to 2.0
HEPA Filters	0.0 to 4.0
Activated Carbon Filters	0.0 to 2.0

- F. Provide one gauge for each filter bank, suitable for flush or surface mounting. Include an air filter gauge accessory package consisting of mounting bracket, aluminum tubing, two static pressure tips, and vent valves for each gauge.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Where air handling equipment is to be used for temporary heating or ventilation of a facility, do not operate equipment until specified filter media has been installed.
- B. Contractor shall be responsible for maintaining the cleanliness of air handling apparatus and air distribution systems during construction through regular inspection and changing of filter media throughout construction period.

- C. Where air handling apparatus is used during construction period, install new filter media prior to start of air balancing.
- D. Deliver one extra new set of filter media to Owner prior to substantial completion.
- E. Install units as shown on Drawings and details according to manufacturer's instructions.
- F. Reinforce filter holding frames per manufacturer's instructions.
- G. Maintain necessary clearance for changing filters.

3.2 FILTER GAUGES

- A. Install filter gauge static pressure tips upstream and downstream of filters.
- B. Mount gauge on outside of filter housing or filter plenum in accessible position outside of the unit housing, install tubing and gauge valves between gauge and sensor tips.
- C. Adjust and level each gauge.

END OF SECTION

SECTION 23 52 13

ELECTRIC HOT WATER BOILERS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes
 - 1. Electric Hot Water Boiler.
- B. Related Sections
 - 1. Applicable provisions of Division 01 shall govern Work under this Section.
 - 2. Section 23 05 00 – Basic HVAC Requirements.
 - 3. Section 23 05 23 – General Duty Valves for HVAC Piping
 - 4. Section 23 09 93 – Sequence of Operations for HVAC Controls.
 - 5. Section 23 21 13 – Hydronic Piping

1.2 REFERENCES

- A. American National Standards Institute (ANSI)
 - 1. ANSI Z21.13 – Gas-Fired Low Pressure Steam and Hot Water Boilers.
- B. American Society of Mechanical Engineers (ASME)
 - 1. ASME - Boiler and Pressure Vessel Code I - Rules of Construction of Power Boilers.
 - 2. ASME - Boiler and Pressure Vessel Code IV - Rules for Construction of Heating Boilers.
 - 3. ASME - Boiler and Pressure Vessel Code VIII - Rules for Construction of Pressure Vessels.
 - 4. ASME - Boiler and Pressure Vessel Code IX - Welding and Brazing Qualifications.
 - 5. ASME - CSD-1 Control and Safety Devices for Automatically Fired Boilers.
- C. National Fire Protection Association (NFPA)
 - 1. NFPA 70 - National Electric Code (NEC)
- D. Underwriters Laboratories, Inc. (UL)
 - 1. UL 296 - Oil Burners.
 - 2. UL 795 - Commercial Industrial Gas Heating Equipment.

1.3 ENERGY EFFICIENCY

- A. Manufacturer of boilers with capacity of less than 300,000 btu/hr input must label boiler as Energy Star.
- B. Boilers with capacity of 300,000 btu/hr input must meet efficiencies specified. Minimum

boiler efficiencies are based on Federal Energy Management Program (FEMP) recommendations.

1.4 SUBMITTALS

- A. Division 01 - Submittal Procedures: Shop Drawings, product data and samples.
- B. Submit data concerning dimensions, capacities, and material of construction, wiring diagrams, ratings, piping diagrams, weights, manufacturer's installation requirements, warranty information, and performance limitations.
- C. Submit manufacturer's installation instructions including required clearance to combustible materials.

1.5 REGISTRATION

- A. Complete Boiler and Unfired Pressure Vessel (UPV) Installation Registration and forward to Wisconsin Department of Commerce in accordance with Wisconsin Administrative Code Chapter Comm 41.24.

1.6 WARRANTY

- A. Provide 5-year Boiler pressure vessel warranty against leakage due to defective workmanship.

PART 2 PRODUCTS

2.1 ELECTRIC HOT WATER BOILER

- A. Provide one 300 KW, 480/60/3 resistance element type electric boiler for standby service. Boiler shall be of moderate watt density type (70 WPSI) and constructed to latest ASME, NEC and UL applicable standards. The following features shall be included:
 - 1. ASME pressure vessel Section IV rated at 30, 125 or 160 psig.
 - 2. 3-1/2 inch fiberglass insulation secured to vessel.
 - 3. Enameled heavy gauge sheet metal enclosure.
 - 4. Full sized structural steel base.
 - 5. Incoloy sheathed immersion resistance type heating elements constructed of high grade resistance wire 80 percent nickel, 20 percent chromium surrounded by compacted magnesium oxide in Incoloy 800 sheathing. Compression fittings shall permit elements to be individually replaced with standard tools.
 - 6. Minimum of 8 steps of control.
 - 7. Proportioning step control with hot water temperature sensor. Control to energize required heating circuits via magnetic contactors. Control to be field selectable between linear sequence and progressive sequence (first on-first off) and automatically recycle to zero output upon startup and restart. Include adjustable

- interstage time delays, and capability to slave verneir SCR stages.
8. Hinged access doors.
 9. Manual and automatic temperature limit switches.
 10. Blowdown valve.
 11. Float type low water cutoff and auxiliary low water cutoff.
 12. Safety relief valve.
 13. Pressure and temperature gauges.
 14. NEMA 1 control cabinet with power switch, contactors, power light and pilot step lights. Controls shall allow 10 percent over voltage condition without adversely affecting circuit components. Include load limiter feature, outdoor reset, door interlock, ground fault protection, ammeter, voltmeter, flow switch and circuit breaker.
- B. Disconnect switch to be provided by Electrical Contractor.
- C. Warranty shall be 5 years on pressure vessel and one year not to exceed 18 months from shipment on other items.
- D. Provide startup and startup report by factory or authorized field representative.
- E. Boiler to be manufactured by Hydro Steam Industries or approved equal.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install units as shown on Drawings, as detailed, and according to manufacturer's installation instructions.
- B. Set boiler units on 3-1/2 high concrete housekeeping pads.
- C. Install items shipped loose by equipment manufacturer under supervision of equipment manufacturer's field service personnel.

3.2 BOILERS

- A. After flushing piping system, boil out boilers using chemical and procedure recommended by boiler manufacturer. Perform boil-out under supervision of boiler manufacturer's representative.
- B. Manufacturer shall verify in writing that boilers have been cleaned according to their recommendations and are ready for operation.
- C. Isolate boilers from piping system during boil-out.

- D. Pipe vents from gas train to outside atmosphere. Size of each vent shall not be less than connection size to device.
- E. Discharge of boiler water relief valves shall be piped individually and full size to nearest floor drain.
- F. Pipe boiler drains to nearest floor drains.
- G. If remote control panels are used, install interconnecting wiring and pneumatic tubing if used between panels and units.

3.3 MANUFACTURER'S FIELD SERVICES

- A. Prepare and start systems under provisions of Division 01.
- B. Submit four copies of completed start-up report to Engineer/Architect.
- C. Manufacturer shall provide services of factory trained serviceman to supervise installation, initial start-up and testing of boiler-burner unit.
- D. Four copies of written start-up report shall be submitted to Engineer following the start-up and acceptance of installation by manufacturer's representative.
- E. Written report shall be signed by serviceman responsible for performing start-up and adjustment work.
- F. Report shall state scope of work done, indicate all readings taken, including combustion efficiency test, and it shall certify that boiler burner unit has been placed in proper running condition as recommended by manufacturer.
- G. Manufacturer shall provide written service warranty which shall provide factory authorized service for period of one year following acceptance of installation.
- H. One-year service warranty shall be submitted at time of certified shop drawings submittal with record copy sent to Engineer.
- I. One-year service warranty by manufacturer shall provide free parts and labor to correct malfunctions of boiler burner unit during warranty period.

END OF SECTION

SECTION 23 57 00

HEAT EXCHANGERS FOR HVAC

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Plate Heat Exchangers.
- B. Related Sections:
 - 1. Applicable provisions of Division 01 shall govern Work under this Section.
 - 2. Section 23 05 00 – Basic HVAC Requirements.
 - 3. Section 23 21 13 - Hydronic Piping.
 - 4. Section 23 83 16 – In-Floor Hydronic Heating.

1.2 REFERENCES

- A. American Society of Mechanical Engineers (ASME)
 - 1. ASME – Boiler and Pressure Vessel Code VIII – Rules for Construction of Pressure Vessels-Latest Edition (BPVC).

1.3 SUBMITTALS

- A. Division 01 – General Requirements Submittal Procedures: Shop Drawings, product data, and samples.
- B. Include data concerning dimensions, weights, capacities, pressure drops, fouling factors, flow rates, entering and leaving conditions, and material of construction.
- C. Capacities shall be guaranteed by manufacturer.

1.4 OPERATION AND MAINTENANCE DATA

- A. Operations and maintenance data shall comply with submission and content requirements specified in Division 01.

PART 2 PRODUCTS

2.1 PLATE HEAT EXCHANGERS

- A. Manufacturers:
 - 1. Alfa Laval.
 - 2. Graham Corporation.

3. ITT Bell & Gossett.
 4. ITT Standard.
 5. Taco Inc.
 6. Substitutions: In accordance with Division 01 – General Requirements.
- B. Plate Heat Exchanger Assembly:
1. Plate and frame type with gasketed heat transfer channel plates mounted on carrying bars and held between a stationary frame plate and a moveable pressure plate.
 2. Design pressure of 200 psig at 230 degrees F in each circuit with no pressure in other circuit.
 3. Construct and stamp heat exchangers in accordance with latest ASME Boiler and Pressure Vessel Code Section VIII.
 4. Type 304 or 316 stainless steel corrugated channel plates with one piece Nitrile or EPDM gaskets, whichever material suitable for fluids used.
 5. Gaskets may be glued or non-glued type.
 6. Provide relieving grooves on gaskets to prevent cross contamination between fluids.
 7. Provide OSHA compliant aluminum splashguard over channel plate rack.
 8. Carbon steel pressure plates with enamel paint or epoxy coating.
 9. Plates shall not require additional stiffeners for support.
 10. Carbon steel carrying bars with zinc yellow chromate finish or epoxy coated finish.
 11. Studded port type pipe connections to accept ANSI flanges for 3-inch and larger. Carbon steel NPT tapings or stainless steel NPT nozzles for connections 2 inches and smaller. Factory seal connections prior to shipment to prevent entrance of foreign material.
 12. Provide heat exchangers with capacities and operating characteristics indicated on Drawings.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install units as shown on Drawings, as detailed, and according to manufacturer's installation instructions.
- B. Provide clearance around units as shown on Drawings and as recommended by manufacturer for service access.
- C. Provide elbows, flanges, and unions on piping to allow for servicing heat exchangers.

3.2 PLATE HEAT EXCHANGERS

- A. Bolt to concrete pad. Apply grease to threaded surfaces of compression bolts and cover with plastic sleeving.

END OF SECTION

**Dane County Transfer Station
and Clean Sweep Building
05/11/2010**

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SECTION 23 72 00

AIR-TO-AIR ENERGY RECOVERY EQUIPMENT

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes
 - 1. Air-to-Air Heat Exchangers (Fixed plate type)
- B. Related Sections
 - 1. Applicable provisions of Section 23 05 00 shall govern Work under this Section.
 - 2. Section 23 05 00 – Basic HVAC Requirements.
 - 3. Section 23 07 00 - HVAC Insulation.
 - 4. Section 23 33 00 - Air Duct Accessories.

1.2 QUALITY ASSURANCE

- A. Reference Section 23 05 00 - General Requirements.

1.3 SUBMITTALS

- A. Section 23 05 00 – Basic HVAC Requirements – Submittal Procedures: Shop Drawings, product data, and samples.
- B. Include unit dimensions, weights, materials of construction, thermal characteristics, ratings, fabrication methods, manufacturer's installation requirements, and appropriate identification.

1.4 DESIGN CRITERIA

- A. Capacity, efficiency, and operating characteristics as indicated on Drawings.

PART 2 PRODUCTS

2.1 AIR-TO-AIR HEAT EXCHANGERS (Fixed polymer membrane type)

- A. Manufacturers:
 - 1. Renew Aire, Inc.
 - 2. Substitutions: Section 23 05 00 – Basic HVAC Requirements – Product Requirements.
- B. Design:
 - 1. Units to be fixed polymer membrane type, capable of operating at temperatures from a minimum of -10 degrees F to maximum of 95 degrees F and withstanding entrained moisture from outside air or steam cleaning without damage or deterioration in performance.

- C. Casing:
 - 1. Construct casings from minimum 22-gauge galvanized or aluminized steel suitable for flanged installation.
 - 2. Provide units with hinged and gasketed access doors to allow manual cleaning of heat exchange surfaces.
- D. Heat Transfer Surface:
 - 1. Use polymer membrane for heat exchange surfaces. Seal edges with high temperature sealant. Design surfaces to prevent mixing of airstreams.
- E. Filters:
 - 1. Furnish 2-inch pleated filters and filter track on both entering air sides of unit. Filter rack may be integral with unit or installed independently in duct upstream of unit.
- F. Controls:
 - 1. Furnish integral and service switch to shutdown unit when servicing heat exchange surfaces.
 - 2. Factory pipe and wire controls so that only field connections are required.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install units in accordance with unit manufacturer's installation requirements, in locations indicated on Drawings, and as detailed.

3.2 AIR-TO-AIR HEAT EXCHANGERS (FIXED PLATE TYPE)

- A. Coordinate insulation of unit casing with Section 23 07 00 – HVAC Insulation to insulate casing in manner specified.
- B. Install filter rack with panel filters where supply and exhaust airstreams enter units. Pipe condensate drain pan to nearest floor drain.

END OF SECTION

SECTION 23 73 12

AIR HANDLING UNIT COILS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes
 - 1. Coils used in air handling units.
- B. Related Sections
 - 1. Applicable provisions of Division 01 shall govern Work under this Section.
 - 2. Section 23 05 00 – Basic HVAC Requirements.
 - 3. Section 23 09 14 – Pneumatic and Electrical Instrumentation and Control Devices for HVAC.
 - 4. Section 23 09 23 – Direct Digital Control System for HVAC.
 - 5. Section 23 73 13 - Modular Indoor Central-Station Air-Handling Units.
 - 6. Section 23 82 00 - Convection Heating and Cooling Units.

1.2 REFERENCES

- A. Air-Conditioning and Refrigeration Institute
 - 1. ARI 410 - Forced Circulation Air-Cooling and Air-Heating Coils.

1.3 SUBMITTALS

- A. Division 01 - Submittal Procedures: Shop Drawings, product data, and samples.
- B. Submit data concerning dimensions, capacities, flow rate, pressure drop, materials of construction, ratings, weights, and appropriate identification at same time that air-handling equipment, in which coils will be located.

1.4 DESIGN CRITERIA

- A. Select coil sizes, capacities, configuration, and operating characteristics as shown on Drawings or as scheduled. Coil capacity ratings shall be ARI 410 certified.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Air Handling Unit Coils:
 - 1. Aerofin Corporation.
 - 2. Trane.
 - 3. Carrier Corporation.

4. Controlair, Inc.
5. McQuay International.
6. RAE Corporation.
7. L.J. Wing.
8. York Division Johnson Controls.
9. Substitutions: In accordance with Division 01.

2.2 HOT WATER COILS

- A. Use galvanized steel casing, end supports, top channel, and bottom channel to produce a rigid frame with allowance for expansion and contraction of finned tube section.
- B. Construct coils of 0.025-inch tube wall seamless copper tubes of 5/8-inch maximum outside diameter with maximum of 8 aluminum fins per inch suitable for working pressures to 125 psig and temperatures to 250 degrees F.
- C. Coil fins may be continuous serpentine or plate fin type.
- D. Construct coil headers of cast iron, steel, or seamless copper.
- E. Where cast iron headers are used, expand tubes into headers. Where steel or copper headers are used, braze tubes to header.
- F. Provide coils with bronze spring turbulators where required to provide capacities indicated.

PART 3 EXECUTION

3.1 HOT WATER COILS

- A. Install in central station air handling unit casings or on structural support frames for field erected units, making allowance for pitching as recommended by manufacturer.
- B. Mount coils in field erected units to allow for individual removal.
- C. Comb bent or crushed fins after installation. Clean dust and debris from each coil to ensure its cleanliness.
- D. Install a separate air vent and drain valve for each coil header in such a manner that vent and drain valves are located outside of air handling unit casing.
- E. Provide offsets in piping to facilitate coil removal.
- F. Unless otherwise specified, pipe coils for counter flow arrangement.

END OF SECTION

SECTION 23 73 13

MODULAR INDOOR CENTRAL-STATION AIR-HANDLING UNITS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes
 - 1. Indoor central station package air handling units.
- B. Related Sections
 - 1. Applicable provisions of Division 01 shall govern all work under this Section.
 - 2. Section 23 05 00 – Basic HVAC Requirements.
 - 3. Section 23 05 13 - Motor Requirements for HVAC Equipment.
 - 4. Section 23 05 14 - Variable Frequency Drives.
 - 5. Section 23 09 14 – Pneumatic and Electric Instrumentation and Control Devices for HVAC.
 - 6. Section 23 09 23 – Digital Control Systems for HVAC.
 - 7. Section 23 09 93 – Sequence of Operations for HVAC Controls.
 - 8. Section 23 33 00 - Air Duct Accessories.
 - 9. Section 23 41 00 - Particulate Air Filtration.
 - 10. Section 23 73 12 - Air Handling Unit Coils.

1.2 REFERENCES

- A. Air Movement and Control Association (AMCA)
 - 1. AMCA 203 – Field Performance Measurement of Fan Systems.
- B. Air-Conditioning and Refrigeration Institute (ARI)
 - 1. ARI 430 -Standard for Central Station Air Handling Units.
- C. National Fire Protection Association (NFPA)
 - 1. NFPA 90A - Standard for Installation of Air Conditioning and Ventilation Systems.

1.3 SUBMITTALS

- A. Division 01 - Submittal Procedures: Shop Drawings, product data, and samples.
- B. Submit Shop Drawings including the following information:
 - 1. Specific manufacturer and model numbers.
 - 2. Submittal equipment identification corresponding to Drawings and schedules.
 - 3. Unit dimensional and weight data.
 - 4. Materials of construction.
 - 5. Capacities and ratings

6. Fan curves.
 7. Fan type.
 8. Drive and motor information, reference Section 23 05 13 - Motor Requirements for HVAC Equipment.
 9. Vibration isolation, reference Section 23 05 48 – Vibration and Seismic Controls for HVAC Piping and Equipment.
 10. Coil performance data.
 11. Sound power levels.
 12. Filter information, reference Section 23 41 00 – Particulate Air Filtration.
 13. Information for accessories.
- C. Indicate operating point on fan curves at design air quantity and indicate drive loss factor.

1.4 DESIGN CRITERIA

- A. Furnish factory fabricated packaged air handling units complete with fans, motors, drives, coils, drain pans, filter sections, access sections, and damper sections, meeting configuration shown on Drawings or as scheduled.
- B. Units to be tested, rated, and certified in accordance with ARI Standard 430 and bear ARI certification label.
- C. All material shall meet NFPA 90A flame spread and smoke develop rating requirements.
- D. Each fan and motor combination shall be capable of delivering 110 percent of scheduled air quantity at scheduled static pressure. Motor furnished with fan shall not operate into motor service factor when operating under these conditions.
- E. Consider drive efficiency in motor selection according to manufacturer's published recommendation or according to AMCA 203, Appendix L.
- F. Where inlet and outlet ductwork at any fan is changed from that shown on Drawings, provide any motor, drive, and wiring changes required due to increased static pressure or baffling necessary to prevent uneven airflow or improve mixing.

1.5 EXTRA MATERIALS

- A. Division 01 – Execution and Closeout Requirements: Extra stock materials.
- B. Furnish one spare set of fan drive belts.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Modular Indoor Central-Station Air-Handling Units:
 - 1. Carrier Corporation.
 - 2. McQuay International.
 - 3. Trane.
 - 4. York Division - Johnson Controls.
 - 5. Substitutions: In accordance with Division 01.

2.2 CASING

- A. Double wall construction with heavy gauge steel framework and panels throughout mounted on an integral base rail.
- B. Casing shall have 2-inch thick, non-compressed, 1-1/2 lb./cu.ft. fiberglass thermal insulation between solid exterior and solid interior steel panels for all sections.
- C. Panels shall be gasketed and removable without affecting integrity of casing structure. Casing shall be airtight, watertight, and rust inhibited with baked enamel or mill galvanized finish.
- D. Access doors shall be double wall, of same construction and thickness as casing, hinged, continuously gasketed, with metal cam-lock handles.
- E. Plastic handles shall not be permitted. Door swing shall open in direction against pressure of unit.
- F. Provide access doors on access side of casing for fan section, access sections, filter sections, damper sections, and upstream and downstream of every coil.
- G. Locate double wall, insulated drain pans below cooling coil section. Slope pans for removal of condensate. Provide drain connection on both sides of casing.

2.3 FANS

- A. Plenum type centrifugal style, statically and dynamically balanced. For variable speed applications, dynamically balance fan through entire range of operation.
- B. Fan wheels shall be backward inclined, forward curved plug, or airfoil type as specified or required by performance characteristics.
- C. Fasten fans to hollow or solid steel shafts and design for continuous operation at maximum rated static pressure.
- D. Fan bearings shall be self-aligning, pillow block, regreasable ball type selected for a minimum average L-50 life of 200,000 hours.
- E. Furnish extended grease lines from bearings to allow servicing from exterior of unit.

- F. Furnish variable pitch sheaves for drives 3 hp and smaller and fixed pitch sheaves for drives 5 hp and larger. Design drives for 150 percent of motor rating.
- G. Mount fan, drive, and motor assembly inside fan casing section and integrally isolate within unit. Vibration isolation shall comply with Section 23 05 48 – Vibration and Seismic Controls for HVAC Piping and Equipment.
- H. Provide flexible connection and thrust restraints at fan discharge connection to casing.
- I. Provide plug fans with a metal fan inlet guard.
- J. Provide open drip-proof motor. Reference Section 23 05 13 - Motor Requirements for HVAC Equipment.

2.4 COILS

- A. Coils furnished in accordance with Section 23 73 12 - Air Handling Unit Coils.
- B. Air handling unit coils mounted in casing shall be accessible for removal from either side of unit casing without disturbing adjacent sections.
- C. Enclose entire coil frame, headers, and U-bends within air handling unit casing.
- D. Extend coil piping connections, air vent, and drain connections to exterior of casing.
- E. Provide sealing collars to prevent leakage where coil connections, air, and drain connections penetrate air handling unit casing.
- F. Support coils along entire length within casing and pitch coil for proper drainage.
- G. Blank off space between coil frames and air handling unit casing.

2.5 FILTER SECTION

- A. Provide filters in accordance with Section 23 41 00 – Particulate Air Filtration.
- B. Filter box section may be furnished by air handling unit manufacturer in accordance with requirements of Section 23 41 00 – Particulate Air Filtration.
- C. Filter box sections furnished by air handling unit manufacturer shall be of same construction as casing specified above.
- D. Provide static pressure taps that are arranged to prevent damage to filter elements during replacement.
- E. Provide minimum 2-inch gap between final and prefilters for static pressure probes.

2.6 ACCESS SECTIONS

- A. Same construction as casing with access doors as specified above on both sides of access section.
- B. Provide access sections where shown on Drawings.

2.7 DAMPER SECTION

- A. Same construction as casing with access doors as specified above on both sides of damper section.
- B. Outside air and return air dampers shall be parallel blade type with interconnecting linkage.
- C. Dampers shall be low leakage, not exceeding 5 cfm/sq. ft. at 1.0-inch w.g. Damper blades shall be double-skin airfoil type, with blade edge seals and metal compressible jamb seals.
- D. Extend damper linkage outside unit for external actuator mounting. Internal actuator mounting is not permitted.
- E. Reference drawings for damper arrangement top and rear or rear and bottom.
- F. Reference Section 23 09 14 – Pneumatic and Electric Instrumentation and Control Devices for HVAC for damper actuation.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install all air handling units and accessories as indicated on Drawings or scheduled and according to manufacturer's installation instructions.
- B. Mount units at appropriate height above floor to insure proper condensate trap depth and condensate drainage. Provide concrete pad or support stand as indicated on drawings.
- C. Install air-handling unit to provide for adequate service access. Coordinate with other trades to assure air handling unit does not infringe upon access or service clearances of other equipment.
- D. Lubricate fan bearings. Verify fan isolators have proper deflection.
- E. Upon completion of installation of air handling units, start-up and operate equipment to demonstrate capability and compliance with requirements.
- F. Field correct malfunctioning components then re-test to demonstrate compliance.

END OF SECTION

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SECTION 23 81 28
SPLIT SYSTEM AIR CONDITIONING UNITS

PART 1 GENERAL

1.1 SUMMARY

- A. This section contains specifications for split system air conditioning units for this project.
- B. Related Sections
 - 1. Applicable provisions of Division 01 govern work under this Section.
 - 2. Section 23 05 00 – Basic HVAC Requirements.
 - 3. Section 23 05 29 – Hangers and Supports for HVAC Piping and Equipment.
 - 4. Section 23 09 93 – Sequence of Operations for HVAC Controls.

1.2 REFERENCE STANDARDS

- A. Air-Conditioning and Refrigeration Institute (ARI)
 - 1. ARI 210 – Unitary Air-Conditioning and Air-Source Heat Pump Equipment
- B. Underwriters Laboratories, Inc. (UL)

1.3 DESIGN CRITERIA

- A. Units shall be certified in accordance with ARI Standard 210.
- B. Units and remote electrically powered components shall contain a unit mounted, factory prewired terminal block. Electrical components shall be U.L. tested, and U.L. labeled.
- C. The units (except for power and control wiring to remote condensing units, thermostats and other specialty control interlocking) shall be factory prewired within the unit cabinet and shall meet national, state and local codes. Wiring shall be numbered and connected to a numbered wiring terminal.
- D. The entire split system air conditioning unit shall be furnished and installed with components and accessories required for a fully functional system. Verify field piping requirements with the Manufacturer.

1.4 SHOP DRAWINGS

- A. Submit shop drawings for equipment specified under this section. Include data concerning sizes, dimensions, weights, heating capacities, materials of construction, ratings, electrical data, wiring diagrams, refrigerant piping diagrams, controls, options and manufacturers installation requirements, instructions and recommendations.

- B. The Manufacturer's shop drawing submittal shall include complete component descriptive literature, detailed electrical wiring and refrigerant piping diagrams and drawings that have been specifically prepared for this project.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Approved Manufacturers:
 - 1. Mitsubishi
 - 2. Friedrich
 - 3. Carrier.
 - 4. Substitutions: In accordance with Division 01 – General Requirements.

2.2 OUTDOOR UNIT

- A. Air-cooled, remote mounting, compressor-condensing unit.
- B. Unit cabinet shall be zinc, or similarly coated with a corrosion resistant coating and have removable panels for service access.
- C. Compressor shall be high efficiency, hermetic type with thermal overloads. Compressor shall have vibration isolators to keep sound to a minimum.
- D. Condenser coil shall have copper tubes with aluminum fins.
- E. Condenser fan shall be propeller type, with a totally enclosed, direct drive fan motor.
- F. Condenser low ambient capacity control shall be capable of providing continuous unit cooling capability down to 0 degrees F ambient outside temperature.
- G. Outdoor unit shall contain a full charge of refrigerant and oil for the entire system.
- H. Refrigeration system shall include external service valves on the outdoor unit for unit servicing, and a factory supplied, pre-insulated liquid and suction line kit for field installation.

2.3 UNIT ELECTRICAL AND CONTROLS

- A. Units shall be complete with motor starters, relays, and control thermostat. Indoor unit fan shall have fan speed controller to allow for fan speed selection from three speeds.
- B. Units shall have single point electrical connection (on each section) with electrical characteristics as specified on the equipment schedule, and shall allow either aluminum or copper main conductors to be connected to terminal block power connections.
- C. Control thermostat shall be electronic, seven day programmable type with LCD display, auto-

changeover control, set-up and set-back schedules, built-in compressor time delay and battery back-up.

PART 3 EXECUTION

3.1 GENERAL

- A. The entire system and components shall be installed and operated in strict accordance with the Manufacturer's instructions and recommendations.
- B. Both the indoor and outdoor sections shall be mounted level.
 - 1. Indoor Unit
 - a. Extend cooling coil condensate drain line from the unit condensate connection to the nearest clear water waste drain location.
 - b. Adjust the unit fan speed to provide proper unit operation, or as specified.
 - 2. Outdoor Unit
 - a. Furnish a weatherproof fusible electrical disconnect switch with fuses to disconnect all electrical power to outside units.
 - b. Outdoor units shall be mounted on a concrete pad as specified on the plans.
- C. Start-Up
 - 1. Three copies of a written service report shall be submitted to the Engineer following the initial start-up. It shall be signed by the serviceman responsible for performing the startup and adjustment work. It shall indicate that installation is complete, indicate readings taken, and shall state that the unit has been placed in proper running condition as recommended by the unit manufacturer and within the intent of the Contract Documents.

END OF SECTION

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SECTION 23 82 00

CONVECTION HEATING AND COOLING UNITS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes
 - 1. Unit Heaters.
 - 2. Fan Coil Units
- B. Related Sections:
 - 1. Applicable provisions of Division 01 shall govern Work under this Section.
 - 2. Section 01 91 00 – Commissioning.
 - 3. Section 23 05 00 – Basic HVAC Requirements.
 - 4. Section 23 05 13 - Motor Requirements for HVAC Equipment.
 - 5. Section 23 05 23 - General-Duty Valves for HVAC Piping.
 - 6. Section 23 36 00 - Air Duct Accessories.
 - 7. Section 23 81 28 – Split System Air Conditioners.

1.2 REFERENCES

- A. Air-Conditioning and Refrigeration Institute.
 - 1. Air-Conditioning and Refrigeration Institute (ARI)
 - a. ARI 210 - Standard for Unitary Air-Conditioning Equipment.
 - b. ARI 410 - Standard for Forced-Circulation Air-Cooling and Air-Heating Coils.

1.3 SUBMITTALS

- A. Division 01 - Submittal Procedures: Shop Drawings, product data, and samples.
- B. Include dimensions, capacities, materials of construction, ratings, weights, wiring diagrams, and appropriate identification for equipment in this section. Include color selection chart where applicable.

1.4 OPERATION AND MAINTENANCE DATA

- A. Operations and maintenance data shall comply with submission and content requirements specified in Division 01.

1.5 DESIGN CRITERIA

- A. Forced Circulation Coils: Ratings certified in accordance with ARI 410.
- B. Electrical equipment and heaters shall be UL listed for service specified.

- C. Electrical components and work must be in accordance with National Electrical Code.

PART 2 PRODUCTS

2.1 UNIT HEATERS

- A. Manufacturers:
 - 1. Airtherm, LLC.
 - 2. Mestek Technology, Inc.
 - 3. McQuay International.
 - 4. Modine Manufacturing Company.
 - 5. Reznor.
 - 6. Trane.
 - 7. Substitutions: In accordance with Division 01.
- B. Construct casing of 18-gauge steel with baked enamel finish and heating elements of copper tubing with aluminum fins. Use aluminum fan blades, balanced for quiet operation. Provide safety guard for fan/drive assembly. Test coils units at 200 psig.
- C. Furnish adjustable horizontal and vertical discharge louvers for units with horizontal discharge. Provide an adjustable cone diffuser for projection units with vertical discharge.
- D. Furnish motors with characteristics as scheduled. Motors shall be totally enclosed type. Single phase, 120-volt motors, permanently lubricated, and provided with thermal overload protection, and disconnect switch at unit.

2.2 FAN COIL UNITS

- A. Manufacturers:
 - 1. Carrier Corporation.
 - 2. McQuay International.
 - 3. Modine Manufacturing Company.
 - 4. Trane.
 - 5. York.
 - 6. Substitutions: In accordance with Division 01.
- B. Unit types and arrangement: Vertical downflow.
- C. Furnish with separate hot water coil and DX cooling coil, speed selector switch, condensate drain pan, and casing.
- D. Use centrifugal type fans, statically and dynamically balanced for operation without objectionable noise and vibration. Mount fan assembly on rubber isolators.
- E. Motors to be permanent split capacitor type with built-in thermal overload protection. Provide a manual disconnect switch inside cabinet.

- F. Provide ducted units with air inlet and outlet duct collars.
- G. Provide access doors in cabinet to allow maintenance of internal mechanical and electrical devices.
- H. Units in exposed locations to have an 18-gauge steel cabinet with baked enamel finish in one of manufacturer's standard colors, selected by Architect. Provide concealed units with a galvanized steel cabinet.
- I. Acoustically and thermally insulate units with minimum 1/2-inch fiberglass insulation. Insulate drain pans with 1/2-inch fire retardant closed cell foam insulation.
- J. Furnish each unit with filter rack and 1-inch panel filters as specified in Section 23 41 00 – Particulate Air Filtration.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install units in accordance with manufacturer's installation instructions.
- B. Install branch water or steam/condensate piping to each unit with a minimum of three elbows to allow for expansion and contraction of piping system.
- C. Coordinate location of units with other trades to assure correct recess size for recessed units.
- D. After installation, provide protective covers to prevent accumulation of dirt on units during balance of construction.

3.2 UNIT HEATERS

- A. Suspend units from building structure and as high as possible to maintain headroom beneath units. Supporting from piping systems will not be accepted.
- B. Install a drain valve on coil side of shutoff valves for each hot water unit heater.

3.3 FAN COIL UNITS

- A. Mount units in locations indicated on Drawings and as detailed. Install a drain valve on coil side of shutoff valves for each hot and chilled water coil.

END OF SECTION

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SECTION 23 83 16
IN-FLOOR HYDRONIC HEATING SYSTEM

PART 1 GENERAL

1.1 SUMMARY

- A. This section includes specifications for the in-floor heating system, including piping, fittings, specialties and controls.

- B. Related Sections
 - 1. Applicable provisions of Division 01 shall govern work under this section.
 - 2. Section 23 05 00 – Basic HVAC Requirements.
 - 3. Section 23 05 15 - Piping Specialties.
 - 4. Section 23 05 23 – General Duty Valves for HVAC Piping.
 - 5. Section 23 05 29 – Hangers and Supports for HVAC Piping and Equipment.
 - 6. Section 23 07 00 - HVAC Insulation.
 - 7. Section 23 21 13 - Hydronic Piping.
 - 8. Section 23 22 16 – Underground Heating Piping.

1.2 ENGINEERED SHOP DRAWINGS

- A. The in-floor system provider shall provide a fully engineered, detailed design and layout of the in-floor heating system. The engineered shop drawings shall be submitted and shall include the following items at a minimum:
 - 1. Piping materials
 - 2. Detailed in slab piping layouts
 - 3. Piping specialties and manifolds
 - 4. Control components and schematic control diagrams
 - 5. Detailed installation instructions

- B. The in-floor system provider shall calculate and verify the required GPM and pressure drop for each piping loop and the total piping system and compare this to the pump capacities listed on the plans. If the actual engineered installation requires a change in pump requirements, the supplier shall notify the contractor and the engineer, in writing of the new requirements. Should the supplier fail to identify changes in pump requirements prior to the system being installed, the supplier will be responsible for all costs associated with the replacement of system pumps to obtain the required performance of the in-floor piping system.

- C. The shop drawings shall be specifically prepared for this project. Incomplete or generic shop drawings are not acceptable.

- D. Control sensing element locations shall be identified on the shop drawings.

- E. The control system shop drawings submitted shall include electrical interconnecting schematic diagrams.

1.3 DESIGN CRITERIA

- A. System electrical components shall be U.L. listed and shall bear the U.L. label.
- B. Controls and control components shall be provided by the same manufacturer providing the in-floor heating piping system or shall be a manufacturer of in-floor heating system controls as determined by the piping system manufacturer. The in-floor heating system piping and controls shall have single source responsibility.
- C. Transformers, relays, operators, thermostats and valves not specifically mentioned within the specifications but necessary to make the in-floor heating control system complete and operative within the functional intent of this specification shall be furnished and installed by the HVAC contractor. For the control sequence of operation, provide the necessary control components and wiring, to provide a fully functional system.
- D. Setpoints shall be adjustable and the controls shall allow manual override to select off, operating or idling modes.

1.4 QUALIFICATIONS

- A. Prequalified contractors performing work of this specification section are listed in the Division 00 – Instructions to Bidders.
- B. Contractors must submit documented experience of similar projects as indicated in Division 00 – Instructions to Bidders.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Piping and Accessories
 - 1. Wirsbo
 - 2. Roth
 - 3. Heatlink
 - 4. Rehau.
 - 5. Substitutions: In accordance with Division 01 – General Requirements.
- B. Controls
 - 1. Tekmar
 - 2. Or approved equal.

2.2 PIPING

A. Pipe

1. Cross-linked polyethylene, 3/4 inch nominal I.D. tubing rated for a maximum working temperature of 180°F and a maximum working pressure of 100 PSI, ASTM Spec. F-876. Piping section within the slab shall be continuous without joints or fittings.

B. Fittings

1. Constructed of dezincification brass consisting of a barbed insert, compression ring and a compression nut.

C. Specialties

1. Provide all piping specialties and supports for a complete installation.

D. Manifolds

1. Cast brass construction, dezincification resistant in sizes and arrangements as specified on the plans with integral, manual shut-off valves on return headers and integral manual balancing valves on supply headers.
2. Fittings and specialties
 - a. End caps with integral gasket, fill/drain valve and manual air vent, bushings, and manifold support brackets.

2.3 CONTROLS

A. Controller

1. Microprocessor based, hydronic in-floor heating system controller capable of full control of system pumps, slab temperature and supply/return water temperature through control and measurement of the slab temperature, supply water temperature, and return water temperature.
2. The controller shall allow manual adjustment of the following; panel system supply/return water temperature differential (set at 20 degrees F nominal), maximum panel supply water temperature (set at 140 degrees F nominal), valve operator speed, slab operating mode temperature and slab idle mode temperature.

B. Temperature Sensors

1. Slab temperature sensors and piping water temperature sensors (as specified on the plan, or as required for full system control). Piping temperature sensors shall be the immersion well type, mounted in the piping.

C. Control setpoints shall be adjustable.

2.4 CONTROL VALVES AND OPERATORS

- A. Provide automatic control valve(s) and valve operators for a fully functional system.
- B. Valves shall be rated for the fluid being controlled and shall be constructed for the pressure and temperature ratings of the piping system served.
- C. Valve bodies 2-1/2 inch size and larger shall have flanged connections. Smaller valve bodies may be either screwed or flanged. Screwed connections shall have union fittings.
- D. The valve operator(s) shall have electric type, oil submerged, motorized, positive-positioning electric type operators with external position indicators.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Horizontal piping shall be run level without pockets.
- B. Provide manual air vents and vent all high points and vent at the manifold locations.
- C. Mount valves and operators in location and position for ease of service.
- D. The in-floor heating system piping shall be pressure tested (before slab construction) with compressed air at a pressure of 60 PSIG for a period of not less than 24 hours. Isolate and protect equipment not designed to withstand the test pressure. During slab pour, a pressure of 60 PSIG shall be maintained on the in-floor tubing system. The 60 PSIG pressure shall be maintained for a period of not less than 24 hours thereafter to verify system integrity. Notify the Engineer at least 72 hours before pipe testing so that they can be present during the pipe testing process.
- E. The entire in-floor piping and control system shall be installed in strict accordance with the manufacturer's published instructions and recommendations.
- F. The Contractor shall obtain from the manufacturer of the in-floor heating system, certified installation supervision and startup indicating that the entire system has been installed and placed into operation in accordance with the manufacturer's instructions and recommendations. The Contractor shall obtain a certified report prepared and signed by the manufacturer's representative in responsible charge. The startup reports shall be submitted to the Engineer along with or prior to the Contractor's certification of completion.
- G. The Contractor shall set and calibrate automatic control system devices to achieve the required sequence of operation. Temperature sensors provided shall be tested for accuracy at its specific sensing location and replaced where error exceed plus or minus two degrees.

END OF SECTION

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SECTION 26 00 00

BASIC ELECTRICAL REQUIREMENTS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
1. General Electrical Requirements.
 2. Work Included in Contract.
 3. Definitions.
 4. Dimensions and Equipment Location.
 5. Owner Supplied Products.
 6. Work by Owner.
 7. Pre-Installation Meetings.
 8. Demonstration and Training Meetings.
 9. Product Data.
 10. Shop Drawings.
 11. Test Reports.
 12. Manufacturer's Certificates.
 13. Manufacturer's Instructions.
 14. Manufacturer's Field Reports.
 15. Quality Assurance and Control of Installation.
 16. Temporary Facilities and Controls.
 17. Delivery, Storage, and Handling Requirements.
 18. Product Options.
 19. Product Substitution Procedures.
 20. Final Cleaning and Painting.
 21. Starting of Systems.
 22. Demonstration and Instructions.
 23. Project Record Documents.
 24. Extra Material and Spare Parts.
 25. Operation and Maintenance Manuals.
 26. Warranties.
 27. Identification.
 28. Pre-bid Survey.

1.2 GENERAL ELECTRICAL REQUIREMENTS

- A. Mention of any article, operation or method requires that Contractor shall provide same and perform each operation in complete accordance with conditions stated.
- B. Contractor shall provide all material, labor, equipment and transportation as necessary to complete project in compliance with Contract Documents.

- C. In general, this work includes everything essential for a complete electrical system in operating order as shown on drawings and indicated in specifications.
- D. Work shall be installed in accordance with National, State, and Local codes, ordinances, laws, and regulations. Comply with all applicable OSHA regulations.
- E. Materials shall have a UL or ETL label where a UL or ETL standard or testing requirement exists.
- F. All work shall be installed in accordance with all State and Local Inspection Authorities having jurisdiction together with recommendations of manufacturer whose equipment is to be supplied and installed under this Contract.
- G. Before submitting a bid, each bidder shall examine all specifications and drawings relating to their work and shall become fully informed as to extent and character of work required and its relation to other work within project area.
- H. Contractor, in conjunction with Engineer's representative, shall establish exact locations of all materials and equipment to be installed.
- I. Consideration shall be given to construction features, equipment of other trades and requirements of equipment proper.
- J. All materials shall be suitably stored and protected prior to installation and all work shall be protected after installation, during construction and prior to acceptance.
- K. Contractor shall furnish all scaffolding, rigging, hoisting and services necessary for delivery, erection and installation of all equipment and apparatus required to be installed by Contractor.
- L. All such equipment shall be removed by Contractor upon completion of project.
- M. Refer to Division 01 for temporary electrical service.

1.3 WORK INCLUDED IN CONTRACT

- A. Contractor shall provide auxiliary contacts, buttons, and switches on starters as required.
- B. Contractor shall provide power wiring (120 V or greater) to control panels, motor starters, variable frequency drives, motors, electric actuators, electric devices and smoke detectors.

1.4 DEFINITIONS

- A. Exposed: Exposed to view in any room, corridor or stairway.
- B. Code: National, State and Local Electrical codes including OSHA requirements.

- C. Signal Voltage: NEC class 1, 2, or 3 remote control, signaling, or power limited circuits.
- D. Low Voltage: 50 to 600 volts.
- E. Medium Voltage: 601 to 35,000 volts.
- F. High Voltage: 35,001 volts and greater.
- G. Electrical Ductbank: Assembly consisting of electrical conduits encased in concrete.

1.5 DIMENSIONS AND EQUIPMENT LOCATION

- A. Drawings depicting electric work are diagrammatic and show, in their approximate location, symbols representing electrical equipment and devices.
- B. Exact locations of such equipment and devices shall be established in field in accordance with instructions from Engineer/Architect as established by manufacturer's installation drawings and details.
 - 1. Contractor shall refer to shop drawings and submittal drawings for all equipment requiring electrical connections to verify rough-in and connection locations.
 - 2. Unless specifically stated, no measurement of an electric drawing derived by scaling shall be used as a dimension to work by.
 - 3. Dimensions noted on electric drawings are subject to measurements of adjacent and previously completed work.
 - 4. All measurements shall be performed prior to actual installation of equipment.

1.6 OWNER SUPPLIED PRODUCTS

- A. Reference Division 01 for Owner supplied products.

1.7 WORK BY OWNER

- A. Reference Division 01 for work by Owner.

1.8 PRE-INSTALLATION MEETINGS

- A. When required in individual specification sections, convene pre-installation meeting at Project site prior to commencing work of specific section.
- B. Require attendance of parties directly affecting, or affected by, Work of specific section.
- C. Notify Engineer/Architect four days in advance of meeting date.
- D. Prepare agenda and preside at meeting:
 - 1. Review conditions of installation, preparation and installation procedures.
 - 2. Review coordination with related work.

- E. Record minutes and distribute copies within two days after meeting to participants, with two (2) copies to Engineer/Architect, and those affected by decisions made.

1.9 DEMONSTRATION AND TRAINING MEETING

- A. Contractor shall schedule and administer demonstration and training sessions for Owner for each portion of equipment and products that are required to have training in proper operation and maintenance.
- B. Contractor shall schedule representatives of the equipment manufacturer to attend demonstration and training sessions to provide additional information as necessary.

1.10 PRODUCT DATA

- A. Product Data: Submit to Engineer Engineer/Architect for review for limited purpose of checking for conformance with information given and design concept expressed in Contract Documents.
- B. Provide copies and distribute in accordance with Submittal Procedures article in Division 01 and for record documents purposes described in Division 01.
- C. Submit number of copies Contractor requires, plus three copies Engineer/Architect will retain.
- D. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturers' standard data to provide information specific to this Project.
- E. Indicate product utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.
- F. After review distribute in accordance with Submittal Procedures article in Division 01 and provide copies for record documents described in Division 01.

1.11 SHOP DRAWINGS

- A. Shop Drawings: Submit to Engineer/Architect for review for limited purpose of checking for conformance with information given and design concept expressed in Contract Documents.
- B. Produce copies and distribute in accordance with Submittal Procedures article in Division 01 and for record documents purposes described in Division 01.
- C. Indicate special utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.
- D. Shop drawings shall be submitted in advance of construction and installation so as to not cause delay in other Contractor's work.

- E. Data submitted for Engineer's review shall be numbered consecutively, shall be noted to correlate with electrical drawings and shall bear:
 - 1. Name and location of project.
 - 2. Name of Contractor.
 - 3. Date of submittal.
 - 4. Date of drawings and date of each correction and revision.
 - 5. If more than one type of lighting fixture (or other material) is on submitted sheet, proposed equipment shall be conspicuously checked with red pen by Electrical Contractor.
- F. Shop drawings for different systems and equipment shall, be bound separately by specification section and not bound by manufacturer.
- G. Submittals which contain different specification section systems bound together shall be returned not reviewed and returned to Contractor for re-submittal.
- H. Lighting Fixture shop drawings shall consist of single submittal with all project light fixtures included. Submittals grouped by manufacturer shall not be accepted. Contractor shall be responsible for coordinating drawings from his various suppliers in order to comply with this requirement.
- I. Contractor shall examine shop drawings and equipment brochures prior to submission.
- J. Contractor shall verify that materials and equipment depicted will properly fit into construction.
- K. Contractor shall also review all previously completed work related to installation of equipment depicted to insure that it has been properly installed.
- L. No materials or equipment subject to prior review by Engineer shall be fabricated or installed by Contractor, without approval.
- M. Engineer's review of shop drawings shall not relieve Contractor of responsibility for deviations from requirements of drawings and specifications, unless prior approval for such deviations has been granted.
- N. Submit in form of one reproducible transparency and one opaque reproduction.
- O. Submit number of opaque reproductions Contractor requires, plus three copies Engineer/Architect will retain.
- P. After review, Contractor shall reproduce and distribute (3) three copies to Engineer/Architect, maintain copies required for Record Documents described in Division 01.

1.12 TEST REPORTS

- A. Operation of equipment and electrical systems does not constitute an acceptance of work by Owner.
- B. Final acceptance is to be made after Contractor has adjusted their equipment and demonstrated that it meets or exceeds requirements of drawings and specifications.
- C. After work is completed and prior to acceptance, Contractor shall conduct following tests, tabulate data, date, sign and submit to Engineer:
 - 1. Standard megger insulation test on each feeder.
 - 2. Ground resistance test.
 - 3. Clamp ammeter test on each feeder conductor with all utilization equipment energized.
 - a. Load current in each phase conductor of feeder or portion thereof supplying panel shall not differ from average connected load currents in feeder conductors by more than 7-1/2 percent.
 - b. If load current does differ by more than 7-1/2 percent, Contractor shall change phase loading to same or receive written approval from Engineer that this is not required due to nature of load.
- D. Upon completion of installation, Contractor shall furnish certificates of approval from authorities having jurisdiction.
- E. Contractor shall demonstrate that all work is complete and is in specified operating condition, with raceway and conduit system properly grounded, wiring free from grounds, shorts, and entire installation is free from any physical defects.
- F. In presence of Engineer and Owner, Contractor shall demonstrate proper operation of all systems.
- G. Perform other testing as specifically directed in other sections of specifications for specific equipment.

1.13 MANUFACTURER'S CERTIFICATES

- A. When specified in individual specification sections, submit certification by manufacturer, installation/ application subcontractor, or Contractor to Engineer/Architect, in quantities specified for Product Data.
- B. Indicate material or product conforms to or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.
- C. Certificates may be recent or previous test results on material or Product, but must be acceptable to Engineer/Architect.

1.14 MANUFACTURER'S INSTRUCTIONS

- A. When specified in individual specification sections, submit printed instructions for delivery, storage, assembly, installation, start-up, adjusting, and finishing, to Engineer for delivery to Owner in quantities specified for Product Data.
- B. Indicate special procedures, perimeter conditions requiring special attention, and special environmental criteria required for application or installation.

1.15 MANUFACTURER'S FIELD REPORTS

- A. Submit reports for Engineer's benefit as contract administrator or for Owner.
- B. Submit report in duplicate within 30 days of observation to Engineer/Architect for information.
- C. Submit for information for limited purpose of assessing conformance with information given and design concept expressed in Contract Documents.

1.16 QUALITY ASSURANCE/CONTROL OF INSTALLATION

- A. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship to produce Work of specified quality.
- B. Comply fully with manufacturer's instructions, including each step in sequence.
- C. Should manufacturer's instructions conflict with Contract Documents, request clarification from Engineer/Architect before proceeding.
- D. Comply with specified standards as a minimum quality for the Work except when more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.
- E. Perform Work by persons qualified to produce workmanship of specified quality.
- F. Verify field measurements are as indicated on Shop Drawings or as instructed by manufacturer.
- G. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion or disfigurement.

1.17 TEMPORARY FACILITIES AND CONTROLS

- A. Reference Division 01 for temporary facilities and control requirements.

1.18 PRODUCT DELIVERY, STORAGE AND HANDLING REQUIREMENTS

- A. Transport and handle products in accordance with manufacturer's instructions.

- B. Promptly inspect shipments to ensure products comply with requirements, quantities are correct, and products are undamaged.
- C. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage.
- D. Store and protect products in accordance with manufacturer's instructions.
- E. Store with seals and labels intact and legible.
- F. Store sensitive products in weather tight, climate controlled, enclosures in an environment favorable to product.
- G. For exterior storage of fabricated products, place on sloped supports above ground.
- H. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.
- I. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.
- J. Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.

1.19 PRODUCT OPTIONS

- A. Products Specified by Reference Standards or by Description Only: Any product meeting those standards or description.
- B. Products Specified by Naming One or More Manufacturers: Products of one of manufacturers named and meeting specifications; no options or substitutions allowed.
- C. Products Specified by Naming One or More Manufacturers with Provision for Substitutions: Submit request for substitution for any manufacturer not named in accordance with following article.
- D. Materials and equipment required shall be of new manufacture.
- E. Items specified shall be of latest type or model produced by manufacturer specified. If model number is obsolete, substitute current manufacturer's product.

1.20 PRODUCT SUBSTITUTION PROCEDURES

- A. Substitutions may be considered when a product becomes unavailable through no fault of Contractor.

- B. Document each request with complete data substantiating compliance of proposed Substitution with Contract Documents.
- C. A request constitutes a representation that Contractor:
 - 1. Has investigated proposed product and determined that it meets or exceeds quality level of specified product.
 - 2. Will provide same warranty for Substitution as for specified product.
 - 3. Will coordinate installation and make changes to other Work that may be required for the Work to be complete with no additional cost to Owner.
 - 4. Waives claims for additional costs or time extension that may subsequently become apparent.
 - 5. Will reimburse Owner and Engineer/Architect for review or redesign services associated with re-approval by authorities having jurisdiction.
- D. Substitutions will not be considered when they are indicated or implied on shop drawings or product data submittals, without separate written request, or when acceptance will require revision to Contract Documents.
- E. Substitution Submittal Procedure:
 - 1. Submit three copies of request for Substitution for consideration. Limit each request to one proposed Substitution.
 - 2. Submit Shop Drawings, Product Data, and certified test results attesting to proposed product equivalence. Burden of proof is on proposer.
 - 3. Lighting Fixtures: Request for substitutions shall include photometric test reports performed by an independent testing laboratory.
 - 4. Contractor shall provide samples of proposed equipment for Engineer's review, if requested by Engineer.
 - 5. Contractor shall furnish any other information or materials as requested by Engineer to establish equality.
 - 6. Engineer will notify Contractor in writing of decision to accept or reject request.
- F. Contractor's submitting equipment for approval as an equal, shall include in their bid all incidental costs that may result from use of approved equipment.
- G. Such costs shall include, but not be limited to, additional costs that may be incurred by other contractors whose scope of work is affected by use of "equal" products.
- H. Electrical Contractor shall be responsible for those costs even if they do not become evident until after bidding.
- I. Only one request for substitution will be considered for each product.
- J. When substitution is not accepted, provide specified product.

1.21 FINAL CLEANING AND PAINTING

- A. Rubbish resulting from work shall be removed and disposed of on a daily basis in such manner as to be acceptable to Architect.
- B. Contractor shall clean all exposed iron work, interior and exterior of cabinets and pull boxes, etc., and remove rubbish and debris resulting from work.
- C. Where painted surfaces of equipment have been damaged or rusted during construction, Contractor shall paint same to match final.
- D. Clean other equipment as indicated in other sections of specification for specific equipment.

1.22 STARTING OF SYSTEMS

- A. Coordinate schedule for start-up of various equipment and systems.
- B. Notify Engineer/Architect and Owner seven days prior to start-up of each item.
- C. Verify each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, and for conditions that may cause damage.
- D. Verify tests, meter readings, and specified electrical characteristics agree with those required by equipment or system manufacturer.
- E. Verify wiring and support components for equipment are complete and tested.
- F. Execute start-up under supervision of applicable Contractor's personnel in accordance with manufacturer's instructions.
- G. 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.

1.23 DEMONSTRATION AND INSTRUCTIONS

- A. Demonstrate operation and maintenance of products to Owner's personnel two weeks prior to date of Substantial Completion.
- B. Demonstrate Project equipment and instruct in classroom environment located at site and instructed by manufacturer's representative who is knowledgeable about the Project.
 - 1. For equipment or systems requiring seasonal operation, perform demonstration for other season within six months.
 - 2. Utilize operation and maintenance manuals as basis for instruction. Review contents of manual with Owner's personnel in detail to explain all aspects of operation and

maintenance.

3. Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shutdown of each item of equipment at agreed time, at equipment location.
4. Prepare and insert additional data in operations and maintenance manuals when need for additional data becomes apparent during instruction.
5. Required instruction time for each item of equipment and system is specified in individual sections.

1.24 PROJECT RECORD DOCUMENTS

- A. Maintain on site one set of following electrical record documents; record actual revisions to the Work:
 1. Locations of all buried conduit or similar items. Include buried depth.
 2. Field changes of dimension or detail.
 3. Changes made by field order or change order.
 4. Details not on original contract drawings.
 5. Changes to circuit numbers.
 6. Junction box locations and conduit runs, with trade sizes indicated, for all lighting, power, and electrical systems installed.
 7. Record documents include:
 - a. Drawings.
 - b. Specifications.
 - c. Addenda.
 - d. Change Orders and other modifications to the Contract.
 - e. Reviewed Shop Drawings, Product Data, and Samples.
 - f. Manufacturer's instruction for assembly, installation, and adjusting.
- B. Ensure entries are complete and accurate, enabling future reference by Owner.
- C. Store record documents separate from documents used for construction.
- D. Record information concurrent with construction progress, not less than weekly.
- E. Specifications: Legibly mark and record at each product section description of actual products installed, including following:
 1. Manufacturer's name and product model and serial number.
 2. Product substitutions or alternates utilized.
 3. Changes made by Addenda and modifications.
- F. Record Drawings and Shop Drawings: Legibly mark each item to record actual construction including:
 1. Measured depths of foundations in relation to finish first floor datum.
 2. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.

3. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work.
4. Field changes of dimension and detail.
5. Details not on original Contract drawings.

G. Submit documents to Engineer/Architect for review.

1.25 EXTRA MATERIAL AND SPARE PARTS

- A. Furnish spare parts, maintenance, and extra products in quantities specified in individual specification sections.
- B. Deliver to Project site and place in location as directed by Owner; obtain receipt prior to final payment.

1.26 OPERATION AND MAINTENANCE MANUALS

- A. Electrical Contractor shall assemble and submit to Architect for subsequent submission to Owner, three complete sets of Manual of Operation and Maintenance for each of electrical and communications systems.
- B. Each manual shall consist of 3-ring binder volume instructing Owner's personnel in operation and maintenance of system in question.
- C. All information shall be bound and secured in manual.
- D. Manual shall cover all phases of operation of equipment and shall be illustrated with photographs, drawings, and wiring diagrams.
- E. Manuals shall accurately describe operation, construction and adjustable features of complete system and its component parts.
- F. Manual shall be complete with an equipment parts listing to facilitate ordering of spare and replacement parts.
- G. Each manual shall contain two sets of final shop drawings depicting equipment as installed.

1.27 WARRANTIES

- A. Obtain warranties and bonds executed in duplicate by responsible subcontractors, suppliers, and manufacturers, within ten days after completion of applicable item of work.
- B. Execute and assemble transferable warranty documents and bonds from subcontractors, suppliers, and manufacturers.
- C. Verify documents are in proper form, contain full information, and are notarized.

- D. Co-execute submittals when required.
- E. Include Table of Contents and assemble in three D side ring heavy duty binder with durable plastic cover.
- F. Time of Submittals:
 1. For equipment or component parts of equipment put into service during construction with Owner's permission, submit documents within ten days after acceptance.
 2. Make other submittals within ten days after Date of Substantial Completion, prior to final Application for Payment.
 3. For items of Work for which acceptance is delayed beyond Date of Substantial Completion, submit within ten days after acceptance, listing date of acceptance as beginning of warranty or bond period.

1.28 IDENTIFICATION

- A. Entrance door to primary electrical room shall have porcelain enameled sign lettered "DANGER HIGH VOLTAGE". This same sign shall also be placed on primary switch.
- B. Each distribution and lighting panel shall be equipped with typewritten directory describing loads served. Directory shall be contained in steel frame mounted on inside face of panel's door and shall be covered with sheet of clear plastic.
- C. Switchboards, transformers, switchgear, telephone backboards, transfer switches, panels and cabinets shall be provided with 1/8-inch minimum thickness 5 ply lamecoid plastic nameplates indicating usage, plan designation and voltage where applicable. In Equipment and Mechanical Rooms, this identification may be on exterior of unit, in other areas identification shall be inside door or cover. Nameplates shall be black with white engraved lettering. Lettering shall be 1/2-inch high minimum. Fasten nameplates with escutcheon pins.
- D. Junction and pullboxes smaller than 12 inch x 12 inch shall be identified by using permanent marker on coverplate indicating originating panelboard and circuit(s) or system served.
- E. Junction and pull boxes with dimensions 12 inch x 12 inch and larger shall be stenciled or provided with permanent labels as follows:
 1. Lighting and power feeders and branch circuits - 120, 208, 277, 480. Add "EM" for emergency circuits, ex. 120EM, etc.
 2. Medium voltage feeders - 5KV, 15KV, etc. as applicable for system voltage.
 3. Clock - CLK.
 4. Voice/Data communications - V/D COM.
 5. Fire Alarm - FA.
 6. Signal voltage lighting controls - LVLC.
 7. Area of rescue assistance system - RA.
 8. Master Antenna Television System - MATV.
 9. Nurse call system - NC.

10. Building paging system - PA.
 11. Electronic Card Key Access System - CA.
- F. Branch wiring shall be color coded per industry standards.
- G. If Owner does not have a pre-established color code, use following colors unless otherwise required by code:
1. 120/208 volt systems.
 - a. A-phase: solid black.
 - b. B-phase: solid red.
 - c. C-phase: solid blue.
 - d. Different colors shall be used to identify switched legs.
 - e. Neutral conductor: solid white.
 - f. Provide additional markings for neutral conductors in the same raceway as required by code.
 2. 480/277 volt systems
 - a. A-phase: Solid brown.
 - b. B-phase: solid orange.
 - c. C-phase: solid yellow.
 - d. Different colors shall be used to identify switched legs.
 - e. Neutral conductor: solid gray.
 - f. Provide additional markings for neutral conductors in the same raceway as required by code.
- H. Where wires of different systems junction in common box, each cable shall be grouped with its own system and identified using tags or identification strips.
- I. For three phase systems, each phase shall be identified at all terminals using code markers.
- J. Cover plates for control stations controlling remote equipment shall be engraved to identify device being controlled.
- K. Motor starters, remote control stations, etc., shall be identified with engraved lamecoid nameplates fastened to equipment with escutcheon pins. Nameplates shall be 1/8 -inch 5 ply lamecoid with 1/4-inch white letters on a black background. Adhesive cloth labels, similar to those manufactured by Brady Label Co., may be used on motor switches and controls only, indicating number, designation, size and usage of motor.
- L. On inside of coverplates for light switches, occupancy sensors, receptacles, and special purpose outlets, provide a permanent label identifying panel and circuit number feeding device. Adhesive plastic tape will be permitted for this use.
- M. On light fixtures at wiring entrance point, provide permanent label identifying panel and circuit number feeding fixture. Adhesive plastic tape will be permitted for this use.

- N. Refer to individual specification sections for more specific or additional identification requirements.

1.29 PREBID SURVEY

- A. Before submitting their bid, Contractor shall tour project site and review following items:
 - 1. Exact configuration of areas requiring demolition, temporary power, relocating, etc.
 - 2. Site conditions such as material storage, staging areas, parking, etc.
 - 3. Problems with work sequence.
- B. Any conditions found that are not shown on drawings or stated within project manual that may affect scope of work shall be reported to Engineer.

PART 2 PRODUCTS

2.1 FIRESTOPPING

- A. Firestopping materials shall include, but not be limited to, mortars, sealants and caulks, putties, collars, intumescent wrap strips mastics, and firestop pillows. Materials and methods used shall be recognized by an independent testing agency and shall have flame and temperature ratings assigned by specific agency.
- B. Materials using solvents or those requiring hazardous waste disposal shall not be used.
- C. Firestop assemblies shall meet fire test and hose stream test requirements of independent testing agency;
 - 1. Acceptable Manufacturers:
 - a. 3M Corporation.
 - b. Rectorseal Corporation.

2.2 SLEEVES

- A. Sleeves: ASTM A53, Schedule 40 galvanized steel pipe.

2.3 ACCESS PANELS

- A. Access panels required by code or otherwise to electrical service equipment shall be supplied and installed by Electrical Contractor.

PART 3 EXECUTION

3.1 FIRESTOPPING

- A. Openings in fire rated construction and annular spaces around conduits, cable trays, and other penetrating items shall be protected in accordance with NEC article 300-21 and in accordance with Wisconsin Administrative Code, Department of Commerce Chapter 51.049. Fire rating of protective seal shall be at least that of floor or wall into which it is installed, so that original

fire rating of construction is maintained.

- B. Wall or floor penetration openings shall be as small as possible.
- C. Openings and annular spaces required by code to be protected shall be protected.
- D. Installation of materials and assemblies shall be in strict accordance with manufacturer's instructions.

3.2 SLEEVES

- A. Where conduits, cables trays, or other electrical raceways must pass through floors or walls that are to be constructed of poured in place concrete, contractor shall provide sleeves in formwork prior to concrete pour. It shall be Electrical Contractor's responsibility to provide all sleeves for his work unless specifically indicated otherwise on drawings. Prior to installing sleeves, contractor shall prepare drawings indicating locations, quantities, sizes, and spacings of all sleeves anticipated. Drawings shall be forwarded to structural engineer for approval.
- B. Floor sleeves shall extend minimum of 2 inches above finished floor.

END OF SECTION

SECTION 26 05 19

BUILDING WIRE AND CABLE

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Building Wire.
 - 2. Building Cable.
 - 3. Wiring Connectors.
 - 4. Connections.
- B. Related Sections:
 - 1. Applicable provisions of Division 01 shall govern all work under this Section.
 - 2. Section 26 00 00 – Basic Electrical Requirements.

1.2 REFERENCES

- A. International Electrical Testing Association (NETA):
 - 1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
- B. National Fire Protection Association (NFPA):
 - 1. NFPA 70 - National Electrical Code (NEC).

1.3 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum five years.

1.4 FIELD MEASUREMENTS

- A. Verify field measurements are as indicated on Drawings.

1.5 COORDINATION

- A. Division 01 - Administrative Requirements: Requirements for coordination.
- B. When wire and cable destination is indicated and routing is not shown, determine routing and lengths required.
- C. Wire and cable routing indicated is approximate unless dimensioned. Include wire and cable lengths within 10 feet of length shown.

PART 2 PRODUCTS

2.1 BUILDING WIRE

- A. Product Description: Single conductor insulated wire.
- B. Conductor: Copper only.
- C. Insulation Voltage Rating: 600 volts, rated 75 degrees C unless otherwise noted.
- D. In mechanical rooms, light fixtures, and others high temperature applications, insulation shall be rated 90 degrees C. or greater.
- E. Provide following wiring types:
 - 1. Concealed or exposed dry interior locations: Use only building wire Type THHN/THWN or XHHW insulation in raceway.
 - 2. Above Accessible Ceilings: Use only building wire Type THHN/THWN or XHHW insulation in raceway.
 - 3. Wet or Damp Interior Locations: Use only building wire Type XHHW-2 insulation in raceway.
 - 4. Exterior Locations: Use only building wire Type XHHW-2 insulation in raceway.
 - 5. Underground Locations: Use only building wire Type XHHW-2 or USE insulation, in raceway.
- F. Solid or Stranded conductor for 10 AWG and smaller. Conductor 8 AWG and larger shall be stranded.
- G. Conductor not smaller than 12 AWG for power and lighting circuits.
- H. Conductor not smaller than 14 AWG for control circuits.
- I. All wires shall be new, delivered to the site in unbroken cartons and shall be less than one year old out of manufacturer's stock.

2.2 WIRING CONNECTORS

- A. Conductors No. 10 AWG and Smaller: Scotch 3M - Scotch-lok compression type solderless connectors with plastic cover.
- B. Joints, Taps, and Splices in Conductors No. 8 AWG and Larger: Solderless compression type connectors, tool and die applied, of a type that will not loosen under vibration or normal strains. Burndy "Hy-Dent" type or equivalent.
- C. Rubber insulating electrical tape: Scotch 3M model 23, 30-mil tape.
- D. Split bolt connectors are not acceptable.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Install in accordance with manufacturer's written instructions and in accordance with recognized industry practices.
- B. Run wire and cable in conduit, unless otherwise indicated on drawings.
- C. Do not draw conductors into conduits until building is enclosed and watertight and until work that may cause conductor damage has been completed.
- D. Voltage drop for branch circuits and feeder circuit combined shall not exceed requirements of NEC Article 215.
- E. Examine areas and conditions under which conductors are to be installed and notify Engineer in writing of conditions detrimental to proper and timely completion of work.
- F. Do not proceed with work until unsatisfactory conditions have been corrected.

3.2 JOINTS, TAPS AND SPLICES

- A. Each tap, joint, or splice in conductors No. 8 AWG and larger shall be taped with two half-lap layers of vinyl plastic electrical tape and a finish wrap of color coding tape, where required by code.
- B. Cable splices shall be made only in distribution and junction boxes.

3.3 PREPARATION

- A. Completely and thoroughly swab raceway before installing wire.

3.4 INSTALLATION

- A. Route wire and cable to meet project conditions.
- B. Conductors shall not be installed at temperatures below manufacturer's minimum installation temperature.
- C. Neatly train and lace wiring inside boxes, equipment, and panelboards.
- D. Identify and color code wire and cable under provisions of Section 26 05 53 – Electrical Identification.
- E. Identify each conductor with its panel and circuit number or other designation indicated.
- F. Special Techniques - Building Wire in Raceway:

1. Pull conductors into raceway at same time.
 2. Install building wire 4 AWG and larger with pulling equipment.
- G. Special Techniques - Wiring Connections:
1. Clean conductor surfaces before installing lugs and connectors.
 2. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.
 3. Tape uninsulated conductors and connectors with electrical tape to 150 percent of insulation rating of conductor.
 4. Install solderless pressure connectors with insulating covers for copper conductor splices and taps, 8 AWG and smaller.
 5. Install insulated spring wire connectors with plastic caps for copper conductor splices and taps, 10 AWG and smaller.
 6. When 10 AWG and smaller stranded conductors are used install crimp on fork terminals for device terminations. Do not place bare stranded conductors directly under screws.

3.5 BRANCH CIRCUIT CONDUCTORS

- A. Install branch circuits and switched circuits as required to comply with circuiting, switching, and control functions shown on drawings.
- B. Conductors shall be size 12 AWG minimum, unless otherwise noted, for branch circuit wiring, including motor circuits.
- C. Size 120V branch circuits for length of run on following basis:
 1. 0 to 75 ft. run from panelboard to first outlet: No. 12 AWG minimum.
 2. 75 to 125 ft. run: increase one wire size, No. 12 AWG becomes No. 10 AWG.
 3. 126 to 200 ft run: increase two wire sizes, No. 12 AWG becomes No. 8 AWG.
 4. 201 and above: wiring to be sized for 3 percent maximum voltage drop.
- D. Provide individual neutral conductors for branch circuits serving isolated ground receptacles and computer equipment. No common neutrals for these circuits.
- E. Route branch circuits and switch legs as dictated by construction, these specifications, or instruction from Engineer.
- F. Size conduit, outlet boxes, and other raceway system components in accordance with NEC requirements as minimum.
- G. Circuit numbers as shown on drawings are for Contractor to plan their wiring and for estimating purposes and are not necessarily exact circuit numbers to be used in specific panel for particular load.
- H. Exact circuit numbers for each load are to be selected by Contractor at their option.

- I. Balanced load on panelboard bus will be determining factor in arrangement of circuits. Panelboards average load shall not differ from phase to phase by plus or minus 7.5 percent.
- J. Motor and equipment branch wiring.
 - 1. Furnish and install motor circuits in accordance with schedules on drawings and code requirements, from source of supply to associated motor starter, and from starter to motor terminal box, including necessary and required intermediate connections.
 - 2. Conductor and conduit size for motor branch circuits, if shown on drawings, are sized for motor requirement only.
 - 3. Control wiring is not included in conduit sizes shown on drawings.
 - 4. Motors shall have proper conductor sizes as per NEC requirements and nameplate ratings.
 - 5. Contractor shall be responsible for verification of ratings of motors and installing proper branch circuits.
 - 6. Obtain manufacturer's wiring diagrams and shop drawings for equipment requiring electrical connections.
 - 7. Check drawings and specifications of other divisions of work for equipment and work, which shall be included in order to provide a complete electrical installation.
 - 8. Motor connections shall be made by compression type connectors using proper tools and fittings to assure good electrical continuity and low resistance joint.

3.6 FEEDER INSTALLATION

- A. Install in accordance with manufacturer's written instructions, and in accordance with recognized industry practices.
- B. Extend feeders at full capacity from origin to termination.
- C. Feeder conduits shall contain only those conductors constituting a single feeder circuit.
- D. Where feeder conductors are run in parallel, conductors shall be of same length, same material, circular-mil area, insulation type, and terminated in same manner.
- E. Where parallel feeder conductors run in separate raceways, each raceway shall have same physical characteristics.
- F. Feeders shall follow most accessible routes, concealed in construction in finished areas, exposed to minimum temperature gradient and to minimum temperature fluctuation.
- G. Confine feeders to insulated portions of building, unless otherwise specified.
- H. Trapped feeder runs without facilities for continuous drainage are not acceptable.
- I. Feeder conduits shall not be routed in conduit floor slabs or below basement or grade level floor slabs.

- J. Feeder conductors in switchboards, panelboards, pullboxes, gutters, and other open wiring spaces shall be bundled by feeder using plastic tie wraps at intervals not greater than 3 feet on center.

3.7 FIXTURE WIRES

- A. Use conductor with insulation suitable for current, voltage, and temperature to which conductor will be subjected.
- B. Provide minimum No. 12 wire size for conductors supplying power to a single fixture. 600V insulation minimum.
- C. Insulation suitable for operation at 90 degrees C. minimum for lighting fixtures with integral ballast, mogul base sockets, quartz lamps, or otherwise where subject to excessive temperatures.
- D. Fixture wiring shall be continuous wiring system to lampholder or to ballast and from ballast to lampholder.

3.8 WIRE COLOR

- A. General
 - 1. For wire sizes 10 AWG and smaller, install wire colors in accordance with following:
 - a. Black and red for single phase circuits at 120/240 volts.
 - b. Black, red, and blue for circuits at 120/208 volts single or three phase.
 - c. Brown, orange, and yellow for circuits at 277/480 volts single or three phase.
 - 2. For wire sizes 8 AWG and larger, identify wire with colored tape at terminals, splices and boxes. Colors are as follows:
 - a. Black and red for single phase circuits at 120/240 volts.
 - b. Black, red, and blue for circuits at 120/208 volts single or three phase.
 - c. Orange, brown, and yellow for circuits at 277/480 volts single or three phase.
- B. Neutral Conductors: White. When two or more neutrals are located in one conduit, individually identify each with proper circuit number.
- C. Branch Circuit Conductors: Install three or four wire home runs with each phase uniquely color coded.
- D. Feeder Circuit Conductors: Uniquely color code each phase.
- E. Ground Conductors:
 - 1. For 6 AWG and smaller: Green.
 - 2. For 4 AWG and larger: Identify with green tape at both ends and visible points

including junction boxes.

3.9 FIELD QUALITY CONTROL

- A. Division 01 - Quality Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Perform inspections and tests listed in NETA ATS, Section 7.3.1.

END OF SECTION

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SECTION 26 05 26

GROUNDING AND BONDING

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Rod electrodes.
 - 2. Wire.
 - 3. Grounding well components.
 - 4. Mechanical connectors.
 - 5. Exothermic connections.

- B. Related Sections:
 - 1. Applicable provisions of Division 01 shall govern all work under this Section.
 - 2. Section 26 00 00 – Basic Electrical Requirements.
 - 3. Section 26 05 19 - Building Wire and Cable.

1.2 REFERENCES

- A. Institute of Electrical and Electronics Engineers (IEEE):
 - 1. IEEE 142 - Recommended Practice for Grounding of Industrial and Commercial Power Systems.
 - 2. IEEE 1100 - Recommended Practice for Powering and Grounding Electronic Equipment.

- B. International Electrical Testing Association (NETA):
 - 1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

- C. National Fire Protection Association (NFPA):
 - 1. NFPA 70 - National Electrical Code.
 - 2. NFPA 99 - Standard for Health Care Facilities.

1.3 SYSTEM DESCRIPTION

- A. Grounding systems use the following elements as grounding electrodes:
 - 1. Metal underground water pipe.
 - 2. Metal building frame.
 - 3. Concrete-encased electrode.
 - 4. Ground ring.
 - 5. Rod electrode.

1.4 DESIGN REQUIREMENTS

- A. Provide all material, labor and incidentals necessary for completion of this section of work.

1.5 PERFORMANCE REQUIREMENTS

- A. Grounding System Resistance: 5 ohms maximum.

1.6 QUALITY ASSURANCE

- A. Provide grounding materials conforming to requirements of NEC, IEEE 142, and UL labeled.
- B. Perform Work in accordance with National Electric Code and state and local code requirements.

1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years experience.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store and protect products under provisions of Division 01 - Product Requirements.
- B. Accept materials on site in original factory packaging, labeled with manufacturer's identification.
- C. Protect from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original packaging.
- D. Do not deliver items to project before time of installation. Limit shipment of bulk and multiple-use materials to quantities needed for immediate installation.

1.9 COORDINATION

- A. Coordinate complete grounding and bonding of building reinforcing steel prior to concrete placement.

PART 2 PRODUCTS

2.1 ROD ELECTRODES

- A. Manufacturers:
 - 1. Galvan Industries/Erico Inc.
 - 2. LTV/Copperweld, Inc.
 - 3. Eritech/Erico, Inc.
 - 4. Lyncole XIT Grounding.

5. Harger Lightning and Grounding.
6. Substitutions: In accordance with Division 01 - Product Requirements.

B. Product Description:

1. Material: Copper-clad steel.
2. Diameter: 3/4 inch.
3. Length: 10 feet.

- C. Connector: Connector shall be exothermic welded connection unless otherwise noted. Provide U-bolt clamp in ground test wells and where indicated on drawings.

2.2 WIRE

- A. Material: Stranded copper. Provide tin plated copper where exposed to corrosive environment.
- B. Connection to Electrodes: 2/0 AWG, minimum size.
- C. Grounding Electrode Conductor: Copper conductor, bare.
- D. Bonding Conductor: Copper conductor, bare.

2.3 GROUNDING WELL COMPONENTS

- A. Well Pipe: 8 inches NPS (DN200) by 24 inches long fiberglass pipe with belled end.
- B. Well Cover: Fiberglass with legend "GROUND" embossed on cover.

2.4 MECHANICAL CONNECTORS

A. Manufacturers:

1. Erico, Inc.
2. ILSCO Corporation.
3. O-Z Gedney Co.
4. Thomas & Betts, Electrical.
5. Burndy Electric.
6. Substitutions: In accordance with Division 01 - Product Requirements.

- B. Description: Bronze connectors, suitable for grounding and bonding applications, in configurations required for particular installation.

2.5 EXOTHERMIC CONNECTIONS

A. Manufacturers:

1. Thermoweld.
2. Cadweld, Erico, Inc.

3. Harger Lightning Protection.
 4. Exothermic Welding Co.
 5. Thomas & Betts, Electrical.
 6. Substitutions: In accordance with Division 01 - Product Requirements.
- B. Product Description: Exothermic materials, accessories, and tools for preparing and making permanent field connections between grounding system components.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify of existing conditions before starting work.
- B. Verify final backfill and compaction has been completed before driving rod electrodes.

3.2 PREPARATION

- A. Remove paint, rust, mill oils, and other surface contaminants at connection points.

3.3 EXISTING WORK

- A. Modify existing grounding system to maintain continuity to accommodate renovations.
- B. Extend existing grounding system using materials and methods as specified.

3.4 INSTALLATION

- A. Install in accordance with IEEE 142.
- B. Install rod electrodes near location of electric service entrance unless otherwise shown on drawings. Install additional rod electrodes, if required, to achieve specified resistance to ground.
- C. Install interconnecting wire 2 feet below finish grade.
- D. Install grounding and bonding conductors concealed from view.
- E. Install grounding well pipe with cover at rod locations as indicated on Drawings. Install well pipe top flush with finished grade.
- F. Bond together metal siding not attached to grounded structure; bond to ground.
- G. Bond together reinforcing steel and metal accessories in pool and fountain structures.
- H. Install ground grid under access floors as indicated on Drawings. Construct grid of 4 AWG bare copper wire installed on 24 inch centers both ways. Bond each access floor pedestal to

grid.

- I. Bond together each metallic raceway, pipe, duct and other metal object entering space under access floors. Bond to underfloor ground grid. Install 2 AWG bare copper bonding conductor.
- J. Bond to lightning protection system. Refer to Division 13.
- K. Install continuous grounding using underground cold water system, driven ground rods, and building steel as grounding electrode.
- L. Ground electrical systems and equipment as required by code, utility, local ordinances, and to requirements herein.
- M. Install separate code rated grounding conductors to special equipment and activity areas as required by code.
- N. Bond all metallic piping systems and service equipment as required by NEC.
- O. Permanently attach grounding conductors prior to energizing equipment.
- P. Drive ground rods to depth 4-inches below finished grade.
- Q. Grounding electrode conductor shall be continuous without splice from nearest building grounding electrode. Ground to service equipment. Install bonding jumper around water meter. Attach non-ferrous metal tag to warn against removal. Make connections to ground electrodes with approved molded exothermic weld process.

3.5 EQUIPMENT GROUND

- A. Bond metallic conduits, supports, cabinets, and other equipment so ground will be electrically continuous from service to outlet boxes.
- B. Permanently ground entire light and power system in accordance with NEC, including service equipment, distribution panels, lighting panelboards, switch and starter enclosures, motor frames, grounding type receptacles, and other exposed non-current carrying metal parts of electrical equipment.
- C. Accomplish grounding of electrical system by using insulated grounding conductor installed with feeders and branch circuit conductors in conduits.
- D. Size grounding conductors in accordance with NEC.
- E. Install from grounding bus of serving panel to ground bus of served panel, grounding screw of receptacles, lighting fixture housing, light switch outlet boxes or metal enclosures of service equipment.

- F. Install grounding conductor in nonmetallic and flexible conduit to complete equipment ground continuity.
- G. Ground wire shall be bonded at equipment and at first junction box of conduit system on line side of flexible conduit to the system.
- H. Install grounding conductors to permit shortest and most direct path from equipment to ground.
- I. When grounding conductor runs through metallic conduit, bond to conduit at entrance and exit with bolted clamp.
- J. Ground neutral at service only.
- K. Install separate equipment grounding conductor in each conduit containing feeder conductors.
- L. Install green equipment grounding conductor in all conduits serving branch circuits.
- M. Green ground bar in panels, where required to be similar to neutral bar, except tinted green and bonded to panel tub.
- N. Connections shall be accessible for inspection and checking.
- O. No insulation shall be installed over ground connections.
- P. Ground connection surfaces shall be cleaned and all connections shall be made so that it is impossible to move them.
- Q. Attach grounds permanently before permanent building service is energized.
- R. Ground metal lighting poles. Install ground lug on inside wall of pole directly across from handhole.
- S. Install grounding and bonding in patient care areas to meet requirements of NFPA 99.

3.6 FIELD QUALITY CONTROL

- A. Division 01 - Quality Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Grounding and Bonding: Perform inspections and tests listed in NETA ATS, Section 7.13. Make final grounding system measurements two days after latest rainfall.
- D. Perform ground resistance testing in accordance with IEEE 142. Contractor shall make ground resistance measurements. Measure in normally dry conditions, not less than 48 hours

after rainfall.

- E. Perform leakage current tests in accordance with NFPA 99.
- F. Perform continuity testing in accordance with IEEE 142.
- G. When improper grounding is found on receptacles, check receptacles in entire project and correct. Perform retest.

END OF SECTION

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SECTION 26 05 29

ELECTRICAL HANGERS AND SUPPORTS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Conduit supports.
 - 2. Formed steel channel.
 - 3. Spring steel clips.
 - 4. Sleeves.
 - 5. Mechanical sleeve seals.
 - 6. Firestopping relating to electrical work.
 - 7. Firestopping accessories.
 - 8. Equipment bases and supports.

- B. Related Sections
 - 1. Applicable provisions of Division 01 shall govern all work under this Section.
 - 2. Section 26 00 00 – Basic Electrical Requirements.
 - 3. Division 03 Concrete: Product requirements for concrete for placement by this section.

1.2 REFERENCES

- A. ASTM International (American Society for Testing and Materials):
 - 1. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
 - 2. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.
 - 3. ASTM E814 - Standard Test Method for Fire Tests of Through-Penetration Fire Stops.

- B. FM Global (FM):
 - 1. FM - Approval Guide, A Guide to Equipment, Materials & Services Approved By Factory Mutual Research For Property Conservation.

- C. National Fire Protection Association (NFPA):
 - 1. NFPA 70 - National Electrical Code.

- D. Underwriters Laboratories Inc. (UL):
 - 1. UL 263 - Fire Tests of Building Construction and Materials.
 - 2. UL 723 - Tests for Surface Burning Characteristics of Building Materials.
 - 3. UL 1479 - Fire Tests of Through-Penetration Firestops.

4. UL - Fire Resistance Directory.

- E. Intertek Testing Services (Warnock Hersey Listed) (WH):
1. WH - Certification Listings.

1.3 DEFINITIONS

- A. Firestopping (Through-Penetration Protection System): Sealing or stuffing material or assembly placed in spaces between and penetrations through building materials to arrest movement of fire, smoke, heat, and hot gases through fire rated construction.

1.4 SYSTEM DESCRIPTION

- A. Firestopping Materials: ASTM E119, ASTM E814, UL 263, UL 1479 to achieve fire ratings as noted on Drawings for adjacent construction, but not less than 1 hour fire rating.
- B. Surface Burning: ASTM E84, UL 723 with maximum flame spread / smoke developed rating of 25/450.
- C. Firestop interruptions to fire rated assemblies, materials, and components.

1.5 PERFORMANCE REQUIREMENTS

- A. Firestopping: Conform to UL for fire resistance ratings and surface burning characteristics.
- B. Firestopping: Provide certificate of compliance from authority having jurisdiction indicating approval of materials used.

1.6 QUALITY ASSURANCE

- A. Perform Work in accordance with State and Municipality standards.

1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum five years documented experience.
- B. Installer: Company specializing in performing work of this section with minimum five years documented experience.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store and protect products under provisions of Division 01 - Product Requirements.
- B. Accept materials on site in original factory packaging, labeled with manufacturer's identification.

- C. Protect from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original packaging.

1.9 ENVIRONMENTAL REQUIREMENTS

- A. [Division 01- Product Requirements: Environmental conditions affecting products on site.
- B. Do not apply firestopping materials when temperature of substrate material and ambient air is below 60 degrees F.
- C. Maintain this minimum temperature before, during, and for minimum three (3) days after installation of firestopping materials.
- D. Provide ventilation in areas to receive solvent cured materials.

PART 2 PRODUCTS

2.1 CONDUIT SUPPORTS

- A. Hanger Rods: Threaded high tensile strength galvanized carbon steel with free running threads.
- B. Beam Clamps: Malleable Iron, with tapered hole in base and back to accept either bolt or hanger rod. Set screw: hardened steel.
- C. Conduit clamps for trapeze hangers: Galvanized steel, notched to fit trapeze with single bolt to tighten.
- D. Conduit clamps - general purpose: One hole malleable iron for surface mounted conduits.
- E. Cable Ties: High strength nylon temperature rated to 185 degrees F. Self-locking.

2.2 FORMED STEEL CHANNEL

- A. Product Description: Galvanized 12 gage thick steel. With holes 1-1/2 inches on center.

2.3 SPRING STEEL CLIPS

- A. Product Description: Mounting hole and screw closure.

2.4 SLEEVES

- A. Sleeves for Conductor/Cables Through Non-fire Rated Floors: 18 gage thick galvanized steel.
- B. Sleeves for Conductor/Cables Through Non-fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Steel pipe or [18] gage thick galvanized steel.

- C. Sleeves for Conductor/Cables Through Fire Rated and Fire Resistive Floors and Walls, and Fire Proofing: Prefabricated fire rated sleeves including seals, UL listed.
- D. Fire-stopping Insulation: Glass fiber type, non-combustible.

2.5 MECHANICAL SLEEVE SEALS

- A. Manufacturers:
 - 1. Link-Seal, Inc.
 - 2. NMP Corporation.
 - 3. Substitutions: In accordance with Division 01 - Product Requirements.
- B. Product Description: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between object and sleeve, connected with bolts and pressure plates causing rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

2.6 FIRESTOPPING

- A. Manufacturers:
 - 1. Dow Corning Corp.
 - 2. Fire Trak Corp.
 - 3. Hilti Corp.
 - 4. International Protective Coating Corp.
 - 5. 3M fire Protection Products.
 - 6. Specified Technology, Inc.
 - 7. Substitutions: In accordance with Division 01 - Product Requirements.
- B. Product Description: Different types of products by multiple manufacturers are acceptable as required to meet specified system description and performance requirements; provide only one type for each similar application.
 - 1. Silicone Firestopping Elastomeric Firestopping: Multiple component silicone elastomeric compound and compatible silicone sealant.
 - 2. Foam Firestopping Compounds: Multiple component foam compound.
 - 3. Formulated Firestopping Compound of Incombustible Fibers: Formulated compound mixed with incombustible non-asbestos fibers.
 - 4. Fiber Stuffing and Sealant Firestopping: Composite of ceramic fiber stuffing insulation with silicone elastomer for smoke stopping.
 - 5. Mechanical Firestopping Device with Fillers: Mechanical device with incombustible fillers and silicone elastomer, covered with sheet stainless steel jacket, joined with collars, penetration sealed with flanged stops.
 - 6. Intumescent Firestopping: Intumescent putty compound which expands on exposure to surface heat gain.
 - 7. Firestop Pillows: Formed mineral fiber pillows.

- C. Color: [Black].

2.7 FIRESTOPPING ACCESSORIES

- A. Primer: Type recommended by firestopping manufacturer for specific substrate surfaces and suitable for required fire ratings.
- B. Dam Material: Permanent:
 - 1. Mineral Fiber Board.
 - 2. Mineral Fiber Matting.
 - 3. Alumina silicate fire board.
- C. Installation Accessories: Provide clips, collars, fasteners, temporary stops or dams, and other devices required to position and retain materials in place.
- D. General:
 - 1. Furnish UL listed products or products tested by independent testing laboratory.
 - 2. Select products with rating not less than rating of wall or floor being penetrated.
- E. Non-Rated Surfaces:
 - 1. Stamped steel, chrome plated, hinged, split ring escutcheons or floor plates or ceiling plates for covering openings in occupied areas where conduit is exposed.
 - 2. For exterior wall openings below grade, furnish modular mechanical type seal consisting of interlocking synthetic rubber links shaped to continuously fill annular space between conduit and cored opening or water-stop type wall sleeve.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify openings are ready to receive sleeves.
- C. Verify openings are ready to receive firestopping.

3.2 PREPARATION

- A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter affecting bond of firestopping material.
- B. Remove incompatible materials affecting bond.
- C. Install backing and damming materials to arrest liquid material leakage.
- D. Obtain permission from Architect/Engineer before drilling or cutting structural members.

- E. Install hangers, supports, and anchors only after structural work, where work is to be installed, has been completed. Correct inadequacies such as proper placement of inserts, anchors, and other building structural attachments.
- F. Examine areas and conditions under which equipment and associated components are to be installed and notify Architect, in writing, of conditions detrimental to proper and timely completion of work. Do not proceed with work until unsatisfactory conditions have been corrected.

3.3 INSTALLATION - HANGERS AND SUPPORTS

- A. Anchors and Fasteners:
 - 1. Concrete Structural Elements: Provide precast inserts, expansion anchors, powder actuated anchors and preset inserts.
 - 2. Steel Structural Elements: Provide beam clamps, spring steel clips, steel ramset fasteners, and welded fasteners.
 - 3. Concrete Surfaces: Provide self-drilling anchors and expansion anchors.
 - 4. Hollow Masonry, Plaster, and Gypsum Board Partitions: Provide toggle bolts and hollow wall fasteners.
 - 5. Solid Masonry Walls: Provide expansion anchors and preset inserts.
 - 6. Sheet Metal: Provide sheet metal screws.
 - 7. Wood Elements: Provide wood screws.
 - 8. Install anchors at proper locations to prevent stresses from exceeding those permitted by ANSI B31 and to prevent the transfer of loading and stresses to connected equipment.
 - 9. Installation methods shall be in conformity with the manufacturer's recommendations for maximum holding power, but in no case shall the depth of hole be less than four bolt diameters. Minimum distance between the center of any expansion anchor and an edge of exterior corner of concrete shall be not less than 4-1/2 times the diameter of the hole in which it is installed.
- B. Inserts:
 - 1. Install inserts for placement in concrete forms.
 - 2. Install inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
 - 3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.
 - 4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
 - 5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut recessed into and grouted flush with slab.
- C. Install conduit and raceway support and spacing in accordance with NEC.

- D. Do not fasten supports to pipes, ducts, mechanical equipment, or conduit.
- E. Install multiple conduit runs on common hangers.
- F. Supports:
 1. Fabricate supports from structural steel or formed steel channel. Install hexagon head bolts to present neat appearance with adequate strength and rigidity. Install spring lock washers under nuts.
 2. Install surface mounted cabinets and panelboards with minimum of four anchors.
 3. In wet and damp locations install steel channel supports to stand cabinets and panelboards 1 inch (25 mm) off wall.
 4. Support vertical conduit at every floor.

3.4 SUPPORT OF CONDUIT

- A. Fasten conduit to structural parts of building in a manner acceptable to Engineer.
- B. Do not use perforated hanger iron.
- C. Install concrete insert channel as required, with spacings as recommended by manufacturer. Install with anchor and caps, insert joiner clips and closer seals as required.
- D. Support conduit as follows:
 1. Single conduit runs vertical surfaces: galvanized, heavy duty, sheet steel straps; back straps to be provided for all exposed conduit and conduit on exterior walls.
 2. Single conduit runs horizontal surfaces: galvanized, heavy duty, one hole malleable iron or 2 hole steel pipe straps.
 3. Multiple conduit runs vertical surfaces: Horizontal or vertical rack channel with conduit straps as required.
 4. Multiple conduit runs horizontal surfaces: Single or double rack channel trapeze, complete with conduit straps as required; all supported with threaded hanger rods.
 1. Conduit runs through roof: conduit extending through roof shall pass through ceiling box at roof lines. Provide 14 gauge minimum copper box complete with watertight soldered seams and flanged to serve as pitch pocket for each conduit. Conduit and pitch pocket shall be installed in advance of roofing work.

3.5 INSTALLATION - FIRESTOPPING

- A. Install material at fire rated construction perimeters and openings containing penetrating sleeves, piping, ductwork, conduit and other items, requiring firestopping.
- B. Apply primer where recommended by manufacturer for type of firestopping material and substrate involved, and as required for compliance with required fire ratings.

- C. Apply firestopping material in sufficient thickness to achieve required fire and smoke rating, to uniform density and texture.
- D. Place intumescent coating in sufficient coats to achieve rating required.
- E. Remove dam material after firestopping material has cured.
- F. Fire Rated Surface:
 - 1. Seal opening at floor, wall, partition, ceiling, and roof as follows:
 - a. Install sleeve through opening and extending beyond minimum of one (1) inch on both sides of building element.
 - b. Size sleeve allowing minimum of one (1) inch void between sleeve and building element.
 - c. Pack void with backing material.
 - d. Seal ends of sleeve with UL listed fire resistive silicone compound to meet fire rating of structure penetrated.
 - 2. Where conduit and wireway penetrates fire rated surface, install firestopping product in accordance with manufacturer's instructions.
- G. Non-Rated Surfaces:
 - 1. Seal opening through non-fire rated wall, partition floor, ceiling, and roof opening with material matching surface penetrated.
 - 2. Interior partitions: Seal penetrations at telecommunication rooms. Apply sealant to both sides of penetration to completely fill space between surface and conduit.

3.6 INSTALLATION - EQUIPMENT BASES AND SUPPORTS

- A. Provide housekeeping pads of concrete, minimum 3-1/2 inches thick and extending 6 inches beyond supported equipment. Refer to Division 03 Concrete.
- B. Using templates furnished with equipment, install anchor bolts, and accessories for mounting and anchoring equipment.
- C. Construct supports of formed steel channel. Brace and fasten with flanges bolted to structure.

3.7 INSTALLATION - SLEEVES

- A. Exterior watertight entries: Seal with adjustable interlocking rubber links.
- B. Conduit penetrations not required to be watertight: Sleeve and fill with silicon foam.
- C. Set sleeves in position in forms. Provide reinforcing around sleeves.
- D. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.

- E. Extend sleeves through floors six (6) inches above finished floor level. Caulk sleeves.
- F. Where conduit or raceway penetrates floor, ceiling, or wall, close off space between conduit or raceway and adjacent work with fire stopping insulation and caulk airtight. Provide close fitting metal collar or escutcheon covers at both sides of penetration.
- G. Install stainless steel escutcheons at finished surfaces.

3.8 FIELD QUALITY CONTROL

- A. Division 01 - Quality Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Inspect installed firestopping for compliance with specifications and submitted schedule.

3.9 CLEANING

- A. Provide under provisions of Division 01- Execution Requirements.
- B. Clean adjacent surfaces of firestopping materials.

3.10 PROTECTION OF FINISHED WORK

- A. Provide under provisions of Division 01- Execution Requirements.
- B. Protect adjacent surfaces from damage by material installation.

END OF SECTION

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SECTION 26 05 33

RACEWAY AND BOXES

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Conduit.
 - 2. Tubing.
 - 3. Raceways.
 - 4. Wireways.
 - 5. Outlet Boxes.
 - 6. Pull Boxes.
 - 7. Junction Boxes.
 - 8. Handholes.

- B. Related Sections:
 - 1. Applicable provisions of Division 01 shall govern all work under this Section.
 - 2. Section 26 00 00 – Basic Electrical Requirements.
 - 3. Section 26 05 53 - Electrical Identification.

1.2 REFERENCES

- A. American National Standards Institute (ANSI):
 - 1. ANSI C80.1 - Rigid Steel Conduit, Zinc Coated.
 - 2. ANSI C80.3 - Specification for Electrical Metallic Tubing, Zinc Coated.
 - 3. ANSI C80.5 - Aluminum Rigid Conduit - (ARC).

- B. National Electrical Manufacturers Association (NEMA):
 - 1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
 - 2. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies.
 - 3. NEMA OS 1 - Sheet Steel Outlet Boxes, Device Boxes, Covers, and Box Supports.
 - 4. NEMA OS 2 - Nonmetallic Outlet Boxes, Device Boxes, Covers, and Box Supports.
 - 5. NEMA RN 1 - Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.
 - 6. NEMA TC 2 - Electrical Polyvinyl Chloride (PVC) Tubing and Conduit.
 - 7. NEMA TC 3 - PVC Fittings for Use with Rigid PVC Conduit and Tubing.

1.3 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store and protect products under provisions of Division 01 - Product Requirements.

- B. Protect conduit from corrosion and entrance of debris by storing above grade. Provide

appropriate covering.

- C. Protect PVC conduit from sunlight.

1.4 COORDINATION

- A. Coordinate mounting heights, orientation and locations of outlets mounted above counters, benches, and backsplashes.

PART 2 PRODUCTS

2.1 DESIGN REQUIREMENTS

- A. Minimum Raceway Size: 3/4 inch unless otherwise specified.

2.2 METAL CONDUIT

- A. Rigid Steel Conduit: ANSI C80.1.
- B. Intermediate Metal Conduit (IMC): Rigid steel.
- C. Fittings and Conduit Bodies: NEMA FB 1; Fittings for metal raceways shall be steel or malleable iron and shall be zinc galvanized, or cadmium plated. Do not use aluminum or die cast fittings.

2.3 PVC COATED METAL CONDUIT

- A. Product Description: NEMA RN 1; rigid steel conduit with external PVC coating, 40 mil thick.
- B. Fittings and Conduit Bodies: NEMA FB 1; steel fittings with external PVC coating to match conduit, PVC gasketed for mating surfaces

2.4 FLEXIBLE METAL CONDUIT

- A. Product Description: Interlocked steel construction.
- B. Fittings: NEMA FB 1. Threaded, grounding type, insulated throat, two screw clamp type with locknuts, externally secured.
- C. Minimum size 1/2 inch with the exception that 3/8 inch diameter may be used in lengths not to exceed 6 foot, to serve individual lighting fixtures installed in a suspended accessible ceiling system.

2.5 LIQUIDTIGHT FLEXIBLE METAL CONDUIT

- A. Product Description: Interlocked steel construction with PVC sunlight resistant jacket.

- B. Fittings: NEMA FB 1. Liquid tight, suitable for grounding, suitable for wet locations, tapered threaded hub, non-metallic materials.

2.6 ELECTRICAL METALLIC TUBING (EMT)

- A. Product Description: ANSI C80.3; galvanized tubing.
- B. Fittings and Conduit Bodies: NEMA FB 1; steel or malleable iron, compression, threaded, insulated throat, gland compression type, rain and concrete tight type.

2.7 NONMETALLIC CONDUIT

- A. Product Description: NEMA TC 2; Schedule 40 or 80 PVC, UL listed, and as required by NEC. Sunlight resistant.
- B. Rated for 90 degrees C. cable.
- C. Fittings and Conduit Bodies: NEMA TC 3, schedule 40 or 80, to match conduit.
- D. Expansion fittings. PVC material, Carlon series E945 or equivalent.
- E. Expansion straps. PVC material, Carlon series E978 or equivalent.

2.8 EXPANSION FITTINGS

- A. Expansion fittings: Copper bonding jumper, Crouse-Hinds Type XJ.
- B. Expansion/deflection fittings: Copper bonding jumper, Crouse-Hinds Type XD.

2.9 SURFACE METAL RACEWAY

- A. Manufacturers:
 - 1. Carlon Electrical Products.
 - 2. Hubbell Wiring Devices.
 - 3. Thomas & Betts Corp.
 - 4. Walker Systems Inc.
 - 5. The Wiremold Co.
 - 6. Substitutions: In accordance with Division 01 - Product Requirements.
- B. Product Description: Sheet metal channel with fitted cover, suitable for use as surface metal raceway.
- C. Finish: Gray.
- D. Fittings, Boxes, and Extension Rings: Furnish manufacturer's standard accessories; match finish on raceway.

2.10 SURFACE NONMETAL RACEWAY

- A. Manufacturers:
 - 1. Carlon Electrical Products.
 - 2. Hubbell Wiring Devices.
 - 3. Thomas & Betts Corp.
 - 4. Walker Systems Inc.
 - 5. The Wiremold Co.
 - 6. Panduit.
 - 7. Substitutions: In accordance with Division 01 - Product Requirements.
- B. Product Description: Plastic channel with fitted cover, suitable for use as surface raceway.
- C. Finish: Gray.
- D. Fittings, Boxes, and Extension Rings: Furnish manufacturers' standard accessories, finish to match raceway.

2.11 WIREWAY

- A. Product Description: General purpose type wireway.
- B. Knockouts: Manufacturer's standard.
- C. Size: length as indicated on Drawings.
- D. Cover: Screw cover.
- E. Connector: Flanged.
- F. Fittings: Lay-in type with removable top, bottom, and side; captive screws.
- G. Finish: Rust inhibiting primer coating with gray enamel finish.

2.12 OUTLET BOXES

- A. Sheet Metal Outlet Boxes: NEMA OS 1, galvanized steel.
 - 1. Luminaire and Equipment Supporting Boxes: Rated for weight of equipment supported; furnish 1/2 inch (13 mm) male fixture studs where required.
 - 2. Concrete Ceiling Boxes: Concrete type.
- B. Cast Boxes: NEMA FB 1, Type FD, aluminum. Furnish gasketed cover by box manufacturer.
- C. Wall Plates for Finished Areas: As specified in Section 26 27 26.
- D. Wall Plates for Unfinished Areas: Furnish gasketed cover.

2.13 PULL AND JUNCTION BOXES

- A. Sheet Metal Boxes: NEMA OS 1, galvanized steel.
- B. Hinged Enclosures: As specified in Section 26 27 16.
- C. Surface Mounted Cast Metal Box: NEMA 250, Type 4X; flat-flanged, surface mounted junction box:
 - 1. Material: Cast aluminum.
 - 2. Cover: Furnish with ground flange, neoprene gasket, and stainless steel cover screws.
- D. In-Ground Cast Metal Box: NEMA 250, Type 6, outside flanged, recessed cover box for flush mounting:
 - 1. Material: Cast aluminum.
 - 2. Cover: Smooth cover with neoprene gasket and stainless steel cover screws.
- E. Polymer concrete composite Handholes: Die-molded, polymer concrete composite hand holes:
 - 1. Cable Entrance: Pre-cut 6 inch x 6 inch cable entrance at center bottom of each side.
 - 2. Cover: polymer concrete composite, weatherproof cover with nonskid finish. Secure cover with stainless steel hex bolts.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify outlet locations and routing and termination locations of raceway prior to rough-in.

3.2 RESTRICTIONS

- A. Split, crushed, or scarred conduit is not acceptable.
- B. Welded conduit is not acceptable.
- C. Do not route conduit over boiler, under boiler or in slabs below boiler, incinerator, or other high temperature equipment.
- D. PVC conduit may not be used in the interior of building except at following locations.
 - 1. PVC conduit may be used for grounding conductors.
 - 2. Greenhouses.
 - 3. Pool Equipment Rooms.

3.3 SYSTEM DESCRIPTION

- A. Raceway and boxes located as indicated on Drawings, and at other locations required for splices, taps, wire pulling, equipment connections, and compliance with regulatory

requirements.

- B. Raceway and boxes are shown in approximate locations unless dimensioned. Provide raceway to complete wiring system.
- C. Underground More than 5 feet outside Foundation Wall: Provide schedule 40 nonmetallic conduit, unless otherwise noted on drawings.
- D. Provide cast metal boxes in pavement or sidewalks and nonmetallic handhole in grass areas, unless otherwise noted.
- E. Underground Within 5 feet from Foundation Wall: Provide rigid steel conduit.
- F. In or Under Slab on Grade: Provide schedule 40 nonmetallic conduit.
- G. Outdoor Locations, Above Grade: Provide rigid steel conduit, unless otherwise noted. Provide cast metal outlet, pull, and junction boxes.
- H. In Slab Above Grade: Feeder conduit shall not be installed in slab. Provide schedule 40 nonmetallic conduit with EMT elbow so any conduit above slab shall be metallic.
- I. Wet and Damp Locations: Provide rigid steel conduit. Provide cast metal junction and pull boxes. Provide flush mounting outlet box in finished areas.
- J. Concealed Dry Locations: Provide rigid steel, intermediate metal conduit or electrical metallic tubing. Provide sheet-metal boxes. Provide flush mounting outlet box in finished areas. Provide hinged enclosure for large pull boxes.
- K. Exposed Dry Locations: Provide rigid steel, intermediate metal conduit or electrical metallic tubing, unless otherwise noted. Provide sheet-metal boxes. Provide flush mounting outlet box in finished areas. Provide hinged enclosure for large pull boxes.
- L. Provide separate conduit system for each of the following systems:
 - 1. 208 volt normal power wiring systems.
 - 2. 208 volt code required emergency power wiring systems (load side of transfer switch).
 - 3. 208 volt optional emergency power wiring systems (load side of transfer switch).
 - 4. 480 volt normal power wiring systems.
 - 5. 480 volt code required emergency power wiring systems (load side of transfer switch).
 - 6. 480 volt optional emergency power wiring systems (load side of transfer switch).
 - 7. Medium voltage wiring systems.
 - 8. Low voltage lighting control systems.
 - 9. Lightning Protection Systems
 - 10. Fire alarm systems.

11. Halon 1301 fire suppression systems.
12. Area of rescue assistance call systems.
13. Closed circuit television (CCTV) systems.
14. Electronic Card Key Access System
15. Clock Systems.
16. Voice/data communications raceway systems.
17. Master antenna television (MATV) systems.
18. Intercom, paging or sound system.
19. Nurse call systems.

3.4 INSTALLATION

- A. Install Work in accordance with State and Municipality standards.
- B. All conduits containing service entrance conductors shall be rigid metal conduits.
- C. Ground and bond raceway and boxes in accordance with Section 26 05 26.
- D. Fasten raceway and box supports to structure and finishes in accordance with Section 26 05 29.
- E. Identify raceway and boxes in accordance with Section 26 05 53.
- F. Arrange raceway and boxes to maintain headroom and present neat appearance.

3.5 INSTALLATION - RACEWAY

- A. Raceway routing is shown in approximate locations unless dimensioned. Route to complete wiring system.
- B. Arrange raceway supports to prevent misalignment during wiring installation.
- C. Support raceway using coated steel or malleable iron straps, lay-in adjustable hangers, clevis hangers, and split hangers.
- D. Group related raceway; support using conduit rack. Construct rack using steel channel specified in Section 26 05 29; provide space on each for 25 percent additional raceways.
- E. Secure conduits in place with malleable corrosion-proof alloy straps or hangers. Conduit straps used in corrosive areas shall be PVC coated.
- F. Do not support raceway with wire or perforated pipe straps. Remove wire used for temporary supports.
- G. Do not attach raceway to ceiling support wires or other piping systems.

- H. Construct wireway supports from steel channel specified in Section 26 05 29.
- I. Route exposed raceway parallel and perpendicular to walls.
- J. Route raceway installed above accessible ceilings parallel and perpendicular to walls.
- K. Route conduit under slab from point-to-point.
- L. Conduits routed within concrete construction such as poured walls, floor slabs, topping slabs, shall comply with following requirements.
 - 1. Conduits shall be parallel to each other, spaced on center to center distance of at least three times conduit trade diameter, and provided with minimum of 2 inches of concrete.
 - 2. Contractor shall note that precast planks below topping slabs may camber. Topping slab thickness will be less at high point of camber.
 - 3. Conduits larger than 1-1/4 inch inside diameter shall not be installed in floor slabs. Conduits over 3/4 inch ID shall not be installed in topping slabs.
 - 4. Conduits embedded in structural frame slab shall comply with applicable provisions of American Concrete Institute (ACI), Standard 318. Refer to structural drawings for locations of structural frames.
 - 5. Conduits used for feeders shall not be embedded in concrete floor slabs or concrete topping slabs.
 - 6. Conduits in poured concrete construction shall not cross other conduits or other piping.
 - 7. Unless specifically indicated on electrical drawings, conduits installed in poured concrete construction shall be approved by Structural Engineer prior to conduit installation.
 - 8. Contractor will be required to submit drawings showing conduit sizes and routings to Structural Engineer for their review. Approval may not be given prior to bidding. Contractors who base their bid on assumption that conduits will be allowed in concrete construction do so at their own risk. No changes will be made to contract if, during construction, Structural Engineer prohibits installation of conduit in concrete construction.
 - 9. In areas constructed of precast concrete conduits may be run in cores of planks.
- M. Maintain clearance between raceway and piping for maintenance purposes.
- N. Maintain 12-inch clearance between raceway and surfaces with temperatures exceeding 104 degrees F.
- O. Where conduits must cross or follow the same path as water, steam or other fluid piping, run electrical conduits above such piping wherever possible.
- P. Cut conduit square using saw or pipe cutter; de-burr cut ends.

- Q. Bring conduit to shoulder of fittings; fasten securely.
- R. Join nonmetallic conduit using cement as recommended by manufacturer. Wipe nonmetallic conduit dry and clean before joining. Apply full even coat of cement to entire area inserted in fitting. Allow joint to cure for minimum 20 minutes.
- S. Install conduit hubs to fasten conduit to cast boxes in damp and wet locations.
- T. Install no more than equivalent of three 90 degree bends between boxes. Install conduit bodies to make sharp changes in direction, as around beams. Install hydraulic one-shot bender to fabricate or factory elbows for bends in metal conduit larger than 2-inch size.
- U. Avoid moisture traps; install junction box with drain fitting at low points in conduit system.
- V. Provide a watertight conduit system where installed in wet locations such as underground, or where embedded in concrete.
- W. Install fittings to accommodate expansion and deflection where raceway crosses seismic, control and expansion joints.
- X. Install suitable pull string or cord in each empty raceway except sleeves and nipples.
- Y. Install suitable caps to protect installed conduit against entrance of dirt and moisture.
- Z. Close ends and unused openings in wireway.
- AA. Conduit runs that extend through areas of different temperature or atmospheric conditions or that are partly indoors and partly outdoors shall be sealed, drained, and installed in manner that will prevent drainage of condensed or entrapped moisture into cabinets, motors, or equipment enclosures.
- BB. Conduit connections at motors, transformers, and other equipment that vibrates.
 1. Flexible metal conduit between 18 inches and 36 inches long for conduit connections at equipment that vibrates.
 2. Liquid-tight flexible metal conduit where flexible connections are required and where conduit will be exposed to moisture, dirt, fumes, oil, corrosive atmosphere, etc. Provide with connectors to assure liquid-tight, permanently grounded connection. Locate so it is least subject to physical abuse. Corrosive areas are identified on floor plan.
 3. Use double locknuts and insulated bushings with threads fully engaged.
- CC. Direct buried underground conduit.
 1. Exterior underground direct buried conduits shall be buried at depth of not less than 30 inches below grade.
 2. Provide conduits or ducts terminating below grade with means to prevent entry of

dirt or moisture.

3. Underground conduits shall slope 1/8 inch per foot for proper drainage. Conduits shall drain toward manholes and junction boxes, not the electrical equipment.

3.6 INSTALLATION - SURFACE RACEWAY

- A. Surface Raceway: Install flat-head screws, clips, and straps to fasten raceway channel to surfaces; mount plumb and level. Install insulating bushings and inserts at connections to outlets and corner fittings.
- B. Where exposed raceways and electrical devices are required in existing construction, exposed raceway, fittings and boxes shall be used provided that installation meets following:
 1. Raceways shall be routed horizontally along corner surfaces formed by walls and ceilings, directly above edges of bases at floor, along tops of window mullions and door frames.
 2. Raceways shall be routed vertically along corners formed by adjacent walls and along edges of door frames.
 3. Surface raceways shall not be routed down or across open wall surfaces except in portions of runs not exceeding 12 inches in length.
 4. Surface raceways shall be painted to match wall finishes on which the raceways are routed. If wood backing is required, it shall be continuous and painted to match surrounding surfaces.
 5. If raceways are installed prior to painting, raceways will then be painted as part of painting contract.
 6. Fittings and boxes used with surface metal raceways shall be specifically designed and approved for use with such raceways.

3.7 INSTALLATION - BOXES

- A. Install wall mounted boxes at elevations to accommodate mounting heights as indicated on Drawings.
- B. Adjust box location up to 10 feet prior to rough-in to accommodate intended purpose.
- C. Orient boxes to accommodate wiring devices oriented as specified in Section 26 27 26.
- D. In Accessible Ceiling Areas: Install outlet and junction boxes no more than 6 inches from ceiling access panel or from removable recessed luminaire.
- E. Locate flush mounting box in masonry wall to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat opening.
- F. Do not install flush mounting box back-to-back in walls; install with minimum 6 inches separation. Install with minimum 24 inches separation in acoustic rated walls.

- G. Secure flush mounting box to interior wall and partition studs. Accurately position to allow for surface finish thickness.
- H. Install stamped steel bridges to fasten flush mounting outlet box between studs.
- I. Install flush mounting box without damaging wall insulation or reducing its effectiveness.
- J. Install adjustable steel channel fasteners for hung ceiling outlet box.
- K. Do not fasten boxes to ceiling support wires or other piping systems.
- L. Support boxes independently of conduit.
- M. Install gang box where more than one device is mounted together. Do not use sectional box.
- N. Install gang box with plaster ring for single device outlets.

3.8 INTERFACE WITH OTHER PRODUCTS

- A. Install conduit to preserve fire resistance rating of partitions and other elements, using materials and methods in accordance with Section 07 84 00.
- B. Route conduit through roof openings for piping and ductwork or through suitable roof jack with pitch pocket. Coordinate location with roofing installation specified in Division 07.
- C. Locate outlet boxes to allow luminaires positioned as indicated on Drawings.
- D. Align adjacent wall mounted outlet boxes for switches, thermostats, and similar devices.

3.9 ADJUSTING

- A. Division 01 - Quality Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Adjust flush-mounting outlets to make front flush with finished wall material.
- C. Install knockout closures in unused openings in boxes.

3.10 CLEANING

- A. Clean interior of boxes to remove dust, debris, and other material.
- B. Clean exposed surfaces and restore finish.

END OF SECTION

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SECTION 26 05 53

ELECTRICAL IDENTIFICATION

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Nameplates.
 - 2. Labels.
 - 3. Wire markers.
 - 4. Stencils.
 - 5. Underground Warning Tape.

- B. Related Sections:
 - 1. Applicable provisions of Division 01 shall govern all work under this Section.
 - 2. Section 26 00 00 – Basic Electrical Requirements.
 - 3. Division 09 – Finishes: Execution requirements for painting specified by this section.

1.2 QUALITY ASSURANCE

- A. Perform Work in accordance with State and Municipality standards.

1.3 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum five years documented experience.

- B. Installer: Company specializing in performing Work of this section with minimum five years documented experience.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store and protect products under provisions of Division 01 - Product Requirements.

- B. Accept identification products on site in original containers. Inspect for damage.

- C. Accept materials on site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.

- D. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.

1.5 ENVIRONMENTAL REQUIREMENTS

- A. Division 01 - Product Requirements: Environmental conditions affecting products on site.

- B. Install labels only when ambient temperature and humidity conditions for adhesive are within range recommended by manufacturer.

1.6 EXTRA MATERIALS

- A. Furnish under provisions of Division 01 - Execution Requirements.

PART 2 PRODUCTS

2.1 NAMEPLATES

- A. Product Description: Laminated three-layer plastic with engraved black letters on white contrasting background color.
- B. Nameplates shall match identification shown on drawings.
- C. Letter Size:
 - 1. 3/8-inch high letters for identifying voltages, phase and number of wires.
 - 2. 3/4-inch high letters for identifying equipment and loads.
 - 3. Panelboards: Nameplates shall state: panel identification, voltage, phase and number of wires (example: LP1/BH1, 277/480V, 3PH, 4W).
 - 4. Medium voltage cables: nameplates shall be self-extinguishing, resistant to oil, water and solvents. Nameplate shall be minimum size 1 inch X 4 inches. Nameplate shall note: switch feeder from, phase, where feeder starts and where feeder ends.
- D. Minimum nameplate thickness: 1/8 inch.

2.2 LABELS

- A. Labels: Printed adhesive label tags, with 1/8-inch minimum height black letters on white background.
- B. Wiring device labels: Printed adhesive label tags, with 1/8-inch minimum height black letters on clear background.

2.3 WIRE AND CABLE IDENTIFICATION

- A. Different conductor insulation colors and electrical tape colors shall be used to identify the different phases of conductors in a given circuit.
- B. Code color requirements shall always be followed where applicable.
- C. Following colors shall be as follows unless otherwise required by code:
 - 1. 120/208 volt systems
 - a. A-phase: solid black.
 - b. B-phase: solid red.

- c. C-phase: solid blue.
 - d. Different colors shall be used to identify switched legs.
 - e. Neutral conductor: solid white. Provide additional markings for neutral conductors in the same raceway as required by code.
- 2. 480/277 volt systems
 - a. A-phase: Solid brown.
 - b. B-phase: solid orange.
 - c. C-phase: solid yellow.
 - d. Different colors shall be used to identify switched legs.
 - e. Neutral conductor: solid gray. Provide additional markings for neutral conductors in the same raceway as required by code.
 - 3. Ground Conductors: solid green. Provide additional markings for ground conductors in the same raceway as required by code.
 - 4. For additions to existing buildings use existing color code system unless it violates code. If no wire color coding system is used; use color coding system listed above.

D. Wire and cable labels:

- 1. Feeder and branch circuits: label shall indicate panel and circuit number as actual installed.
- 2. Control Circuits: Control wire number as indicated on schematic and interconnection diagrams.

2.4 CONDUIT AND RACEWAY MARKERS

A. Conduit color/stencil markings:

- 1. Medium Voltage System: Orange lettering on white background noting: HIGH VOLTAGE - "actual line-to-line voltage".
- 2. 480 Volt System: Yellow color band.
- 3. 208 Volt System: Blue color band.
- 4. Fire Alarm System: Red colored band.
- 5. Telephone/Data System: Gray colored band.

2.5 STENCILS

A. Stencils: With clean cut symbols and letters of following size:

- 1. Up to 2 inches Outside Diameter of Raceway: 1/2-inch high letters.
- 2. 2-1/2 to 6 inches Outside Diameter of Raceway: 1 inch high letters.
- 3. 1/2-inch high letters minimum for identifying boxes and other equipment.

2.6 UNDERGROUND WARNING TAPE

- A. Description: 4-inch wide plastic tape, colored yellow with suitable warning legend describing type of buried electrical lines.

2.7 PANELBOARD DIRECTORIES

- A. Suitable for complete description of load served.
- B. Directory shall be removable.
- C. Typewritten card, describing loads served.
- D. Provide steel frame holder on inside cover of door to hold directory.
- E. Directory shall be covered with a clear plastic sheet.

PART 3 EXECUTION

3.1 GENERAL

- A. Where mixed voltages are used in one building (e.g. 4160 volt, 480 volt, 208 volt) each switch, switchboard, junction box, equipment, etc., on each system must be labeled for voltage in addition to the other requirements listed herein.
- B. All branch circuit and power panels must be identified with the same symbol used in circuit directory in main distribution center.
- C. Stenciling may only be used on equipment fronts in unfinished areas.
- D. Receptacle labels shall identify panel and circuit number feeding receptacle.
- E. Switch label shall indicate equipment controlled by switch. Do not label light switches unless otherwise noted on drawings.

3.2 PREPARATION

- A. Degrease and clean surfaces to receive adhesive for identification materials.
- B. Prepare surfaces in accordance with Division 09 – Finishes for stencil painting.

3.3 EXISTING WORK

- A. Install identification on existing equipment to remain in accordance with this section.
- B. Re-stencil existing equipment.

3.4 INSTALLATION

- A. Install identifying devices after completion of painting.
- B. Adhesive type labels not permitted except for phase and wire identification.

- C. Hand written labels or embossed tape are not permitted.
- D. Nameplate Installation:
1. Install nameplate parallel to equipment lines.
 2. Install nameplate for each electrical distribution and control equipment enclosure with corrosive-resistant mechanical fasteners.
 3. Install nameplates for each control panel and major control components located outside panel with corrosive-resistant mechanical fasteners.
 4. Secure nameplate to equipment front using screws or rivets.
 5. Secure nameplate to inside surface of door on recessed panelboard in finished locations.
 6. Provide identification for the following:
 - a. Conduit (provide stencil or color band).
 - b. Wires and cables (provide Color code and label).
 - c. Medium voltage cables.
 - d. Junction and pullboxes (provide color code and/or stencil).
 - e. Wiring devices (provide label).
 - f. Equipment (provide nameplates).
 - g. Switchboards (provide nameplate to identify board and each load fed from switchboard)
 - h. Panelboards (provide nameplates and directory).
 - i. Transformers (provide nameplates).
 - j. Motor starters (provide nameplates).
 - k. Motor control centers (provide nameplates).
 - l. Transfer switches (provide nameplates).
 - m. Fire alarm panel (provide nameplates).
 - n. Control panels (provide nameplates).
 - o. Time contactor (provide nameplates).
 - p. Contactor (provide nameplates).
 - q. Disconnect switch (provide nameplates).
- E. Label Installation:
1. Install label parallel to equipment lines.
 2. Install label for identification of individual control device stations.
 3. Install labels for permanent adhesion.
- F. Wire label Installation:
1. Install wire marker for each conductor at panelboard gutters and outlet or equipment connection. Label shall be within one (1) foot of end of conductor.
- G. Conduit Marker Installation:
1. Install conduit marker for each conduit longer than 6 feet.
 2. Conduit Markers Spacing: 50 feet on center, minimum of one visible in every room.

3. Raceway Painting: Identify conduit using field painting in accordance with Division 09 – Finishes.
 - a. Paint colored band on each conduit longer than 6 feet.
 - b. Paint bands 50 feet on center, minimum of one in each room.

H. Stencil Installation:

1. Apply stencil painting in accordance with Division 09 – Finishes.
2. Junction boxes: identify system source and load served.
3. Junction boxes for electrical communications, signal and control systems: Identify system source and equipment serviced, stenciled in black on cover.
4. Junction boxes for Fire Alarm system: Junction box covers shall be painted red with “Fire Alarm” stenciled in black on cover.

I. Underground Warning Tape Installation:

1. Install underground warning tape along length of each underground conduit, raceway, or cable 6 to 8 inches below finished grade, directly above buried conduit, raceway, or cable.

J. Medium Voltage Cable identification:

1. Fasten label to cable with nylon tie-wraps.
2. Install cable labels on each conductor at each cable termination, each pullbox, each manhole, and at all other accessible locations.
3. During entire cable installation, phasing of conductors shall be maintained and identified.

END OF SECTION

SECTION 26 22 00

LOW-VOLTAGE TRANSFORMERS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Dry Type General Purpose Transformers.
- B. Related Sections:
 - 1. Applicable provisions of Division 01 shall govern all work under this Section.
 - 2. Section 26 00 00 – Basic Electrical Requirements.

1.2 REFERENCES

- A. National Electrical Manufacturers Association (NEMA):
 - 1. NEMA ST 1 – Specialty Transformers (Except General Purpose Types).
 - 2. NEMA ST 20 - Dry Type Transformers for General Applications.
- B. International Electrical Testing Association (NETA):
 - 1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

1.3 SUBMITTALS

- A. Division 01 - Submittal Procedures: Procedures for submittals.
- B. Product Data: Submit outline and support point dimensions of enclosures and accessories, unit weight, voltage, kVA, and impedance ratings and characteristics, tap configurations, insulation system type, and rated temperature rise.
- C. Test Reports: Indicate loss data, efficiency at 25, 50, 75 and 100 percent rated load, and sound level.

1.4 CLOSEOUT SUBMITTALS

- A. Division 01 – Execution Requirements: Procedures for closeout submittals.
- B. Project Record Documents: Record actual locations of transformers.

1.5 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum five years experience.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store and protect products under provisions of Division 01 - Product Requirements.
- B. Store in clean, dry space. Maintain factory wrapping or provide additional canvas or plastic cover to protect units from dirt, water, construction debris, and traffic.
- C. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided. Handle carefully to avoid damage to transformer internal components, enclosure, and finish.

PART 2 PRODUCTS

2.1 GENERAL PURPOSE TRANSFORMERS

- A. Manufacturers:
 - 1. Square D.
 - 2. General Electric.
 - 3. Cutler-Hammer.
 - 4. Siemens.
 - 5. Substitutions: In accordance with Division 01 - Product Requirements.
- B. Product Description: NEMA ST 20, factory-assembled, air-cooled, dry type transformers, ratings as indicated on Drawings.
- C. Primary Voltage: Ratings indicated on Drawings.
- D. Secondary Voltage: Ratings indicated on Drawings.
- E. Insulation system and average winding temperature rise for rated kVA as follows:
 - 1. 1-15 kVA: Class 185 with 115 degrees C rise.
 - 2. 16-500 kVA: Class 220 with 115 degrees C rise.
- F. Case temperature: Do not exceed 40 degrees C rise above ambient at warmest point at full load.
- G. Winding Taps:
 - 1. Transformers Less than 15 kVA: Two 5 percent below rated voltage, full capacity taps on primary winding.
 - 2. Transformers 15 kVA and Larger: Two 2-1/2 percent taps above and two 2-1/2 percent taps below.
- H. Sound Levels: Maximum sound levels are as follows: (levels shown shall be measured at 5 feet from the transformer)
 - 1. 1-9 kVA: 40 dB.
 - 2. 10-50 kVA: 45 dB.
 - 3. 51-150 kVA: 50 dB.

4. 151-300 kVA: 55 dB.
 5. 301-500 kVA: 60 dB.
 6. 501-700 kVA: 62 dB.
 7. 701-1000 kVA: 64 dB.
- I. Basic Impulse Level: 10 kV for transformers less than 300 kVA, 30 kV for transformers 300 kVA and larger.
 - J. Ground core and coil assembly to enclosure by means of visible flexible copper grounding strap.
 - K. Mounting:
 1. 1-15 kVA: Suitable for wall mounting.
 2. 16-75 kVA: Suitable for floor mounting.
 3. Larger than 75 kVA: Suitable for floor mounting.
 - L. Coil Conductors: Continuous copper or aluminum windings with terminations brazed or welded.
 - M. Enclosure: NEMA ST 20, Type 1. Furnish lifting eyes or brackets.
 - N. Isolate core and coil from enclosure using vibration-absorbing mounts. No metal-to-metal contact shall occur between coil/core and enclosure.
 - O. Nameplate: Include transformer connection data and overload capacity based on rated allowable temperature rise.
 - P. Overload capacity shall be not less than 15 percent for continuous operation for 115 degrees C rise transformers.
 - Q. Transformer shall have a UL "K" rating of 4 minimum.
 - R. Size as indicated on drawings.

2.2 BUCK-AND-BOOST TRANSFORMERS

- A. Product Description: NEMA ST 1, factory-assembled, dry type two winding buck and boost transformers, ratings as indicated on Drawings.
- B. Insulation system and average winding temperature rise for rated kVA as follows:
 1. 0.25-2 kVA: Class 185 with 80 degrees C rise.
 2. 3-7.5 kVA: Class 220 with 80 degrees C rise.
- C. Primary Voltage: As indicated on Drawings.
- D. Secondary Voltage: As indicated on Drawings.

- E. Mounting: Wall.
- F. Coil Conductors: Copper or aluminum Continuous windings.
- G. Lugs: Suitable for terminating conductors sized for full load ampacity of transformer unit when operating in buck-and-boost configuration shown.
- H. Enclosure: NEMA ST 1, Type 1.
- I. Isolate core and coil from enclosure using vibration-absorbing mounts.
- J. Nameplate: Include transformer connection data.

2.3 SOURCE QUALITY CONTROL

- A. Production test each unit according to NEMA ST20.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify mounting supports are properly sized and located including concealed bracing in walls.

3.2 INSTALLATION

- A. Set transformer plumb and level.
- B. Use flexible conduit, in accordance with Section 26 05 33, 2-foot minimum length, for connections to transformer case. Make conduit connections to side panel of enclosure.
- C. Support transformers in accordance with Section 26 05 29.
 1. Mount wall-mounted transformers using integral flanges or accessory brackets furnished by manufacturer.
 2. Mount floor-mounted transformers on vibration isolating pads suitable for isolating transformer noise from building structure.
 3. Mount trapeze-mounted transformers as indicated on Drawings.
- D. Provide seismic restraints.
- E. Install grounding and bonding in accordance with Section 26 05 26.

3.3 FIELD QUALITY CONTROL

- A. Division 01 - Quality Requirements: Field inspecting, testing, adjusting, and balancing.

- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Perform inspections and tests listed in NETA ATS, Section 7.2.1.

3.4 ADJUSTING

- A. Division 01 – Execution Requirements: Testing, adjusting, and balancing.
- B. Measure primary and secondary voltages and make appropriate tap adjustments.

END OF SECTION

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SECTION 26 24 13

SWITCHBOARDS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Distribution Switchboards.
- B. Related Sections:
 - 1. Applicable provisions of Division 01 shall govern all work under this Section.
 - 2. Section 26 00 00 - Basic Electrical Requirements.
 - 3. Section 26 05 26 - Grounding and Bonding.
 - 4. Section 26 05 53 - Electrical Identification.
 - 5. Section 26 28 13 - Fuses.

1.2 REFERENCES

- A. American National Standards Institute (ANSI):
 - 1. ANSI C12.1 – Electric Meters Code for Electricity Metering.
 - 2. ANSI C39.1 - Requirements, Electrical Analog Indicating Instruments.
- B. Institute of Electrical and Electronics Engineers (IEEE):
 - 1. IEEE C57.13 - Standard Requirements for Instrument Transformers.
 - 2. IEEE C62.41 - Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits.
- C. National Electrical Manufacturers Association (NEMA):
 - 1. NEMA AB 1 - Molded Case Circuit Breakers and Molded Case Switches.
 - 2. NEMA FU 1 - Low Voltage Cartridge Fuses.
 - 3. NEMA KS 1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).
 - 4. NEMA PB 2 - Deadfront Distribution Switchboards.
 - 5. NEMA PB 2.1 - General Instructions for Proper Handling, Installation, Operation, and Maintenance of Deadfront Distribution Switchboards Rated 600 Volts or Less.
- D. International Electrical Testing Association (NETA):
 - 1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

1.3 SUBMITTALS

- A. Division 01 - Submittal Procedures: Procedures for submittals.

- B. Shop Drawings: Indicate front and side views of enclosures with overall dimensions shown; conduit entrance locations and requirements; nameplate legends; size and number of bus bars for each phase, neutral, and ground; and switchboard instrument details.
- C. Product Data: Submit electrical characteristics including voltage, frame size and trip ratings, fault current withstand ratings, and time-current curves of equipment and components.
- D. Test Reports: Indicate results of factory production and field tests.

1.4 CLOSEOUT SUBMITTALS

- A. Division 01 – Execution Requirements: Procedures for closeout submittals.
- B. Project Record Documents: Record actual locations, configurations, and ratings of switchboards and their components on single line diagrams and plan layouts.
- C. Operation and Maintenance Data: Submit spare parts data listing; source and current prices of replacement parts and supplies; and recommended maintenance procedures and intervals.

1.5 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum five years experience.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store and protect products under provisions of Division 01 - Product Requirements.
- B. Deliver in 48 inch maximum width shipping splits, individually wrapped for protection and mounted on shipping skids. Contractor can order wider shipping splits if access to switchboard locations is adequate.
- C. Accept switchboards on site. Inspect for damage.
- D. Store in clean, dry space. Maintain factory wrapping or provide additional canvas or plastic cover to protect units from dirt, water, construction debris, and traffic.
- E. Handle in accordance with NEMA PB 2.1. Lift only with lugs provided. Handle carefully to avoid damage to switchboard internal components, enclosure, and finish.

1.7 ENVIRONMENTAL REQUIREMENTS

- A. Division 01 - Product Requirements: Environmental conditions affecting products on site.
- B. Conform to NEMA PB 2 service conditions during and after installation of switchboards.

1.8 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

1.9 SEQUENCING

- A. Sequence Work to avoid interferences with building finishes and installation of other products.

1.10 MAINTENANCE MATERIALS

- A. Division 01 – Execution Requirements: Spare parts and maintenance products.
- B. Furnish one fuse puller.

1.11 EXTRA MATERIALS

- A. Division 01 – Execution Requirements: Spare parts and maintenance products.
- B. Furnish three of each size and type of fuse installed.

PART 2 PRODUCTS

2.1 DISTRIBUTION SWITCHBOARDS

- A. Manufacturers:
 - 1. Square D.
 - 2. Siemens.
 - 3. GE Electrical.
 - 4. Cutler-Hammer.
 - 5. Substitutions: In accordance with Division 01 - Product Requirements.
- B. Product Description: NEMA PB 2, enclosed switchboard with electrical ratings and configurations as indicated on Drawings.
- C. Device Mounting:
 - 1. Group mounted in frame sizes 100 amp through 600 amp.
 - 2. Individually mounted for 800 amp and larger frame sizes.
- D. Bus:
 - 1. The switchboard bussing shall be plated and of sufficient cross-sectional area to continuously conduct rated full load current with a maximum temperature rise of 50 degrees C, above an ambient temperature of 40 degrees C. bus bars (and all other current carrying parts such as fingers, neutral and ground buses) shall be cold rolled copper, 98 percent minimum conductivity.
 - 2. All bus bars and connections shall be braced to withstand stressed resulting from

- short circuit currents of at least short circuit current rating as indicated on Drawings.
 - 3. All bus bars and bus bar connections shall be machined for maximum contact surface and have silver plated contact connections. At the point of connection, use bronze alloy or cadmium plated bolts with Belleville washers. No clamp joints shall be used. Connections shall be bolted, accessible from front for maintenance.
 - 4. Where spaces are indicated for future breakers, extend bus bars and drill and tap for future breakers.
 - 5. Provide copper ground bus through length of switchboard.
- E. Line and Load Terminations: Accessible from front only of switchboard, suitable for conductor materials and sizes as indicated on Drawings.
 - F. Future Provisions: Fully equip spaces for future devices with bussing and bus connections, insulated and braced for short circuit currents. Furnish continuous current rating as indicated on Drawings.
 - G. Enclosure: Type 1 - General Purpose.
 - H. Align sections at front only.
 - I. Switchboard Height: 90 inches, excluding floor sills, lifting members and pull boxes.
 - J. Finish: Manufacturer's standard light gray enamel over external surfaces. Coat internal surfaces with minimum one coat corrosion-resisting paint, or plate with cadmium or zinc.

2.2 FUSIBLE SWITCH ASSEMBLIES

- A. Manufacturers:
 - 1. Square D.
 - 2. Siemens.
 - 3. General Electric.
 - 4. Cutler-Hammer.
 - 5. Substitutions: In accordance with Division 01 - Product Requirements.
- B. Product Description: NEMA KS 1, Type HD, load interrupter knife switch. Handle lockable in OFF position.
- C. Fuse clips: Designed to accommodate NEMA FU 1, Class J fuses.

2.3 FUSIBLE SWITCH ASSEMBLIES LARGER THAN 800 AMPERES

- A. Manufacturers:
 - 1. Square D.
 - 2. Siemens.
 - 3. General Electric.
 - 4. Cutler-Hammer.

- 5. Substitutions: In accordance with Division 01 - Product Requirements.
- B. Product Description: NEMA KS 1, bolted pressure contact switch.
- C. Fuse Provisions: Designed to accommodate NEMA FU 1, Class L fuses.
- D. Switch shall be dead front type with a fuse door interlock and provisions for padlocking in the open position with at least 3 padlocks.
- E. Bolted pressure contacts are to firmly bolt movable blades to both top and bottom stationary contacts.
- F. Switch shall be designed for load break operation. Easily replaceable stationary arc tips and arc chambers shall be used.
- G. Switch shall be capable of opening and closing into a fault of six times the current rating without fuses at rated voltage, to insure safety on emergency openings.
- H. Switch shall be manually operated.

2.4 MOLDED CASE CIRCUIT BREAKER

- A. Manufacturers:
 - 1. Square D.
 - 2. Siemens.
 - 3. General Electric.
 - 4. Cutler-Hammer.
 - 5. Substitutions: In accordance with Division 01 - Product Requirements.
- B. Product Description: NEMA AB 1, molded-case circuit breaker.
- C. Solid-State Circuit Breaker: Electronic sensing, timing, and tripping circuits for adjustable current settings; ground fault trip with integral ground fault sensing; instantaneous trip; and adjustable short time and long time trip.
- D. Accessories: As indicated on Drawings. Conform to NEMA AB.

2.5 INSULATED CASE CIRCUIT BREAKER

- A. Manufacturers:
 - 1. Square D.
 - 2. Siemens.
 - 3. General Electric.
 - 4. Cutler-Hammer.
 - 5. Substitutions: In accordance with Division 01 - Product Requirements.

- B. Product Description: NEMA AB 1, enclosed, insulated-case circuit breaker.
- C. Trip Unit: Electronic sensing, timing, and tripping circuits for adjustable current settings; ground fault trip (if indicated on drawings) with integral ground fault sensing; instantaneous trip; and adjustable short time and long time trip.
- D. Accessories: As indicated on Drawings. Conform to NEMA AB.

2.6 TRANSIENT VOLTAGE SUPPRESSION DEVICES

- A. Shall meet requirements of Section 26 35 53.

2.7 SOURCE QUALITY CONTROL

- A. Furnish shop inspection and testing in accordance with NEMA PB 2.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify surface is suitable for switchboard installation.

3.2 INSTALLATION

- A. Install in accordance with NEMA PB 2.1.
- B. Tighten accessible bus connections and mechanical fasteners after placing switchboard.
- C. Install fuses in each switch and coordinate sizes with connected load.
- D. Install engraved plastic nameplates in accordance with Section 26 05 53.
- E. Install breaker circuit directory.
- F. Ground and bond switchboards in accordance with Section 26 05 26.

3.3 FIELD QUALITY CONTROL

- A. Division 01 - Quality Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Perform inspections and tests listed in NETA ATS, Section 7.1.

3.4 ADJUSTING

- A. Division 01 - Quality Requirements: Field inspecting, testing, adjusting, and balancing.

- B. Adjust operating mechanisms for free mechanical movement.
- C. Tighten bolted bus connections.
- D. Adjust circuit breaker trip and time delay settings to values as indicated short circuit coordination study.

3.5 CLEANING

- A. Division 01 - Quality Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Touch up scratched or marred surfaces to match original finish.

END OF SECTION

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SECTION 26 24 16

PANELBOARDS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
- B. Distribution Circuit Panelboards.
 - 1. Branch Circuit Panelboards.
 - 2. Electronic Grade Branch Circuit Panelboards.
- C. Related Sections:
 - 1. Applicable provisions of Division 01 shall govern all work under this Section.
 - 2. Section 26 00 00 – Basic Electrical Requirements.
 - 3. Section 26 05 26 - Grounding and Bonding.
 - 4. Section 26 05 53 - Electrical Identification.
 - 5. Section 26 35 53 - Voltage Regulators.

1.2 REFERENCES

- A. Institute of Electrical and Electronic Engineers (IEEE):
 - 1. IEEE C62.41 – Recommended Practice on Surge Voltages in Low Voltage AC Power Circuits.
- B. National Electrical Manufacturers Association (NEMA):
 - 1. NEMA AB 1 - Molded Case Circuit Breakers and Molded Case Switches.
 - 2. NEMA FU 1 – Low Voltage Cartridge Fuses.
 - 3. NEMA ICS 2 – Industrial Control and Systems: Controllers, Contactors, and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC.
 - 4. NEMA ICS 5 - Industrial Control and Systems: Control Circuit and Pilot Devices.
 - 5. NEMA KS 1 – Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).
 - 6. NEMA PB 1 - Panelboards.
 - 7. NEMA PB 1.1 - General Instructions for Proper Installation, Operation, and Maintenance of Panelboards Rated 600 Volts or Less.
- C. International Electrical Testing Association (NETA):
 - 1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
- D. National Fire Protection Association (NFPA):
 - 1. NFPA 70 - National Electrical Code.

- E. Underwriters Laboratories Inc. (UL):
 - 1. UL 67 - Safety for Panelboards.
 - 2. UL 1283 – Electromagnetic Interference Filters.
 - 3. UL 1449 – Transient Voltage Surge Suppressors.

1.3 SUBMITTALS

- A. Division 01 - Submittal Procedures: Procedures for submittals.
- B. Shop Drawings: Indicate outline and support point dimensions, voltage, main bus ampacity, integrated short circuit ampere rating, circuit breaker arrangement and sizes.
- C. Product Data: Submit catalog data showing specified features of standard products.

1.4 CLOSEOUT SUBMITTALS

- A. Division 01 – Execution Requirements: Procedures for closeout submittals.
- B. Project Record Documents: Record actual locations of panelboards and record actual circuiting arrangements.
- C. Operation and Maintenance Data: Submit spare parts listing; source and current prices of replacement parts and supplies; and recommended maintenance procedures and intervals.

1.5 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum five years experience.

1.6 MAINTENANCE MATERIALS

- A. Division 01 – Execution Requirements: Requirements for maintenance products.
- B. Furnish two of each panelboard key. Panelboards shall be keyed alike.

1.7 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Do not store panelboards exposed to weather.
- B. Protect panelboards against damage from work of other trades.

PART 2 PRODUCTS

2.1 DISTRIBUTION PANELBOARDS

- A. Manufacturers:
 - 1. Square D, I-line Series.

2. GE Electrical.
 3. Siemens.
 4. Cutler-Hammer.
 5. Substitutions: In accordance with Division 01 - Product Requirements.
- B. Product Description: NEMA PB 1, circuit breaker type panelboard.
- C. Panelboard Bus: Copper, current carrying components, ratings as indicated on Drawings. Furnish copper ground bus in each panelboard. Bus shall be rated per panelboard schedule, 100 amp minimum.
- D. Minimum integrated short circuit rating: 10,000 amperes rms symmetrical for 240 or 208 volt panelboards; 14,000 amperes rms symmetrical for 480 volt panelboards, unless otherwise indicated on Drawings. Panels shall be fully rated, series rating is not acceptable.
- E. Molded Case Circuit Breakers: NEMA AB 1, bolt-on type, circuit breakers with integral thermal and instantaneous magnetic trip handle for all poles. No handle ties of any sort will be approved. Provide circuit breakers UL listed as Type HACR for air conditioning equipment branch circuits.
- F. Circuit Breaker Accessories: Trip units as indicated on Drawings.
- G. Enclosure: NEMA PB 1, Type 1 indoors, maximum 9.5 inches deep, 42 inches wide, cabinet box.
- H. Provide cabinet front with hinged door with flush lock. Front cover shall allow access to wiring gutters without removal of panel trim. Hinged trim shall be held in place with screw fasteners. Finish in manufacturer's standard gray enamel.
- I. Where indicated on drawings, provide TVSS unit mounted integral to panel. TVSS unit shall meet Section 26 35 53 requirements.

2.2 BRANCH CIRCUIT PANELBOARDS

- A. Manufacturers:
1. Square D, NQOD or NF Series.
 2. GE Electrical.
 3. Siemens.
 4. Cutler-Hammer.
 5. Substitutions: In accordance with Division 01 - Product Requirements.
- B. Product Description: NEMA PB1, circuit breaker type, lighting and appliance branch circuit panelboard.
- C. Panelboard Bus: Copper, current carrying components, ratings as indicated on Drawings, 100

amp minimum. Furnish copper ground bus in each panelboard.

- D. Minimum Integrated Short Circuit Rating: 10,000 amperes rms symmetrical for 208 volt or 240 volt panelboards; 14,000 amperes rms symmetrical for 480 volt panelboards, unless otherwise indicated on Drawings. Panels shall be fully rated, series rating is not acceptable.
- E. Molded Case Circuit Breakers: NEMA AB 1, bolt-on type thermal magnetic trip circuit breakers, with common trip handle for all poles; no handle ties of any sort will be approved. Type HACR for air conditioning equipment circuits, HID rated for high intensity discharge lighting systems, or as indicated on Drawings.
- F. Provide metal directory holders with clear plastic covers.
- G. Do not use tandem circuit breakers.
- H. Enclosure: NEMA PB 1, Type 1 indoors, Type 3R outdoors and damp or wet locations.
- I. Cabinet Box: 6 inches deep, 20 inches (508 mm) wide.
- J. Where indicated on drawings, provide TVSS units mounted integral to panel. TVSS unit shall meet Section 26 35 53 requirements.
- K. Furnish wiring gutters in accordance with NEC.
- L. Top or bottom feed as required.
- M. Furnish with branch breaker positions and nominal current rating as indicated on Drawings.
- N. Fronts:
 - 1. Dead front safety type.
 - 2. Door shall be built into panel front cover trim which allows access to breakers as well as to trim screw fasteners. Front cover construction with concealed trim screws and door hinges. Breaker access door shall have the following features:
 - a. Concealed piano hinge.
 - b. Flush stainless steel cylinder tumbler type lock with spring loaded door pulls.
 - c. Locks keyed alike.
 - d. Code gauge steel with rust inhibiting primer and baked enamel finish.
- O. Circuit Directory:
 - 1. Suitable for complete descriptions.
 - 2. Clear plastic cover.
 - 3. Typewritten card, describing the loads served.
 - 4. Provide steel frame holder on inside cover of door to hold directory. Directory shall be covered with a sheet of clear plastic.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's written instruction, applicable requirements of NEC, NECA's "Standard of Installation," NEMA PB1.1, and in accordance with recognized industry practices.
- B. Install flush or surface mounted as specified on drawings and schedules.
- C. Support panel cabinets independently to structure with no weight bearing on conduits.
- D. Install recessed panelboards to allow cover to be drawn tight against wall to provide neat appearance.
- E. Install surface mounted panelboard interior so there is no gap between the panelboard back-box and cover.
- F. Adjacent panel cabinets shall be of same size and mounted in horizontal alignment.
- G. Attach nameplates. Nameplates for panels in public areas shall be attached to the inside face of the cover. Nameplates for panels in equipment rooms and other non-public areas shall be attached to the outside face of the cover.
- H. Install panelboards plumb.
- I. Height: 6 feet to top of panelboard; install panelboards taller than 6 feet with bottom no more than 4 inches above floor.
- J. Install filler plates for unused spaces in panelboards.
- K. Provide typed circuit directory for each branch circuit panelboard. Revise directory to reflect circuiting changes to balance phase loads.
- L. Install engraved plastic nameplates in accordance with Section 26 05 53.
- M. Install spare conduits out of each recessed panelboard to accessible location: (2) 1 inch to above ceiling, (2) 1 inch to floor below. Identify each as SPARE.
- N. Ground and bond panelboard enclosure according to Section 26 05 26. Connect equipment ground bars of panels in accordance with NFPA 70.

3.2 FIELD QUALITY CONTROL

- A. Division 01 - Quality Requirements: Field inspecting, testing, adjusting, and balancing.

3.3 INSPECTION

- A. Examine area to receive new panelboards to assure adequate clearance for installation.
- B. Start work only after unsatisfactory conditions are corrected.
- C. Inspect and test in accordance with NETA ATS, except Section 4.
- D. Perform circuit breaker inspections and tests listed in NETA ATS, Section 7.6.

3.4 ADJUSTING

- A. Adjust doors and operating mechanisms for free mechanical movement.
- B. Tighten lugs and bus connections.
- C. Clean interior of panelboard.
- D. Sand, prime and paint scratched or marred surfaces to match original finish.
- E. Measure steady state load currents at each panelboard feeder; rearrange circuits in panelboard to balance phase loads to within 20 percent of each other. Maintain proper phasing for multi-wire branch circuits.

END OF SECTION

SECTION 26 27 26

WIRING DEVICES

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Wall Switches.
 - 2. Wall Dimmers.
 - 3. Receptacles.
 - 4. Multi-Outlet Assembly.
 - 5. Occupancy Sensors.
 - 6. Device Plates.
 - 7. Decorative Box Covers.

- B. Related Sections:
 - 1. Applicable provisions of Division 01 shall govern all work under this Section.
 - 2. Section 26 05 33 - Raceway and Boxes.
 - 3. Section 26 05 34 - Floor Boxes.
 - 4. Section 26 05 39 – Underfloor Raceway Assemblies.

1.2 REFERENCES

- A. National Electrical Manufacturers Association (NEMA):
 - 1. NEMA WD 1 - General Requirements for Wiring Devices.
 - 2. NEMA WD 6 - Wiring Devices-Dimensional Requirements.

1.3 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum five years documented experience.

PART 2 PRODUCTS

2.1 GENERAL

- A. Provide all wiring device types from a single manufacturer.
 - 1. Use of manufacturer's name and model or catalog number is for purpose of establishing standard of quality and general configuration desired.
 - 2. Substitutions: In accordance with Division 01 - Product Requirements.

- B. Devices and Cover Plate Colors:
 - 1. Coordinate device and cover plate color with final wall finish; verify color with Engineer/Architect before ordering.

2. Unless noted otherwise, receptacles and light switches controlling emergency or critical loads shall be red in color.
 3. Adjustments in device or cover plate color shall be made in field without additional compensation.
- C. Unless otherwise indicated acceptable manufacturers are:
1. Hubbell.
 2. Leviton.
 3. Arrow-Hart, Inc.
 4. Pass & Seymour.
 5. Substitutions: As approved by Engineer/Architect.

2.2 WALL SWITCHES

- A. Switches:
1. Single Pole Switch: 20 amps, 120-277 volt, specification grade, back or side wired equal to Hubbell cat. No. HBL1221.
 2. Double Pole Switch: 20 amp, 120-277 volt, specification grade, back or side wired equal to Hubbell cat. No. HBL1222.
 3. Three-way Switch: 20 amps, 120-277 volt, specification grade, back or side wired equal to Hubbell cat. No. HBL1223.
 4. Four-way Switch: 20 amps, 120-277 volt, specification grade, back or side wired equal to Hubbell cat. No. HBL1224.
 5. Pilot Light (lighted) - Single Pole Switch: 20 amp, 120-277 volt, specification grade, clear polycarbonate toggle, back or side wired equal to Hubbell cat. No. HBL1221ILC.
 6. Keyed Single Pole Switch: 20 amp, 120-277 volt, specification grade, back or side wired equal to Hubbell cat. No. HBL1221L. Provide owner with a minimum of 4 keys for switches.
 7. Momentary Contact Switch: 20 amps, 120-277 volt, specification grade, back or side wired, three positions, center off equal to Hubbell cat. No. HBL1557.
- B. Explosion-Proof: 20 amp, 120-277 volt, UL listed. Provide Appleton Electric Company, EDS type or equal from Crouse Hinds.

2.3 WALL DIMMERS

- A. Manufacturers:
1. Leviton.
 2. Lutron.
 3. Pass & Seymour.
 4. Substitutions: As approved by Engineer/Architect.
- B. Product Description: NEMA WD 1, Type I, semiconductor dimmer with ON-OFF switch independent of brightness setting for incandescent lamps.

- C. Body and Handle: Plastic with linear slide, coordinate color with Engineer/Architect.
- D. Voltage: 120/277 volts.
- E. Power Rating: Dimmers shall be derated 25 percent to allow next size larger lamp to be installed in lighting fixtures controlled by dimmer, 1000 watts minimum.
- F. Accessory Wall Switch: Match dimmer appearance.

2.4 RECEPTACLES

- A. General:
 - 1. Receptacles shall be flush mounted.
 - 2. Receptacles shall have full grounding straps and be suitable for side or side and back wiring.
 - 3. Receptacles shall be Hubbell Nos. listed below or equal by approved manufacturer.
 - 4. Unless noted otherwise, receptacles shall be 125 volt, 2 pole, 3 wire grounding.
- B. Receptacles
 - 1. Single Convenience Receptacle Where a single receptacle is wired to a dedicated 20 ampere: heavy duty, specification grade, 20 amp, 125 volt, NEMA 5-20R Hubbell cat. No. HBL5361.
 - 2. General use Duplex Convenience Receptacle: heavy duty, specification grade, 15 amp, 125 volt, NEMA 5-15R Hubbell cat. No. HBL5262.
 - 3. Duplex Receptacle Where a single duplex receptacle is wired to a dedicated 20 ampere: heavy duty, specification grade, 20 amp, 125 volt, NEMA 5-20R Hubbell cat. No. 5362.
 - 4. Tamper-Resistant: Commercial specification grade, 20 amp Duplex, 125 volt, NEMA 5-20R, Hubbell cat. No. BR20TR.
 - 5. Weather-Resistant: Corrosion resistant heavy duty, specification grade, 20 amp duplex, 125 volt, NEMA 5-20R, HBL53CM62 (Color – Yellow)
 - 6. GFCI Receptacle: heavy duty, specification grade, self-testing, 20 amp, 125 volt, NEMA 5-20R, UL 2006 compliant, Hubbell cat. No. GFST20.
 - 7. Tamper-Resistant GFCI: Heavy duty commercial grade, 20 amp duplex, 125 volt, NEMA 5-20R, UL 2006 compliant, Hubbell cat. No. GFTR20.
 - 8. Weather-Resistant GFCI: Extra heavy duty grade, 20 amp duplex, 125 volt, NEMA 5-20R, UL 2006 compliant, Hubbell cat. No. GFR5362.
 - 9. Hospital Use Receptacle: hospital grade, 20 amp, 125 volt, NEMA 5-20R Hubbell cat. No. HBL8300.
 - 10. Transient voltage surge suppression Receptacle:
 - a. Comply with UL 1449 and 498.
 - b. Damage alarm sounded when surge protection is not functioning. Provide means to turn off alarm.
 - c. LED indicator to indicate suppression circuit is fully functional.

- d. 3 mov's will each be rated 150 volts, 240 joules and 20MM size.
 - e. Specification grade, 20 amp, 125 volt, NEMA 5-20R.
 - f. Hubbell Cat. No. HBL5362.
- 11. Clock receptacle: receptacle, clock hanger, and stainless steel Hubbell Cat. No. HBL5235.
 - 12. Isolated ground duplex receptacle: Orange, heavy duty, specification grade, 20 amp, 125 volt, NEMA 5-20R Hubbell cat. No. IG5362.
- C. Weatherproof Cover Plate: Gasketed die cast metal plate with hinged and gasketed device covers. Cover shall allow cords to be plugged in and cover closed. Provide Intermatic WP1010MC for single duplex receptacles or WP1030MC for double (quad) duplex receptacles.
 - D. Receptacles fed from emergency circuits shall be red.

2.5 SPECIAL PURPOSE OUTLETS

- A. Refer to "Special Outlet Schedule" on Drawings.
- B. Electrical Contractor shall be responsible for coordinating the following items with actual equipment being furnished for the project prior to installation of outlet.
 - 1. Exact location and orientation of outlet. Field coordinate location of outlet with Engineer/Architect's field representative, location shall not be scaled off electrical drawings.
 - 2. Electrical characteristics of equipment, including voltage, phasing, ampacity, etc.
 - 3. Physical characteristics of termination, e.g. receptacle configuration, cord-and-plug versus hard-wired equipment, etc.

2.6 WALL PLATES

- A. Provide wall plates for wiring devices, with ganging and cutouts as indicated and with metal screws for securing plates to devices, screw heads colored to match finish of plate.
- B. Decorative Cover Plate for flush mounted devices: Thermoplastic, nylon, non-combustible, minimum 0.100-inch thick.
- C. Device plates for surface mounted 4 inch square boxes; 1/2-inch raised galvanized steel covers.
- D. Do not use jumbo cover Plates.
- E. Weatherproof Cover Plate: Gasketed die cast metal plate with hinged and gasketed device covers. Cover shall allow cords to be plugged in and cover closed. Provide Intermatic WP1010MC for single duplex receptacles or WP1030MC for double (quad) duplex receptacles.

F. Plates for devices fed from emergency circuits shall be red.

2.7 MULTIOUTLET ASSEMBLY

A. Manufacturers:

1. Wiremold.
2. Hubbell.
3. Panduit.
4. Substitutions: As approved by Engineer/Architect.

B. Multi-outlet Assembly: Sheet metal channel with fitted cover, with pre-wired receptacles, suitable for use as multi-outlet assembly.

C. Size: As indicated on Drawings.

D. Receptacles: Furnish covers and accessories to accept convenience receptacles specified in this Section.

E. Receptacles: NEMA WD 6, type 5-20R, duplex receptacle.

F. Receptacle Spacing: As indicated on Drawings or as required.

G. Receptacle Color: Coordinate with Engineer/Architect.

H. Channel Finish: Ivory enamel.

I. Fittings: Furnish manufacturer's standard couplings, elbows, outlet and device boxes, and connectors.

2.8 OCCUPANCY SENSORS

A. General:

1. Unit shall have convenient means to bypass sensor in case of failure so lighting can be operated manually.
2. Unit shall be provided with readily viable test LED to indicate when sensor detects motion.
3. Sensor sensitivity and time delay shall be adjustable. Time delay shall be adjustable from 1 minute to 30 minutes at a minimum.
4. Unit shall be UL or ETL listed.
5. Unit shall be provided with 3 year warranty.
6. Occupancy sensors may be infrared, ultrasonic or combination type. Chosen manufacturer shall provide optimum technology needed for each space where sensor is shown.

- B. Manufacturers:
 - 1. Watt Stopper.
 - 2. Leviton.
 - 3. MyTech.
 - 4. Hubbell.
 - 5. Substitutions: As approved by Engineer/Architect.

- C. Passive Infrared Wall Switch:
 - 1. Sensor shall use passive infrared detection method for detecting room occupancy. Unit shall fit in/on standard single gang switch box and require only two wires and grounded box for operation.
 - 2. Rated capacity: 600 watts minimum at 120 volts, 60 Hz, 1000 watts minimum at 277 volts, 60 Hz for fluorescent lamps, larger size to accommodate load as shown on Drawings.
 - 3. Switch shall have manual override for positive off.
 - 4. Area of coverage shall be 250 square feet minimum, greater range to accommodate room size as shown on Drawings.
 - 5. Model Watt Stopper: DI Series.

- D. Ceiling-Mounted Dual Technology Occupancy Sensor:
 - 1. Sensor shall employ both infrared and ultrasonic sensing methods to detect room occupancy. Unit shall fit in/on standard octagon box.
 - 2. Rated capacity shall be 20 amps at 120 or 277 volts, for fluorescent lamps.
 - 3. Area of coverage shall be adjustable. Unit shall be provided with dip switch to allow either detection technology to be independently configured.
 - 4. Unit shall be provided with dip switch to select one of five different sensing modes as dictated by environmental factors.
 - 5. Model: Watt Stopper: DT-300.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify outlet boxes are installed at proper height.
- B. Verify wall openings are neatly cut and completely covered by wall plates.
- C. Verify branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.

3.2 PREPARATION

- A. Clean debris from outlet boxes.

3.3 INSTALLATION

- A. Switches controlling equipment operation of which is not evident from switch position shall include pilot light in conjunction with proper switch.
- B. Each switch shall be complete with engraved plate to identify equipment being controlled. Provide black letters on clear background, 1/8-inch high, minimum.
- C. Do not install devices until after wall finishes have been completely applied.
- D. Any outlets installed prior to walls being finished and used for construction power shall be replaced at time of substantial completion.
- E. Install devices and wall plates plumb and level.
- F. Install switches with OFF position down.
- G. Install wall dimmers to achieve full rating specified and indicated after derating for ganging as instructed by manufacturer.
- H. Do not share neutral conductor on load side of dimmers.
- I. Install receptacles with grounding pole on top.
- J. Connect wiring device grounding terminal to outlet box with bonding jumper and branch circuit equipment grounding conductor.
- K. Route continuous green equipment grounding conductor with branch circuit conductors serving isolated ground receptacles. Terminate equipment ground on isolated ground bus in panelboards.
- L. Install emergency switches, which occur adjacent to normal light switches in separate boxes to maintain systems isolation in accordance with NEC.
- M. Install decorative plates on switch, receptacle, and blank outlets in finished areas.
- N. Connect wiring devices by wrapping solid conductor around screw terminal. Install stranded conductor for branch circuits 10 AWG and smaller.
- O. When stranded conductors are used in lieu of solid, use crimp on fork terminals for device terminations. Do not place bare stranded conductors directly under device screws.
- P. Install galvanized steel plates on outlet boxes and junction boxes in unfinished areas, above accessible ceilings, and on surface mounted outlets.
- Q. Do not use terminals on wiring devices (hot or neutral) for feed-through connections, looped

or otherwise make circuit connections via wire connectors and pigtails.

- R. Provide layer of electrical tape around perimeter sides of each wiring device so that terminations are insulated.
- S. Where GFI protected receptacles are indicated on Drawings, each receptacle indicated shall be GFI receptacle. Standard receptacles protected with upstream GFI receptacle shall not be approved.
- T. Provide arc-fault circuit interrupter (AFCI) for Branch Circuits feeding receptacles in dwelling unit bedrooms. AFCI protection may be provided by AFCI receptacle or AFCI device in circuit breaker panel feeding dwelling unit bedrooms.
- U. Multiple or Special Switch Stations:
 - 1. Grouped local switches under common cover plate as scheduled or noted on drawings. Provide pilot lights on all circuits remote from general area or exterior to building. Eight-gang plate maximum - where two plates are required; same shall be equal in size and located one above other. Switch plates shall include engraved, Bakelite nameplate to identify function of each switch. Nameplate shall be screwed in place.
- V. Occupancy Sensors:
 - 1. Install sensors within rooms in accordance with manufacturer's guidelines and recommendations.
 - 2. Infrared sensors shall be placed where they will have direct line of sight to occupied areas.
 - 3. Ultrasonic sensors shall not be placed immediately adjacent to HVAC diffusers. High velocity air movement may result in nuisance tripping of sensor.

3.4 INTERFACE WITH OTHER PRODUCTS

- A. Coordinate locations of outlet boxes provided under Section 26 05 33 – Raceway and Boxes to obtain mounting heights as indicated on Drawings.
- B. Coordinate installation of wiring devices with floor box service fittings provided under Section 26 05 34 – Floor Boxes.

3.5 FIELD QUALITY CONTROL

- A. Division 01 – Quality Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Inspect each wiring device for defects.
- C. Operate each wall switch with circuit energized and verify proper operation.

- D. Verify each receptacle device is energized.
- E. Test each receptacle device for proper polarity.
- F. Test each GFCI receptacle device for proper operation.
- G. Occupancy Sensors:
 - 1. Sensitivity Test: After sensor has been energized for at least 15 minutes, walk to middle of room (if conference room) or sit at normal desk position (if office). Make no motion for 20 seconds. Move one arm up and down slowly. Test LED should blink.
 - 2. Time Delay Test: Set time delay for 10 minutes. Walk into room to activate sensor, then leave room. Sensor must turn lights off at approximately 10 minutes.
- H. If device fails to properly operate, replace at no extra charge to Owner:

3.6 ADJUSTING

- A. Devices and face plates on common wall with common mounting heights shall be level and square to each other. Adjustments required after installation shall be made without additional compensation.
- B. Mark conductors with panel and circuit number serving device, at device.
- C. Mark panel and circuit number serving device on backside of device plate with permanent marking system that does not show through front of plate.

3.7 CLEANING

- A. Clean exposed surfaces to remove splatters and restore finish.

END OF SECTION

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SECTION 26 28 19

ENCLOSED SWITCHES

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Fusible and Non-fusible switches.
- B. Related Sections:
 - 1. Applicable provisions of Division 01 shall govern all work under this Section.
 - 2. Section 26 00 00 – Basic Electrical Requirements.
 - 3. Section 26 28 13 - Fuses.

1.2 REFERENCES

- A. National Electrical Manufacturers Association (NEMA):
 - 1. NEMA FU 1 - Low Voltage Cartridge Fuses.
 - 2. NEMA KS 1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).
- B. International Electrical Testing Association (NETA):
 - 1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

1.3 SUBMITTALS

- A. Division 01 - Submittal Procedures: Procedures for submittals.
- B. Product Data: Submit switch ratings and enclosure dimensions.

1.4 CLOSEOUT SUBMITTALS

- A. Division 01 – Execution Requirements: Procedures for closeout submittals.
- B. Project Record Documents: Record actual locations of enclosed switches and ratings of installed fuses.

1.5 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum five years experience.

PART 2 PRODUCTS

2.1 FUSIBLE SWITCH ASSEMBLIES

- A. Manufacturers:
 - 1. Square D.
 - 2. Cutler Hammer/Westinghouse.
 - 3. Siemens.
 - 4. General Electric.
 - 5. Substitutions: In accordance with Division 01 - Product Requirements.
- B. Product Description: NEMA KS 1, Type HD with externally operable handle interlocked to prevent opening front cover with switch in ON position, enclosed load interrupter knife switch. Provide means to temporarily override interlock and allow door to be opened with switch on.
- C. Fuse clips: Designed to accommodate NEMA FU 1, Class R fuses.
- D. Enclosure: NEMA KS 1, to meet conditions. Fabricate enclosure from steel finished with manufacturer's standard gray enamel.
 - 1. Interior Dry Locations: Type 1.
 - 2. Exterior Locations: Type 3R.
 - 3. Wet Locations: Type 4.
- E. Service Entrance: Switches identified for use as service equipment are to be labeled for this application. Furnish solid neutral assembly and equipment ground bar.
- F. Furnish switches with entirely copper current carrying parts.
- G. Provide ANSI/UL Class RK1, dual element, time delay, 600 volt fuses in disconnect switches, sized as shown on drawings.
- H. Quick make and break operator mechanism.
- I. Handle attached to box, not cover.
- J. Handle position indication, ON in up position and OFF in down position.
- K. Padlock provisions for up to three padlocks in OFF position.
- L. UL listed lugs for type and size of wire specified.
- M. Spring reinforced fuse clips for Type R fuses.
- N. Provisions for insulated or grounded neutral.

2.2 NONFUSIBLE SWITCH ASSEMBLIES

- A. Manufacturers:
 - 1. Square D.
 - 2. Cutler Hammer/Westinghouse.
 - 3. Siemens.
 - 4. General Electric.
 - 5. Substitutions: In accordance with Division 01 - Product Requirements.
- B. Product Description: NEMA KS 1, Type HD with externally operable handle interlocked to prevent opening front cover with switch in ON position enclosed load interrupter knife switch. Provide means to temporarily override interlock and allow door to be opened with switch on.
- C. Enclosure: NEMA KS 1, to meet conditions. Fabricate enclosure from steel finished with manufacturer's standard gray enamel.
 - 1. Interior Dry Locations: Type 1.
 - 2. Exterior Locations: Type 3R.
 - 3. Wet Locations: Type 4.
- D. Service Entrance: Switches identified for use as service equipment are to be labeled for this application. Furnish solid neutral assembly and equipment ground bar.
- E. Furnish switches with entirely copper current carrying parts.
- F. Quick make and break operator mechanism.
- G. Handle attached to box, not cover.
- H. Handle position indication, ON in up position and OFF in down position.
- I. Padlock provisions for up to three padlocks in OFF position.
- J. UL listed lugs for type and size of wire specified.
- K. Provisions for insulated or grounded neutral.

2.3 SWITCH RATINGS

- A. Switch Rating: Horsepower rated for AC or DC as indicated on Drawings.
- B. Short Circuit Current Rating: UL listed for 200,000 rms symmetrical amperes when used with or protected by Class R fuses (30-600 ampere switches employing appropriate fuse rejection schemes).

PART 3 EXECUTION

3.1 INSTALLATION

- A. Provide disconnect switches for loads as required by code. Review HVAC and Plumbing specifications to determine what equipment is furnished with disconnect switches.
- B. Install all disconnect switches whether furnished under this contract.
- C. Electrical Contractor shall determine need for a disconnect switch requirements for each specific load.
- D. Contractor shall include in their bid all disconnect switches required whether indicated on the drawings or not.
- E. Install enclosed switches plumb.
- F. Height: 5 feet to operating handle.
- G. Install fuses for fusible disconnect switches. Refer to Section 26 28 13 for product requirements.
- H. Install engraved plastic nameplates in accordance with Section 26 05 53.
- I. Apply adhesive tag on inside door of each fused switch indicating NEMA fuse class and size installed.
- J. Install in accordance with manufacturer's written instructions, applicable requirements of NEC and NECA's "Standard of Installation," and in accordance with recognized industry practices.
- K. Locate disconnect switches as shown on drawings or as required by NEC.
- L. Install on equipment support where feasible, or anchor firmly to wall or structural surface.
- M. Provide control circuit interlock as required by NEC.

3.2 ADJUSTMENT

- A. Adjust covers and operating mechanism for free mechanical movement.
- B. Verify overcurrent protection to provide proper operation and compliance with NEC.
- C. Tighten wire and cable connections.
- D. Clean interior of enclosure.

E. Touch up scratched or marred surfaces to match original finish.

3.3 FIELD QUALITY CONTROL

A. Division 01 - Quality Requirements: Field inspecting, testing, adjusting, and balancing.

B. Inspect and test in accordance with NETA ATS, except Section 4.

C. Perform inspections and tests listed in NETA ATS, Section 7.5.

END OF SECTION

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SECTION 26 29 33

MOTOR WIRING

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Connections and wiring to motors.
- B. Related Sections:
 - 1. Applicable provisions of Division 01 shall govern all work under this Section.
 - 2. Section 26 00 00 – Basic Electrical Requirements.
 - 3. Section 26 05 19 - Building Wire and Cable.
 - 4. Section 26 05 26 - Grounding and Bonding.
 - 5. Section 26 05 53 - Electrical Identification.
 - 6. Section 26 28 19 - Enclosed Switches.

1.2 REFERENCES

- A. National Fire Protection Association (NFPA):
 - 1. NFPA 70 - National Electric Code.

1.3 QUALITY ASSURANCE

- A. Installation shall conform to the requirements of the following agencies:
 - 1. National Electrical Code (NEC).
 - a. Including State of Wisconsin and local supplements.
 - 2. National Electrical Contractors Association (NECA).
 - a. NECA - Standard of Installation.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.1 GENERAL

- A. Motor starters shall be furnished by Contractor supplying motor requiring a starter.
- B. Drawings show anticipated horsepower loads and circuit sizes. Loads and circuit sizes shall be used as a guide to provide final performance requirements. Verify actual requirements with Contractor and install accordingly under this Contract.

- C. Contractor to verify, and correct if necessary, if heater elements in starters match installed motor characteristics.
- D. Contractor shall check drawings and specifications of other trades to determine requirements for motor disconnect switches. In each case, Contractor shall install all required disconnect switches.
- E. Contractor shall provide, where required by Code and for motors out of sight of controller, all disconnect switches not specifically supplied by others.
- F. Unless otherwise indicated on drawings or elsewhere in these specifications, all motors shall be furnished by others.
- G. Motors shall be set in place by others and associated motor starters and controllers shall be turned over to Electrical Contractor for installation.
- H. Contractor supplying starters and controllers shall index same and provide Electrical Contractor with written instructions as to proper location in sufficient time to permit installation of a concealed raceway system.
- I. Control wiring shall be responsibility of HVAC Contractor. Electrical Contractor shall extend circuit to control transformers and make final 120V transformer connections. Transformers will be supplied by HVAC Contractor. Control transformer shall be in starter enclosure.
- J. Review HVAC and plumbing specifications and provide all line voltage wiring and connections to controls and auxiliary equipment specified as to be provided by Electrical Contractor or Division 26.
- K. On motor wiring schedule, column stating “starter wiring” refers to line voltage wiring from starter to motor.
- L. Final conduit connection to motor shall be made with liquid-tight flexible metal conduit or flexible metal conduit, except where prohibited by any other section of these specifications.
- M. All conductors serving motors shall be stranded.
- N. Install a separate green equipment grounding conductor, with circuit conductors, to all motors.
- O. Verify proper rotation of each motor as it is being wired or before motor is energized for any reason.

END OF SECTION

SECTION 26 51 00

INTERIOR LIGHTING

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Interior Luminaires.
 - 2. Interior Lamps.
 - 3. Ballasts.
 - 4. Fluorescent Emergency Ballasts.
 - 5. Exit Signs.
 - 6. Emergency Battery Units.
 - 7. Accessories.

- B. Related Sections:
 - 1. Applicable provisions of Division 01 shall govern all work under this Section.
 - 2. Section 26 00 00 – Basic Electrical Requirements.

1.2 REFERENCES

- A. American National Standards Institute (ANSI):
 - 1. ANSI C82.1 - Electric Lamp Ballast-Line Frequency Fluorescent Lamp Ballast.
 - 2. ANSI C82.4 - Ballasts-for High-Intensity-Discharge and Low-Pressure Sodium Lamps (Multiple-Supply Type).

1.3 SUBMITTALS

- A. Division 01 - Submittal Procedures: Procedures for submittals.

- B. Shop Drawings:
 - 1. Include outline drawings, catalog cut sheets, lamp and ballast data, support points, weights, accessory information, and performance data for each luminaire type.
 - 2. For all luminaries with paint color or finish options, include single color original of manufacturers color or finish choices for Architects review.

- C. Product Data: Submit dimensions, ratings, and performance data.

- D. Record Drawings: For installations utilizing remotely mounted low voltage transformers, Electrical Contractor shall provide set of record drawings indicating location of installed transformers to facilitate future maintenance.

- E. Samples: Submit two color chips 3 x 3 inch in size illustrating luminaire finish color where indicated in luminaire schedule.

1.4 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum five years documented experience.

PART 2 PRODUCTS

2.1 GENERAL – INTERIOR LIGHTING

- A. Furnish all labor, materials, tools, equipment, and services for all interior lighting, as indicated, in accordance with provisions of Contract Documents.
- B. Completely coordinate with work of all other trades.
- C. Although such work is not specifically indicated, furnish and install all supplementary or miscellaneous items, appurtenances and devices incidental to or necessary for sound, secure and complete installation.

2.2 INTERIOR LUMINAIRES

- A. Subject to compliance with requirements, fixtures that may be incorporated into work include products specified in lighting fixture schedule on Drawings, and equals listed in accompanying notes.
- B. Basic catalog number only is indicated in lighting fixture schedule. Electrical Contractor shall furnish complete lighting fixtures in quantities, and row lengths as shown on Drawings, including plaster frames, ends, or caps, couplings, connectors, suspension assemblies, mounting brackets and all auxiliary accessories as required.
- C. Reference schedule for description of fixture nomenclature and associated ceiling type and suspension system.
- D. Housing:
 - 1. Shall be free from burrs, sharp corners and edges.
 - 2. Shall be steel, unless noted otherwise, formed and supported to prevent warping and sagging.
 - 3. Provide spring loaded latches for all troffers.
- E. Mounting Accessories:
 - 1. Recessed fixtures:
 - a. Provide trim type and accessories required for installation in ceiling types specified shown on reflected ceiling plan.
 - b. Fixtures mounted in sloped ceilings shall be provided with sloped ceiling adapters and appropriate trim rings and other accessories as required.
 - 2. Surface mounted fixtures: Provide ceiling spacers as required for fixtures not labeled as suitable for direct mounting to a low density ceiling.

3. Suspended fixtures:
 - a. Provide swivel canopy to accommodate any sloped ceilings shown on plans.
 - b. Provide pendant or cable length required to suspend luminaries at indicated height.
 - c. Swivel hangers in mechanical equipment areas shall be shock absorbing type.

- F. Finishes:
 1. Painted finishes shall be polyester powder painted enamel finish, and painted after fabrication unless noted otherwise.
 2. Polished, brushed or other metal finishes shall be finished with clear coat to inhibit finish deterioration and corrosion.
 3. Finish types and colors shall be verified with Architect/Engineer prior to ordering.

- G. Louvers, Reflectors, Lenses:
 1. Louvers and reflectors shall be semi-specular, low iridescent, clear alzak, unless noted otherwise.
 2. Parabolic louver depth shall have minimum actual dimension of 3 inches, unless noted otherwise.
 3. Acrylic lenses shall be pattern 12 prismatic, overall 0.125 inch minimum thickness.

2.3 FLUORESCENT BALLASTS

- A. Manufacturers:
 1. Advance Transformer.
 2. Universal.
 3. Osram/Sylvania.
 4. Substitutions: As approved by Engineer.

- B. Product Description: Electronic ballast, Program Start, suitable for lamps specified, with universal input voltage that will accept any line voltage between 120-277 volts, unless noted as 480 volt on drawings.

- C. Fluorescent ballasts shall be electronic type, unless noted otherwise, and shall meet the following standards:
 1. UL Listed (Class P) Sound Rating A and CSA certified.
 2. Comply with EMI and RFI limits set by FCC (CFR 47 part 18) or NEMA and not interfere with normal electrical equipment.
 3. Meet applicable standards designated by ANSI.
 4. Be potted or conformal coated in metallic case and not contain PCB's.
 5. Provide normal rated lamp life as stated by lamp manufacturers with rated life at 3 hour burn time for each start.

- D. Compact fluorescent ballasts shall be electronic type, unless noted otherwise, and shall meet the following requirements, in addition to those listed above:

1. Provide with ballast shut-off circuit for protection of ballast at end of lamp life.
- E. Nominal power factor of 0.95 or higher.
 - F. Total harmonic distortion of less than 10 percent at 120 or 277 volts.
 - G. Ballast factor 0.85 or better.
 - H. Frequency of operation shall be 20 khz – 50 khz and units shall operate without visible flicker.
 - I. Operating temperature shall not exceed 65 degrees C at any point on case at 40 degree C ambient.
 - J. Ballasts shall carry minimum three (3) year warranty covering replacement parts and labor for life of warranty.
 - K. Ballasts shall be marked with manufacturer's name, part number, supply voltage, power factor, open circuit voltage, current draw for each lamp type and UL Listing.
 - L. Ballasts shall withstand line transients as defined in IEEE 587, Category A.
 - M. Fluorescent ballasts, other than electronic type, shall only be used where specifically noted on Drawings, shall be of High Power Type, CBM and ETL Certified, Best Energy Saving Type and Sound Rated where available.
 - N. Luminaires located within same room shall be tandem wired, masterslave, or provided with three (3) lamp ballasts in following areas:
 1. One (1) lamp or three (3) lamp fluorescent luminaires recess mounted within ten (10) feet center-to-center of each other.
 2. One (1) lamp or three (3) lamp fluorescent luminaires pendant or surface mounted within one (1) foot edge-to-edge of each other.

2.4 HIGH INTENSITY DISCHARGE (HID) BALLASTS

- A. Built in, automatically resetting thermal protector which disconnects ballast from power line in event of over heating.
- B. Provide F-Can ballast to minimize sound level. F-Can ballast are encased in fluorescent ballast type cans and potted with asphalt or polyester insulating material to minimize noise.
- C. Temperature Rating:
 1. For fixtures installed within conditioned spaces rating shall be 104 degrees F.
 2. For fixtures installed within non-conditioned spaces rating shall be 131 degrees F.
- D. HID ballasts shall be provided with three (3) year warranty.

- E. HID ballasts Class A noise rating up through 175 watts and Class B for 250 and 400 watts.

2.5 FLUORESCENT DIMMING BALLASTS AND CONTROLS

A. Manufacturers:

- 1. Advanced.
- 2. Lutron.
- 3. Universal.
- 4. Osram/Sylvania
- 5. Substitutions: As approved by Engineer.

B. Ballast: Selected by dimming system manufacturer as suitable for operation with control unit, suitable for lamp type and quantity specified for luminaire, and as follows:

- 1. Continuous flicker free dimming from 100 to 10 percent.
- 2. Low voltage 0-10VDC control technology.
- 3. Operate at voltage listed in light fixture schedule.
- 4. Programmed start design will preheat lamp cathodes before applying full arc voltage.
- 5. Lamps turn on to any dimmed level without flashing to full brightness.
- 6. Less than 10 percent total harmonic distortion when operated at nominal line voltage.
- 7. Frequency of operation ensures that ballast does not interfere with infrared devices operating between 38 and 42 kHz.
- 8. Inrush current limiting circuitry eliminates circuit breaker tripping, switch arcing, and relay failure.
- 9. Ballasts maintain consistent light output for different lamp lengths with no lamp flickering.
- 10. Class A sound rating.
- 11. 100 percent compatible with controls provided for dimming system.
- 12. Three (3) year standard warranty system commissioning from factory trained representative.
- 13. Dimming range: 100 to 10 percent measured relative light output.
- 14. Lamp current crest factor: Less than 1.7.
- 15. Lamp life shall meet or exceed rating when used with ballast.
- 16. Ballast factor greater than 0.85.
- 17. Power factor greater than 0.95.
- 18. Sound rating: Inaudible in 27dBa ambient.

2.6 LAMPS

A. General – Lamps:

- 1. Lamps shall be provided new.
- 2. Approved manufacturers;
 - a. Fluorescent:
 - 1) Philips.
 - 2) Osram/Sylvania.
 - 3) General Electric.

- 4) Substitutions: As approved by Engineer.
- b. HID:
 - 1) Venture.
 - 2) Philips.
 - 3) Osram/Sylvania.
 - 4) General Electric.
 - 5) Substitutions: As approved by Engineer.
- c. Incandescent:
 - 1) Philips.
 - 2) Osram/Sylvania.
 - 3) General Electric.
 - 4) Substitutions: As approved by Engineer.
- d. Low-Voltage:
 - 1) Philips.
 - 2) Osram/Sylvania.
 - 3) General Electric.
 - 4) Ushio.
 - 5) Substitutions: As approved by Engineer.

B. Fluorescent:

- 1. Color temperature: 3,500K unless noted otherwise.
- 2. Minimum Color Rendering Index (CRI): 85 unless noted otherwise.
- 3. Non-compact lamps:
 - a. Lamp life: Minimum 20,000 hours average based on three hours per start when used on rapid start circuits.
 - b. Lamps shall be 32 watt, T8, minimum 2,900 lumens initial, rapid start, unless noted otherwise.
 - c. Lamps shall meet EPA TCLP standards for disposal as non-hazardous waste.
- 4. Compact Fluorescent:
 - a. Lamp life: Minimum 10,000 hours average based on three hours per start.
 - b. Lamps shall be four pin type, unless noted otherwise.

C. HID:

- 1. High Pressure Sodium.
 - a. Suitable for all burning positions.
 - b. Phosphors coated or clear as scheduled.
- 2. For open metal halide fixtures, provide only ANSI Type "O" metal halide lamps.
- 3. Metal halide lamps shall be pulse start type.

2.7 FLUORESCENT EMERGENCY BALLASTS

A. Manufacturers:

- 1. Bodine.
- 2. Iota.

3. Substitutions: As approved by Engineer.
- B. Fluorescent emergency ballasts shall be compatible with electronic, standard, energy saving, and dimming AC ballasts.
- C. Fluorescent emergency ballasts shall be UL Listed for factory or field installation inside, on top of, or remote from fixture.
- D. Fluorescent emergency ballasts shall operate the following lamps:
 1. T8 lamps: Two (2) F32T8 lamps at 1,350 lumens for minimum of 90 minutes.
 2. Quad tube: Two (2) F18DBX or two F26DBX at 3,500 lumens for minimum of 90 minutes.
 3. Triple tube: Two (2) F32TBX or two F42TBX at 3,500 lumens for minimum of 90 minutes.
- E. Fluorescent emergency ballasts shall have minimum five (5) year warranty.
- F. Provide ballast with test switch in fixture or with remote test switch flush mounted in ceiling or on wall at location acceptable to Engineer/Architect.

2.8 EXIT SIGNS

- A. Exit signage shall have 6-inch high lettering meeting code and standard requirements of federal, state, and local jurisdictions where project is located.
- B. Provide directional arrows as indicated and required by authorities having jurisdiction.
- C. Provide mounting accessories as required to back, end, pendant, or top mount in accordance with project requirements.
- D. Provide with internal, pre-wired Nicad battery backup unless noted otherwise in light fixture schedule.
- E. Exit signage shall be modular design, facilitating replacement of individual parts.
- F. Exit signage shall be illuminated by LED's, unless noted otherwise in light fixture schedule.
- G. Provide exit signs with internal battery backup with integral test switch.

2.9 EMERGENCY BATTERY UNITS

- A. Shall have two (2) MR-16 lamp heads, minimum 12 watts per lamp, or as indicated in light fixture schedule.
- B. Provide internal, pre-wired lead acid battery, unless noted otherwise.

- C. Provide test switch and LED to indicate proper operation.
- D. As noted on Drawings or schedules, each fixture shall be provided with time delay circuit to keep emergency lighting on for user selected amount of time after normal power is restored.

2.10 MAINTENANCE MATERIALS

- A. Division 01 – Execution Requirements: Spare parts and maintenance products.
- B. Furnish two of each plastic lens type.
- C. Furnish six replacement lamps for each lamp installed.
- D. Furnish two of each ballast type.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install suspended luminaires using pendants supported from swivel hangers. Install pendant length required to suspend luminaire at indicated height.
- B. Support luminaires larger than 2 x 4 foot size independent of ceiling framing.
- C. Locate recessed ceiling luminaires as indicated on Drawings. Coordinate all discrepancies between lighting and reflected ceiling plans with architect.
- D. Install surface mounted luminaires plumb and adjust to align with building lines and with each other. Secure to prevent movement.
- E. Install recessed luminaires using accessories and firestopping materials to meet regulatory requirements for fire rating.
- F. Install earthquake clips to secure recessed grid-supported luminaires in place.
- G. Install wall-mounted luminaires at height as indicated on Drawings.
- H. Install accessories furnished with each luminaire.
- I. Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within luminaire.
- J. Install specified lamps in each luminaire.
- K. Electrical Contractor shall check Structural Drawings, architectural reflected ceiling plans, General Construction Drawings and Mechanical Drawings to verify construction and type of surface on or in which lighting fixtures are installed, for ceiling construction proper type of

suspended ceiling and space above same and possible conflicts with equipment of other trades.

1. Determine specific ceiling construction including ceiling materials and ceiling suspension system in each area where suspended ceiling is to be provided.
2. Verify suspended ceiling type with ceiling contractor prior to releasing lighting fixtures for delivery.
3. Furnish fixture of type scheduled complete with accessories necessary to make installation accordance with manufacturer's recommendations including plaster frames, couplings and connectors, suspension assemblies mounting brackets and other auxiliary equipment.

L. Bond fixtures and metal accessories to branch circuit equipment grounding conductor.

M. Fixture Connections:

1. Surface and wall recessed fixtures shall be connected directly to junction box or solid conduit.
2. Ceiling recessed fixtures shall be connected to flexible metal conduit, originating at solidly supported J-Box.
3. Flexible metal conduit shall be minimum 3/8 inch diameter. Conduit length shall allow movement of fixture for maintenance purposes.
4. Minimum wire size shall be #12 AWG.

N. Provide box-outs and other accessories around recessed fixtures as required to maintain fire ratings for spacing required from insulation in ceiling space. Final installation shall meet regulatory requirements and manufacturer's recommendations.

O. Contractor shall verify exit signs are provided and visible along all exit paths shown on Architectural Life Safety Plan.

3.2 FIELD QUALITY CONTROL

- A. Operate each luminaire after installation and connection.
- B. Inspect for proper connection and operation.

3.3 ADJUSTING

- A. Aim and adjust luminaires as indicated on Drawings and adjust as directed by designated Owner personnel.

3.4 CLEANING

- A. Remove dirt and debris from enclosures.
- B. Clean photometric control surfaces as recommended by manufacturer.

C. Clean finishes and touch up damage.

3.5 PROTECTION OF FINISHED WORK

A. Division 01 - Quality Requirements: Protecting finished work.

B. Relamp luminaires having failed or noticeable dim lamps at Substantial Completion.

END OF SECTION

SECTION 26 56 00

EXTERIOR LIGHTING

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes
 - 1. Exterior Luminaries.
 - 2. Poles.
 - 3. Accessories.
- B. Related Sections
 - 1. Applicable provisions of Division 01 shall govern all work under this Section.
 - 2. Section 26 00 00 – Basic Electrical Requirements.

1.2 REFERENCES

- A. American National Standards Institute (ANSI):
 - 1. ANSI C82.1 - Electric Lamp Ballast-Line Frequency Fluorescent Lamp Ballast.
 - 2. ANSI C82.4 - Ballasts-for High-Intensity-Discharge and Low-Pressure Sodium Lamps (Multiple-Supply Type).
 - 3. ANSI O5.1 - Wood Poles, Specifications and Dimensions.

1.3 SUBMITTALS

- A. Division 01 - Submittal Procedures: Procedures for submittals.
- B. Shop Drawings: Indicate dimensions and components for each luminaire not standard Product of manufacturer.
- C. Product Data: Submit dimensions, ratings, and performance data.
- D. Samples: Submit two color chips 3 x 3 inch in size illustrating luminaire finish color where indicated in luminaire schedule.

1.4 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum five years experience.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store and protect products under provisions of Division 01 - Product Requirements.
- B. Store and handle solid wood poles in accordance with ANSI O5.1.

1.6 COORDINATION

- A. Furnish bolt templates and pole mounting accessories to installer of pole foundations.

1.7 MAINTENANCE MATERIALS

- A. Division 01 – Execution Requirements: Spare parts and maintenance products.
- B. Furnish two of each lamp installed.
- C. Furnish two gallons of touch-up paint for each different painted finish and color.
- D. Furnish two ballasts of each lamp type installed.

PART 2 PRODUCTS

2.1 LUMINARIES

- A. Product Description: Complete exterior luminaire assemblies, with features, options, and accessories as scheduled.
- B. Substitutions: In accordance with Division 01 - Product Requirements: Requirements for product options.

2.2 FLUORESCENT BALLASTS

- A. Manufacturers:
 - 1. Cooper Industries Inc.
 - 2. Duro-Test Corp.
 - 3. General Electric Co.
 - 4. Hubbell Lighting.
 - 5. Magnetek Inc.
 - 6. Pass & Seymour.
 - 7. Philips Electronics North America.
 - 8. Thomas Industries, Inc.
 - 9. Substitutions: In accordance with Division 01 - Product Requirements.
- B. Product Description: High-power-factor type electromagnetic ballast certified by Certified Ballast Manufacturers, Inc. to comply with ANSI C82.1, suitable for lamps and environmental conditions specified, with voltage to match luminaire voltage.

2.3 HIGH INTENSITY DISCHARGE (HID) BALLASTS

- A. Manufacturers:
 - 1. Duro-Test Corp.
 - 2. General Electric Co.

3. Philips Electronics North America
4. Radiant Lamp Co.
5. Siemens Corp.
6. Venture Lighting International Inc.
7. Substitutions: In accordance with Division 01 - Product Requirements.

B. Product Description: ANSI C82.4, metal halide lamp ballast, suitable for lamp and environmental conditions specified, with voltage to match luminaire voltage.

2.4 FLUORESCENT LAMPS

A. Manufacturers:

1. Duro-Test Corp.
2. General Electric Co.
3. Hubbell Inc.
4. Philips Electronics
5. Siemens Corp.
6. Substitutions: In accordance with Division 01 - Product Requirements.

2.5 HID LAMPS

A. Manufacturers:

1. Duro-Test Corp.
2. General Electric Co.
3. Philips Electronic North America
4. RCS Industries North America
5. Siemens Corp.
6. Substitutions: In accordance with Division 01 - Product Requirements.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify foundations are ready to receive fixtures.

3.2 INSTALLATION

- A. Install concrete bases for lighting poles at locations as indicated on Drawings, in accordance with Division 03.
- B. Install poles plumb. Install double nuts to adjust plumb. Grout around each base.
- C. Install lamps in each luminaire.
- D. Bond and ground luminaries, metal accessories and metal poles in accordance with Section 26 05 26. Install supplementary grounding electrode at each pole.

3.3 FIELD QUALITY CONTROL

- A. Division 01 - Quality Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Operate each luminaire after installation and connection. Inspect for improper connections and operation.
- C. Measure illumination levels to verify conformance with performance requirements.
- D. Take measurements during night sky, without moon or with heavy overcast clouds effectively obscuring moon.

3.4 ADJUSTING

- A. Division 01 - Quality Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Aim and adjust luminaries to provide illumination levels and distribution as indicated on Drawings.

3.5 CLEANING

- A. Division 01 - Quality Requirements: Final cleaning.
- B. Clean photometric control surfaces as recommended by manufacturer.
- C. Clean finishes and touch up damage.

3.6 PROTECTION OF FINISHED WORK

- A. Division 01 - Quality Requirements: Protecting finished work.
- B. Relamp luminaries having failed lamps at Substantial Completion.

END OF SECTION

SECTION 28 31 00

FIRE DETECTION AND ALARM SYSTEM

PART 1 GENERAL

1.1 SUMMARY

- A. Work covered by this specification section of includes furnishing of all labor, equipment, materials, and performance of all operations associated with installation of Fire Alarm Systems as shown on drawings and as herein specified. In general, work consists of: Furnish and install complete Multiplex/Intelligent Fire Alarm System in **DANE COUNTY WASTE TRANSFER STATION AND HOUSE HOLD HAZARDOUS WASTE FACILITY RODEFELD LANDFILL** as described herein and as shown on drawings; to be wired, connected, and left in first class operating condition. Include sufficient control panels, annunciator panels, manual stations, automatic heat detectors, smoke detectors, alarm indicating appliances, terminations, electrical boxes, and all other necessary material for complete operating systems.
- B. **DESCRIBE IN DETAIL THE SCOPE OF WORK** if this section is not complete, the specifications will be rejected at review time.
- C. Related Sections:
1. Applicable provisions of Division 1 shall govern all work under this section.
 2. Section 08710 - Door Hardware: Door closers, electric locks, electric releases.
 3. Section 13800 - Building Automation and Control.
 4. Section 13930 - Wet-Pipe Fire Suppression Sprinklers: Flow detection and alarm devices.
 5. Section 13935 - Dry-Pipe Fire Suppression Sprinklers: Flow detection and alarm devices.
 6. Section 13950 - Deluge Fire Suppression Sprinklers: Flow detection and alarm devices.
 7. Section 13975 - Standpipes and Hoses: Flow detection and alarm devices.
 8. Section 15820 - Duct Accessories: Smoke dampers.
 9. Section 16123 - Building Wire and Cable.

1.2 REFERENCES

- A. Complete fire alarm installation shall conform to applicable sections of Codes and Standards as follows:
- B. National Fire Protection Association (NFPA):
1. NFPA - 70 - National Electrical Code (NEC) generally, and Article 760 in particular.
 2. NFPA 72 - Local Protective Signaling Systems.
Auxiliary Signaling Systems

Remote Station Systems
Proprietary Signaling Systems
Automatic Fire Detectors
Testing Procedures for Local, Auxiliary, Remote Station, and Proprietary Protective Signaling Systems.

3. NFPA-90A - Installation of Air Conditioning and Ventilating Systems
4. NFPA - 101 - Life Safety Code.

C. State of Wisconsin Codes (COMM).

D. National Electrical Manufacturer's Association (NEMA).

E. Underwriters' Laboratories, Inc. (UL):

1. UL-38 Manually Actuated Signaling Boxes.
2. UL-217 Smoke Detectors for Single and Multiple Stations.
3. UL-268 Smoke Detector for Fire Protective Signaling Systems.
4. UL-464 Audible Signaling Appliances.
5. UL-521 Heat Detectors for Fire Protective Signaling Systems.
6. UL-864 Control Units for Fire Protective Signaling Systems.
7. UL-1481 Power Supplies for Fire Protective Signaling Systems.
8. UL-1971 Visual Signaling Appliances.

1.3 SUBMITTALS

A. Division 1 - Submittal Procedures: Procedures for submittals.

B. Prior to programming system, submit list of all device addresses with location labeling as they will appear in 2 line, 40 character display of fire alarm panel & annunciator. This list will be modified as needed by Owner and returned to Contractor for final programming in to system.

C. Standby battery power calculations, showing current draws for every device and module during standby and alarm and trouble conditions.

D. Submit following information for approval prior to ordering any equipment in accordance with requirements of Division 1, General Conditions.

1. Manufacturer's catalog specification cuts and printed descriptive literature on all components being provided.
2. Bill of materials listing part number and quantity of all components and devices.
3. Description of operations of all functions of system.
4. Type of system and required modules to make up system.
5. Component and module wiring diagrams.
6. Block diagrams showing layout and operation of entire system.
7. Schematic drawings, specific to this project only, of all circuits from field devices to

required terminal strip(s) associated with control panel.

- a. Diagrams shall show schematic wiring of equipment; and all connections to be made to devices.
- b. Terminal connections in equipment shall be numbered to correspond to diagrams for use in making connections.
- c. Wiring diagrams shall be coordinated so that terminal numbering, circuit designation and equipment or device designations are same on all drawings.
- d. All drawings must be submitted and approved by Engineer before ordering or fabrication starts, but such approval will not waive any specification requirements unless specifically stated.

1.4 CLOSEOUT SUBMITTALS

- A. Division 01 - Execution Requirements: Closeout procedures.
- B. Project Record Documents:
 1. Contractor shall submit record drawings for entire work done under this project prior to final payment. These drawings shall show:
 - a. Locations and addresses of alarm initiation devices, audio and visual devices, status monitoring devices, supervised signaling devices, and auxiliary controls devices.
 - b. Conduit layout and size.
 - c. Number/size/type of conductors.
 - d. System riser diagrams.
 - e. Location of end-of-line devices.
 - f. List of custom labels as installed for each initiating device address.
 2. Riser diagrams shall include location of emergency 120VAC panel, panel designation and circuit number used to feed the fire alarm panel. Also, indicate if panel is backed up by emergency generator.
 3. Riser diagrams shall include locations of devices (indicating & initiating) and initiating devices addresses.
- C. Operation and Maintenance Data: Submit manufacturer's standard operating and maintenance instructions.
 1. All maintenance and operating instructions shall be provided by Contractor for system.
 2. These manuals shall include material guide, which shall contain replacement part numbers and description of all components used. If this information is included in instruction section for any of equipment, it will not be necessary to duplicate list. In either case, parts list shall be associated with its respective chassis, modules or kit wherein it is found.
 3. Total listing of parts without such grouping will not be acceptable. In addition, specific operating instruction for each panel shall be framed and posted next panel.

1.5 QUALIFICATIONS

- A. Each and all items of fire alarm system shall be listed as product of SINGLE fire alarm system manufacturer under appropriate category by Underwriters' Laboratories, Inc. (UL), and shall bear UL label.
- B. All equipment shall be supplied by company specializing in fire alarm and smoke detection systems with five (5) years documented experience. Company shall be authorized distributor of proposed equipment.
- C. All work shall be performed by licensed Contractor regularly engaged in installation and servicing of fire alarm systems. Proof of five (5) years documented experience and of factory authorization to furnish and install equipment proposed shall be furnished prior to contract award, if required by Engineer Owner.
- D. Contractor shall be located within 100 miles or less from project site.

1.6 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Deliver, store and handle products under provisions of Division 01.
- B. Receive equipment at job site; verify applicable components and quantity delivered.
- C. Handle equipment to prevent internal components' damage and breakage, as well as denting and scoring of enclosure finish.
- D. Do not install damaged equipment.
- E. Store equipment in clean, dry space and protect from dirt, fumes, water, and construction debris and physical damage.
- F. Make arrangements with Owner at preconstruction meeting for storage of equipment at project site.

1.7 EXTRA MATERIALS

- A. Division 01 - Execution Requirements: Spare parts and maintenance products.
- B. Furnish three of each type of automatic smoke detector without base.

1.8 SUPERVISION

- A. Fire alarm system shall contain independently supervised initiating device circuits. Alarm activation of any initiation circuit shall not prevent subsequent alarm operation of any other initiation circuit.

- B. There shall be supervisory service initiation device circuits for connection of all sprinkler flow and tamper switches. Device activation shall be appropriately annunciated at control panel and remote annunciator.
- C. There shall be independently supervised and independently fused indicating appliance circuits for alarm horn/strobe units. Disarrangement conditions of any circuit shall not affect operation of other circuits.
- D. Auxiliary manual controls shall be supervised so that "off normal" position of any switch shall cause "off normal" system trouble.
- E. Auxiliary circuits for addressable relays shall be supervised, so that blown fuse or open in circuit shall be visibly and audibly annunciated.
- F. LCD annunciator panel shall be supervised. Any ground, short, or open in wiring to fire alarm control panel, as well as any malfunction of annunciator panel itself shall be appropriately annunciated at control panel.
- G. Each independently supervised circuit shall include discrete LCD readout to indicate disarrangement conditions per circuit.
- H. Incoming power to system shall be supervised so that any power failure must be audibly and visually indicated at control panel and remote annunciator. A green "power on" LED shall be displayed continuously while incoming power is present.
- I. System batteries shall be supervised so that low battery condition or disconnection of any battery shall be audibly and visually indicated at control panel and remote annunciator.
- J. System Modules shall be electrically supervised for module placement. Should module becomes disconnected, system trouble indicator shall illuminate and audible trouble signal shall sound.
- K. System shall have provisions for disabling and enabling all circuits individually for maintenance or testing purposes.

1.9 POWER REQUIREMENTS

- A. Control panel shall receive 120 VAC power via branch circuit in building's emergency load panel. This branch circuit shall have a "breaker lock" to prevent accidentally de-energizing of power to fire alarm panel. Circuit breakers shall be painted red and labeled "FIRE ALARM".
- B. Panel shall include a disconnect switch for AC power inside an enclosure near panel or within panel itself. This switch shall be labeled "Fire Alarm Power Disconnect".
- C. Control panel shall include electrical power surge and transient protection.

- D. System shall include sufficient back-up battery capacity to operate entire system upon loss of normal 120 VAC power in normal supervisory mode for period of twenty-four (24) hours with ten (10) minutes of alarm operation at end of this period. Each system shall automatically transfer to standby batteries upon power failure. All battery charging and recharging operations shall be automatic.
- E. Panel shall include a power-limited, filtered and regulated battery charger.
 - 1. Charger shall be combination high rate/float maintenance type.
 - 2. Charger shall charge a fully discharged battery to 70% in 12 hours.
 - 3. Charger shall monitor for AC fail/disconnect, low/no battery, and high battery level. The charger shall include switches and associated LEDs for high rate and AC disconnect.
 - 4. Charger shall provide 5 AMPS regulated 24VDC for peripheral devices requiring +/- 5% regulation and 8 AMPS at 24VDC for standard peripheral devices.
 - 5. Charger shall be compatible with lead acid and Ni-Cad batteries.
- F. All external circuits requiring system operating power shall be 24VDC and shall be individually supervised and fused at control panel.

1.10 ISOLATED LOOP CIRCUIT PROTECTORS (ILCP)

- A. Fire alarm control panel shall include Isolated Loop Circuit Protector (ILCP) on all circuit which extends beyond building. These circuits include, but limited to, initiating device circuits, alarm notification appliance circuits, and signaling line circuits. ILCP shall be located as close as practical to point where circuits leave or enter a building.
- B. ILCP grounding conductor shall be a #12 AWG wire having a maximum length of 25 feet. It shall be run in a straight line and connected to building grounding electrode system.
- C. ILCP shall have a line to line response time of less than (1) nanosecond. Spark gap devices or devices incorporated in or installed within control panel in lieu of ILCP are not acceptable.

1.11 OPERATION OF MULTIPLEX/INTELLIGENT FIRE ALARM SYSTEMS

- A. System alarm operation subsequent to activation of any manual station, automatic detection device, or sprinkler flow switch shall be as follows:
 - 1. All audible alarm indicating appliances shall sound in a temporal code-three ringing pattern until silenced by alarm silence switch at control panel or at remote annunciator.
 - 2. All visual alarm indicating appliances shall flash continuously until system is reset.
 - 3. Any subsequent alarm shall reactivate alarm audible indicating appliances.
 - 4. All doors normally held open by door control devices shall release.
 - 5. A supervised signal to notify local fire department shall be activated.
 - 6. Mechanical controls shall activate or deactivate air handling systems in accordance with NFPA-90A.

7. System alarm LED shall flash on control panel and remote annunciator until alarm has been acknowledged. Once acknowledged, this same LED shall latch on.
 8. A subsequent alarm received from another device shall flash system alarm LED on control panel and remote annunciator. LCD display shall show new alarm information.
 9. A pulsing alarm tone shall occur within control panel and remote annunciator until the event has been acknowledged.
- B. System shall have a single key that will allow operator to display all alarms, troubles, and supervisory service conditions including time and date of each occurrence.
- C. Alarm shall be displayed on an 80-character LCD display as follows:
1. 40 characters for:
 - a. Point address and loop number.
 - b. Type of device.
 - c. Point status.
 2. 40 characters for:
 - a. Custom location label.

1.12 SMOKE DETECTION OPERATION

- A. Activation of any system smoke detector shall initiate an alarm verification operation whereby the panel will reset activated detector and wait for a second alarm activation. If, after (20) seconds and within (1) minute after resetting, a second alarm is reported from same or any other smoke detector, system shall process alarm as described previously. If no second alarm occurs within (1) minute, system shall resume normal operation. Alarm verification shall operate only on single smoke detector alarm. Other activated initiating devices or multiple smoke detector alarms shall be processed and reported immediately. Alarm verification operation shall be selectable by device or zone.
- B. Multiplex/intelligent system shall have capability of displaying number of times (tally) a detector has gone into a verification mode.
- C. Smoke detectors shall be smoke density measuring devices having no self contained alarm set point (fixed threshold).
1. Alarm decision for each detector shall be determined by control panel.
 2. Control panel shall determine condition of each detector by comparing detector's value to stored values.
- D. Control panel shall maintain a moving average of detectors' smoke chamber value to automatically compensate (move threshold) for dust and dirty conditions that could affect detection operations.
- E. System shall automatically maintain constant smoke obscuration sensitivity for each detector (via floating threshold) by compensating for environmental factors.

- F. Photoelectric detector's smoke obscuration sensitivity shall be adjustable to within 0.3 percent of either limit of UL window (0.5 percent to 4.0 percent) to compensate for any environment.
- G. System shall automatically indicate when an individual detector needs cleaning. When a detector's average value reaches a predetermined level, a trouble MESSAGE shall be audibly and visibly indicated at control panel for individual detector. Additionally, LED on detector base shall glow steady giving a visible indication at detector's location. If troubled condition is left unattended, and detector's average value increases to a second predetermined value, another trouble MESSAGE shall be indicated at control panel for individual detector.
- H. To prevent false alarms, these TROUBLE conditions shall in no way decrease amount of smoke obscuration necessary for system activation. For scheduling of maintenance, control panel shall be able to generate a MESSAGE indication for any detector approaching a trouble condition due to dirt or contamination.
- I. Control panel shall continuously perform an automatic self-test routine on each detector, which will functionally check detector electronics and ensure accuracy of values being transmitted to control panel. Any detector that fails this test shall indicate a "SELF TEST FAILED" trouble condition with detector location at control panel.
- J. An operator at control panel, having a proper access level, shall have capability to manually access following information for each detector:
 - 1. Primary status.
 - 2. Device type.
 - 3. Present average value.
 - 4. Present sensitivity value selected.
 - 5. Peak detection values.
 - 6. Detector range (normal, dirty)
- K. Values shall be in "percent of smoke obscuration" format so that no interpretation is required by operator.
- L. An operator at control panel, having a proper access level, shall have capability to manually control following for each detector:
 - 1. Clear peak detection values.
 - 2. Enable or disable the detector.
 - 3. Clear verification tally.
 - 4. Establish alarm sensitivity.
 - 5. Control a detector's relay driver output.
- M. It shall be possible to program control panel to automatically change sensitivity settings of each detector based on time-of-day and day-of-week. There shall be three (3) sensitivity settings available for each detector.

- N. Control panel shall have capability of being programmed for a pre-alarm or two-stage function. This function allows an indication to occur when, for example, a 3 percent detector reaches a threshold of 1.5 percent smoke obscuration.
- O. Control panel shall clear a “detector dirty” trouble after a detector has been removed from its base cleaned and replaced.

1.13 ELEVATOR RECALL OPERATION

- A. After any elevator lobby or machine room smoke detector alarm is verified, it shall, in addition to operations listed above, cause Phase I Emergency Recall Operation according to following sequence.
 1. If alarmed detector is on any floor other than designated level of egress, elevator cabs shall be recalled to main level of egress.
 2. If alarmed detector is on designated level of egress, elevator cab(s) shall be recalled to predetermined alternate recall level as determined by Owner.
 3. Elevator lobby smoke detectors shall be labeled as such in custom label. Labeling shall include floor designations.
 4. Where practical, upon reset of fire alarm control panel, elevators shall automatically resume normal operations.

1.14 ELEVATOR SHUNT TRIP

- A. After an elevator machine room or elevator shaft heat detector is activated, elevator control panel shall deactivate shunt trip breaker supplying power to elevator. Specific elevator shaft zone shall be put into alarm at control panel, and sound general fire alarm.

1.15 SYSTEM RESPONSE

- A. Maximum elapsed time from sensing a fire alarm at a non-smoke detector initiating device or a second smoke detector until it is recorded at control panel and remote annunciator, shall not exceed 5 seconds and not to exceed 15 seconds for remote station reporting. Maximum elapsed time for first smoke detector shall not exceed 35 seconds including verification period and not to exceed 40 seconds for remote station reporting.

1.16 AHU SYSTEM OPERATION/INTERFACE

- A. Control panel shall provide an output alarm interface to air handling/energy management system controllers, which in turns shall perform automatic function as specified in applicable sections of Division 23.
- B. Fire alarm control panel shall provide a manual control mode as such that air handling units can be restarted to override automatic function.
- C. Upon reset of fire alarm system, air handling units shall automatically and sequentially start up to minimize power demand.

1.17 SPRINKLER SYSTEM OPERATION/INTERFACE

- A. Control panel shall have a dedicated supervisory service LED and a dedicated supervisory service acknowledge switch.
- B. Activation of any standpipe or sprinkler valve supervisory (tamper) switch shall activate system supervisory service audible signal and illuminate LED at control panel and remote annunciator. Panel shall provide differentiation between valve tamper activation and opens and/or grounds on initiation circuit wiring.
- C. Pressing supervisory service acknowledge key will silence supervisory audible signal while maintaining supervisory service LED "on" indicating off-normal condition.
- D. Restoring valve to normal position shall automatically reset tamper indication.

1.18 MANUAL DRILL OPERATION

- A. A manual evacuation (drill) switch shall be provided to operate alarm indicating appliances without causing other control circuits to be activated. However, should a true alarm occur, all alarm functions would occur as described previously.

1.19 LED AND LCD TEST OPERATION

- A. Activation of Lamp Test switch shall turn on all LED indicators, LCD display, and local sounder and then return to previous condition.

1.20 SYSTEM DIAGNOSIS

- A. System shall include special software to detect, diagnose and report failures and isolate such failures to a printed circuit board level.

1.21 WATCH-DOG TIMERS

- A. System shall include independent "Watch-Dog" timers to detect and report failure of any microprocessor circuit, memory, or software.

1.22 SILENT WALK TEST WITH HISTORY LOGGING OPERATION

- A. Actuation of "Walk Test" switch/program at control panel shall activate "Walk Test" mode of system, which shall cause following to occur:
 - 1. Fire department circuit connection shall be bypassed.
 - 2. Control relay functions shall be bypassed, such as door holders, elevator capture, fan shut down.
 - 3. Audio and visual circuits shall be bypassed.
 - 4. Control panel shall show a trouble condition.
 - 5. Alarm activation of any initiation device shall silently logged as alarm condition in

- historical data file. Panel shall automatically reset itself after logging of alarm.
6. Any momentary opening of initiating or indicating appliance circuit shall be silently logged as a trouble condition in historical data file. Panel shall automatically reset itself after logging of trouble condition.
- B. If system becomes inactive for period of longer than 10 minutes, panel shall default to normal fire alarm functions.
 - C. Panel shall have capability of dividing system into distinctive walk test groups, minimum of 8 groups.

PART 2 PRODUCTS

2.1 CONTROL PANEL

- A. Manufacturers:
 1. Simplex Time Recorder Company.
 2. Notifier.
 3. Edwards Systems Technology (EST)
 4. Siemens.
 5. Mircom.
 6. Substitutions: In accordance with Division 01 - Product Requirements.

2.2 ENCLOSURES

- A. Provide cabinets of sufficient size to accommodate aforementioned equipment.
- B. Cabinet shall be equipped with locks and transparent door panel providing tamper proof enclosure yet allowing full view of various lights and controls as required above.

2.3 MULTIPLEX/INTELLIGENT FIRE ALARM CONTROL PANEL

- A. Control Panel shall include hardware and software that are compliant with year 2000 computing standards.
- B. Control Panel shall be modular, expandable with solid state, microprocessor based electronics. It shall display through front viewing window only those primary controls and displays essential to operation during a fire alarm condition.
- C. Control panel shall provide following features as standards:
 1. Support intelligent (analog) detection devices.
 2. Number of initiating device loops required for specified quantity of initiating devices plus one (1) spare loop for each five (5) active loops. Each active loop shall include 5 percent spare capacity.
 3. Number of indicating appliance (horn) circuits required for specified quantity horns plus one (1) spare circuit for each ten (10) active circuits. Each active circuit shall

- include 25 percent spare capacity.
 - 4. Number of indicating appliance (strobe) circuits required for specified quantity of strobes plus one (1) spare circuit for each ten- (10) active circuits. Each active circuit shall include 25 percent spare capacity.
 - 5. 80-character liquid crystal display.
 - 6. Printer interface.
 - 7. History log file with a minimum of 600 events.
 - 8. Field programmable.
 - 9. Drift compensation.
 - 10. Sensitivity display in percent.
 - 11. Sensitivity adjustment.
 - 12. Day/night sensitivity adjustment.
 - 13. Auto detector test to meet NFPA 72.
 - 14. Alarm verification with tally counter.
 - 15. Silent walk test.
 - 16. Maintenance alerts.
 - 17. Other features as described below.
- D. Multiplex/intelligent system shall provide ability to recall alarms and trouble conditions in chronological order for purpose of recreating an event history.
- E. Under normal condition, viewing window shall display a "System is Normal" message and current time and date.
- F. Should abnormal condition be detected, appropriate LED (Alarm, Supervisory or Trouble) shall flash. Panel audible signal shall pulse for alarm conditions and sound steady for trouble and supervisory conditions.
- G. LCD shall display following information relative to abnormal condition of a point in system prior to acknowledgement.
- 1. 40 characters for:
 - a. Point address and loop number (i.e. 555-L5).
 - b. Type of device (i.e. smoke, pull station, water-flow).
 - c. Point status (i.e. alarm, trouble).
 - 2. 40 characters for:
 - a. Custom location label (i.e. 4th Floor - Room 444).
- H. Keyboards or keypads shall not be required to operate system during fire alarm conditions. Software functions shall be provided as follows:
- 1. Setting of time and date.
 - 2. LED testing.
 - 3. Alarm, trouble, and abnormal condition listing.
 - 4. Enabling and disabling of each monitor point separately.
 - 5. Activation and deactivation of each control point separately.

6. Changing operator access levels.
 7. Walk Test enable.
 8. Running diagnostic functions.
 9. Displaying historical logs.
 10. Point listing.
- I. Hardware functions shall be provided as follows:
1. Acknowledge alarm or trouble.
 2. Silence alarm or trouble.
 3. Reset system after alarm.
 4. Connect/disconnect fire department tie.
 5. Provide manual evacuation (drill).
 6. Bypass elevator interlock.
 7. Bypass door holders.
 8. Supervise system.
 9. Allow computer interface.
- J. STATUS INDICATORS AND DISPLAYS:
1. A local audible device shall sound during Alarm, Trouble or Supervisory conditions. This audible device shall also sound during each key-press to provide an audible feedback to ensure that key has been pressed properly. Visual display shall distinguish between alarm, trouble and supervisory conditions.
 2. Indicators and displays shall be visible through front viewing window as follows:
 - a. One red system alarm LED.
 - b. One yellow supervisory service LED.
 - c. One yellow trouble LED.
 - d. Green "power on" LED.
 - e. Eighty-character liquid crystal display.
 3. 2-line by 40-character liquid crystal display shall be backlit for enhanced readability. So as to conserve battery standby power, it shall not be lit during an AC power failure unless an alarm condition occurs or there is keypad activity.
 4. A cursor shall be visible on LCD when entering information.
 5. Scrolling through menu options or lists shall be accomplished in a self-directing manner in which prompting messages shall direct user. These controls shall be located behind an access door.
 6. Status data shall be available on this display as follows:
 - a. Initiating device circuits.
 - b. Indicating appliance circuits.
 - c. Auxiliary relays.
 - d. Feedback points.
 - e. Primary State of point.
 - f. Zone information.
 - g. Class "A" Status.
 - h. Current priority of outputs.

- i. Disable/Enable status.
- j. Verification tallies of initiating devices.
- k. Automatic/Manual Control Status of output points.
- l. Acknowledge status.

K. CONTROLS

- 1. Controls (one switch per function per system) shall be visible through front viewing window as follows:
 - a. Alarm Acknowledge key.
 - b. Trouble Acknowledge key.
 - c. Alarm Silence key.
 - d. System Reset key.
- 2. Controls shall be accessible with front door open, though not visible through front viewing window as follows:
 - a. Fire department disconnect/switch.
 - b. Manual evacuation (drill).
 - c. Elevator bypass.
 - d. Fan shut down override/bypass switches.
 - e. Door holder release bypass.
 - f. Key pad for data input and microprocessor control.

L. LED SUPERVISION

- 1. All slave modules LEDs shall be supervised for burnout or disarrangement. Should a problem occur LCD shall display module and LED location numbers to facilitate location of that LED.

M. ACKNOWLEDGMENT

- 1. Two methods of acknowledgment for each abnormal condition shall be provided. One may be chosen depending on NFPA requirements.
- 2. Acknowledge one event at a time from an unacknowledged list of events.
- 3. Pressing appropriate acknowledge button shall display first unacknowledged condition in appropriate list (either alarm, supervisory or trouble), and require another acknowledge button. Press to acknowledge only displayed point.
- 4. After all points have been acknowledged, LEDs shall glow steadily and Sonalert will be silenced.
- 5. Total number of alarms, supervisory and trouble conditions shall be displayed along with a prompt to review each list chronologically, with end of list indicated by an end of list message "END of LIST".
- 6. Pressing appropriate acknowledge button shall globally acknowledge all points.
- 7. All acknowledge functions shall be behind locked door or pass-code protected.
- 8. In pass-code protection, if user has insufficient privilege to acknowledge such conditions, a message shall indicate insufficient privilege but allow user to view points without acknowledging them. Should user have sufficient privilege to acknowledge, a message will be displayed informing user that condition has been

acknowledged.

N. SILENCING

1. If an alarm condition exists and "Alarm Silence" button is pressed, all alarm signals shall cease operation. Strobes shall remain active until system is reset.
2. If trouble conditions exist in system and "Trouble Silence" button has been pressed, aural trouble signal shall cease, but shall resound at time intervals to act as a reminder that fire alarm system is not in a normal operating mode. Both time interval and trouble reminder signal shall be programmable to suit Owner's application.

O. RESET

1. "System Reset" button shall be used to return system to its normal state after an alarm condition has been remedied.
2. Should an alarm condition continue to exist, system shall provide indications that resetting can not be completed and shall remain in an abnormal state. Sonalert and Alarm LED shall remain activated.
3. Display shall indicate total number of alarms and troubles present in system along with a prompt to use ACK keys to review points. These points shall not require acknowledgment if they were previously acknowledged.
4. Should Alarm Silence Inhibit function be active, system shall ignore all key presses. An indication of enabling and disabling inhibit state shall be provided as a feedback to operator.

P. ACCESS LEVELS

1. There shall be three (3) access levels with level 4 being highest level.
 - a. Level 1 actions shall not require a pass-code.
 - b. Pass-codes shall consist of up to five (5) digits.
 - c. Changes to pass-codes shall only be made by authorized personnel.
2. In order to maintain security when entering a pass-code, digits entered shall not be displayed but a cursor shall move along filling position with an X to indicate that digit has been accepted. All key presses shall be acknowledged by a local audible sound.
3. When a correct pass-code is entered, the system shall indicate to operator that "Access Granted". New access level shall be in effect until operator manually logs out or keypad has been inactive for five (5) minutes.
4. Operator entering an invalid code shall be notified with message, "Incorrect Pass-Code", and shall be allowed up to three chances to enter a valid code. After three unsuccessful tries, message, "Access Denied", shall be displayed. Current level shall not be altered, and operator shall no longer be in menu option.
5. Access to a level shall allow operator to perform all actions within that level plus all actions of lower levels, but no actions of higher levels.
6. Keys/switches shall have access levels associated with them as follows:
 - a. Alarm Silence.
 - b. System Reset.

- c. Set Time/Date.
 - d. Manual Control.
 - e. On/Off/Auto Control.
 - f. Disable/Enable.
 - g. Programming functions.
 - h. Clear Historical Alarm Log.
 - i. Clear Historical Trouble Log.
 - j. Walk Test.
 - k. Change Alarm Verification.
7. Acknowledge keys shall also require privileged access to acknowledge points. If operator presses an (ACK) key with insufficient access, an error message shall be displayed. Points shall scroll with (ACK) key presses to view points on list, but points shall not get acknowledged in database.

Q. POINT LISTING

- 1. For maintenance purposes, following lists shall be available from point lists menu:
 - a. All points list by address.
 - b. Monitor point list.
 - c. Signal/speaker list.
 - d. Auxiliary control list.
 - e. Feedback point list.

R. HISTORY LOGGING

- 1. System shall be capable of logging and storing last 400 events (alarm and trouble) in a history log. These events shall be stored in a battery protected random access memory. Each recorded event shall include time and date of that event's occurrence.
- 2. Historical alarm log events shall be stored as follows:
 - a. Alarms.
 - b. Alarm Acknowledgment.
 - c. Alarm Silence.
 - d. System Reset.
 - e. Alarm Historical log cleared.
- 3. Historical trouble log events shall be stored as follows:
 - a. Trouble conditions.
 - b. Supervisory alarms.
 - c. Trouble acknowledgment.
 - d. Supervisory acknowledgment.
 - e. Alarm Verification tallies.
 - f. Walk Test results.
 - g. Trouble Historical log cleared.

S. SILENT WALK TEST WITH HISTORY LOGGING

- 1. System shall be capable of being tested by one person. While in testing mode, alarm activation of an alarm-initiating device shall be silently logged as an alarm condition

- in historical data file. Panel shall automatically reset itself after logging of alarm.
2. Momentary disconnection of an initiating or indicating device circuit shall be silently logged as a trouble condition in historical data file. Panel shall automatically reset itself after logging of trouble condition.
 3. Should silent walk-test feature be on for an inappropriate amount of time (30 minutes max.), it shall revert to normal mode automatically.
 4. Panel shall have capability of dividing system into distinctive walk test groups, a minimum of eight (8) groups.
 5. Should an alarm condition occur from an active point, not in walk test mode, it shall perform operations described above.
 6. After testing is considered complete, testing data may be retrieved from system in chronological order to ensure device/circuit activation.

T. COMPUTER INTERFACE

1. Fire Alarm Control Panel shall operate as a proprietary local system with capability of sending status data to and receiving control data from a Central Processing Unit (CPU) at central reporting stations.
2. CPU would monitor all alarms and troubles and would control selected functions of each Fire Alarm Control Panel.
3. CPU shall supervise all data communication wiring between CPU and Fire Alarm Control Panel for opens, shorts and grounds.

U. FIELD PROGRAMMING

1. System shall be fully programmable, configurable, and expandable in field without need for special tools or PROM programmers and shall not require replacement of memory IC's.
2. All programming may be accomplished through standard control panel keyboard or a keyboard at printer, or use of a PC. All programs shall be stored in non-volatile memory.
3. All programming or reprogramming shall be done by supplier at no charge until system is accepted by owner.

V. TERMINAL/PRINTER INTERFACE

1. Fire Alarm Control Panel shall be capable of operating remote monitors and/or printers.
2. Output shall be ASCII from an EIA RS-232-C connection with an adjustable baud rate.
3. Each RS-232-C port shall be capable of supporting and supervising up to 4 remote CRTs and Printers.
4. Data amplifiers shall be used to increase CRT or printer line distance, if required.
5. RS-232-C port(s) shall be capable of supporting up to 4 remote CRT's and printers.

W. INTELLIGENT NETWORK

1. System must provide communications with intelligent initiating and control devices

individually. These devices shall be individually annunciated at control panel. Annunciation shall include following conditions for each point:

- a. Alarm.
 - b. Trouble.
 - c. Open.
 - d. Short
 - e. Device missing/failed
2. All intelligent devices shall have capability of being disabled or enabled individually.
 3. There shall be no limit to number of detectors, stations, or addressable modules, which may be activated or "in alarm" simultaneously.
 4. Multiple intelligent devices shall be connected to a single pair of wires. Systems that require factory pre-programming to add or delete devices are unacceptable.
 5. Communication format must be a completely digital poll/response protocol to allow t-tapping of circuit wiring. A high degree of communication reliability must be obtained by using parity data bit error checking routines for address codes and check sum routines for data transmission portion of protocol. Systems that do not utilize full digital transmission protocol are not acceptable.

2.4 LCD REMOTE ANNUNCIATOR PANEL

- A. Where shown on drawings, provide and install an 80-character LCD point annunciator.
- B. Annunciators shall have red finish and shall provide "System Alarm" and "System Trouble" indications on 80-character LCD readout.
- C. Annunciator shall communicate to control panel over one twisted shielded wire pair. Operating power shall be 24VDC and be fused at control panel. LED annunciators are not considered equal and will not be accepted.
- D. All wiring between annunciator panel and fire alarm control panel shall be supervised for opens, grounds and shorts.
- E. Under normal operating conditions, LCD shall indicate time, date and "System is Normal" label.
- F. During abnormal conditions, LCD shall indicate type and number of abnormal conditions such as alarms, troubles, and supervisory services. LCD shall display a custom location label for each abnormal condition identical to display at control panel.
- G. LCD annunciator shall provide:
 1. Control push-button switches - for; alarm silence, trouble silence, system reset and LED & LCD test.
 2. Tone Alert - Duplicates control panel tone alert during alarm & trouble conditions.
 3. System trouble LED.
 4. System alarm LED.

5. Power on LED.
6. Four programmable control switches for other functions.
7. To accommodate and facilitate job site changes control switches shall have capability of being programmed on site to provide additional or nonstandard operations and functions.

2.5 MULTIPLEX/INTELLIGENT PERIPHERAL DEVICES

- A. All devices shall be supervised for trouble conditions. System control panel shall be capable of displaying type of trouble condition (open, short, device missing/failed). Failure of a device shall not hinder operation of other system devices.
- B. DEVICE IDENTIFICATION
 1. Each intelligent device must be uniquely identified by an address code entered on each device's base at time of installation. Use of jumpers to set address shall not be acceptable. This address along with loop number shall be indicated, and be visible from ground, on device's housing or base in field using permanent marking.
 2. Location of end-of-line device shall be indicated on device that containing same.
 3. Device identification schemes that do not use uniquely set addresses but rely on electrical position along communication channel are unacceptable. These systems cannot accommodate t-tapping and addition of an intelligent device between existing devices requires re-programming all existing devices beyond added device.
 4. System must verify that proper type device is in place and matches desired software configuration.
- C. INTELLIGENT DETECTOR BASES
 1. Bases shall be suitable for either smoke or heat detector mounting.
 2. Either base or head shall contain electronic circuits that communicate detector's status (normal, alarm, sensitivity status, trouble, etc.) to control panel over two wires. Same two wires shall also provide power to base and detector. Contacts between base and head shall be of bifurcated type using spring-type, self-wiping contacts.
 3. Base shall be lockable. Locking feature must be field removable when not required.
 4. Upon removal of detector's head, a trouble signal shall be transmitted to control panel.
 5. Detector base shall be sealed against rear airflow entry.
 6. Each detector's base or head shall contain LED(s), which shall flash when detector is being scanned by control panel. LED(s) shall turn on steady when detector is in an alarm condition.
 7. Each base shall provide means to allow for function testing of detector at detector's location.
 8. Base shall be common with heat detector and smoke type detectors and shall be compatible with other intelligent detectors, addressable manual stations, and addressable modules on same circuit.

D. INTELLIGENT DETECTORS - GENERAL

1. Smoke and heat detectors must be approved by Engineer prior to installation.
2. Intelligent detectors shall be low-profile type.
3. Smoke detectors shall be listed for sensitivity testing from control panel. Sensitivity test results shall be logged and downloaded to a printer.
4. Detectors shall be plug-in units, which mount to a common base, and shall be UL 268 approved.
5. Detector shall be a 24VDC type which is compatible with fire alarm panel and obtains its operating power from supervisory current in fire alarm detection loop.
6. 24 VDC detector may be reset by actuating control panel reset switch.
7. To minimize false alarms, voltage and RF transient suppression techniques shall be employed.
8. Smoke detectors shall be installed on circuits with alarm verification modules.
9. Smoke detectors shall include an insect screen.
10. Smoke detectors shall communicate actual smoke chamber values to system control panel.
11. If field conditions so require, smoke detection devices shall be covered with plastic bags after installation to maintain cleanliness. Plastic bags shall be red for quick visual identification for removal at time of occupancy.

E. INTELLIGENT IONIZATION SMOKE DETECTORS

1. Detectors shall be of dual chamber type: one chamber for sampling, and one chamber for reference to provide stability over wide changes in environmental conditions such as temperature, humidity and pressure.
2. Detectors shall sense product-of-combustion and report measured level of such products in analog form to control panel.

F. INTELLIGENT PHOTOELECTRIC SMOKE DETECTORS

1. Detectors shall contain no radioactive material.
2. Detectors shall be of the solid state photoelectric type. and shall operate on light scattering photodiode principle using a pulsed infrared LED light.

G. INTELLIGENT THERMAL DETECTORS

1. Detectors shall be a combination rate-of-rise and fixed temperature (135 degrees F unless noted).
2. Detectors shall sense within a temperature range of 32 degrees F to 158 degrees F. Control panel shall be capable of sensing either a set point of 135 degrees F, or a rate-of-rise of 15 degrees F per minute for fire sensing. For utility sensing, a set point may be chosen within stated range and control panel programming shall be capable of using that information to determine specific response such as warning of failure of local temperature controls.

H. INTELLIGENT DUCT SMOKE DETECTORS

1. Duct detectors shall be of photoelectric ionization type specified above. It shall be

- possible to alarm duct detector by using a remote or local test switch.
2. For maintenance purposes, it shall be possible to clean duct housing sampling tubes by accessing them through duct housings front cover.
 3. Detector shall include auxiliary SPDT relays and remote keyed test switch and alarm LED indicator.
 4. In mechanical rooms, alarm LED indicators for duct detectors shall be grouped on a stainless steel cover plate mounted adjacent to main mechanical room door.
 5. Each LED shall be labeled with detectors loop and address.
 6. A floor plan of room showing detectors and addresses shall be located adjacent to cover plate. Provide Plexiglas cover over the plan.

I. PULL STATIONS

1. Pull stations shall contain circuits that communicate station's status (alarm, normal) to control panel over two wires, which also provide power to pull station. Address shall be field programmable on station.
2. Manual stations shall be a single action constructed of high impact, red Lexan with raised white lettering and a smooth high gloss finish.
3. Station shall mechanically latch upon operation and remain so until manually reset a key common to all system locks. Stations which use Allen wrenches or special tools to reset shall not be accepted.
4. Manual station shall be fitted with screw terminals for field wire attachment.

J. INTERFACE MODULES - GENERAL

1. Addressable Interface Modules shall receive their 24VDC power from a separate two wire circuit provided by an appropriate power supply.
2. Module shall be available in either a Class B or Class A supervision version.
3. In Class B version, wiring shall be supervised by an end-of-line device.
4. In Class A version, wiring shall be looped back and connected to module to allow continual operation of controlled devices even if wiring sustains a single break.
5. Interface modules shall be supervised and uniquely identified by control panel. Device identification shall be transmitted to control panel for processing according to program instructions.
6. Should interface modules become non-operational, tampered with, or removed, a discrete trouble signal, unique to device, shall be transmitted to, and annunciated at control panel.
7. Interface modules shall be capable of being programmed for it's "address" location on intelligent device initiating circuit.
8. Interface modules shall be compatible with addressable manual stations and intelligent detectors on same intelligent initiating circuit.

K. INTERFACE MODULES - SUPERVISED CONTROL

1. Interface Modules shall be suited for control of indicating appliances, door holders, and AHU systems.
2. For signals, speakers, fire fighter phone jacks and other device control with Class B

or Class A wiring supervision, interface module shall provide double-pole/double-throw relay switching that can be used to connect any of following through easily replaceable 2 amp fuses:

- a. A zone of signals to a power source.
 - b. Speakers to an audio source.
 - c. Fire fighter phone jacks to a communications channel.
 - d. A variety of controlled devices to appropriate controlling circuits.
3. These interface modules shall communicate supervised wiring status (normal, trouble) to fire alarm control panel and shall receive from fire alarm control panel a command to transfer relay.

L. INTERFACE MODULES - SUPERVISED MONITORING

1. Addressable Interface Modules shall be suited for monitoring of water-flow, valve tamper, Halon Control Panels, non-intelligent detectors.
2. An addressable interface module shall be provided for interfacing normally open direct-contact devices to an intelligent initiating circuit as follows:
 - a. For conventional 2-wire smoke detector and/or contact device monitoring with class B or class A wiring supervision.
 - b. This interface module shall provide power to and monitor status of a zone consisting of conventional 2-wire smoke detectors and/or N/O contact devices as specified elsewhere and shown on drawings.
 - c. Supervision of zone wiring shall be Class B or Class A.
 - d. These interface modules shall communicate zone's status (normal, alarm, trouble) to control panel.
 - e. For conventional 4-wire smoke detector with Class B wiring supervision.
 - f. This interface module shall provide power to and monitor contact status of a zone consisting of conventional 4-wire smoke detectors as specified elsewhere.
 - g. Interface module shall provide detector reset capability and a 2 amp fuse to provide over-current power protection for 4-wire detector.
 - h. These interface modules shall communicate zone's status (normal, alarm, trouble) to control panel.

M. INTERFACE MODULES - NON-SUPERVISED CONTROL

1. This interface module shall provide double-pole/double-throw relay switching for loads up to 120VAC. It shall contain easily replaceable 2 amp fuses, one on each common leg of relay.

2.6 FAULT ISOLATOR MODULE

- A.** System shall Fault Isolator Module (FIM) on initiating device circuits in following situations:
1. Loop extends to another floor.
 2. Loop extends to another building.
 3. Loop has more than 25 devices.

- B. ILCP shall be located as close as practical to point where these conditions occur.
- C. FIM shall automatically re-connect isolated section of loop upon correction of fault conditions. FIM shall not require any address setting, and its operations shall be totally automatic. It shall not be necessary to replace or reset an FIM after it's normal operation.
- D. FIM shall include an LED which shall flash under normal operation and illuminate steady to indicate a short circuit.

2.7 CONVENTIONAL PERIPHERAL DEVICES

A. SPRINKLER WATERFLOW SWITCHES - WET SYSTEMS

1. To be supplied and installed by Fire Protection Contractor under Division 15.
2. Waterflow switches shall consist of a cast aluminum pipe saddle which houses electro-mechanical device which is attached to a corrosion-free, flexible, low-density polyethylene paddle.
3. Paddle shall conform to inside diameter of sprinkler pipe and senses all water movements.
4. To prevent false alarms, flow switch shall incorporate an adjustable time delay mechanism between paddle-operated stem and alarm initiating contacts. A tapped 1/2 inch conduit connection shall be provided.

B. SPRINKLER VALVE TAMPER SWITCHES - WET SYSTEMS

1. To be supplied and installed by Fire Protection Contractor under Division 21.
2. Sprinkler valve tamper switches shall consist of an acid-treated cast aluminum housing with nickel-plated parts to resist corrosion.
3. Switch shall be provided with either one or two sets of S.P.D.T. micro switches as required.

C. HORN/STROBE UNITS

1. Alarm horns shall be polarized and operate on 24 VDC circuit provided by control panel.
2. Each horn assembly shall include separate wire leads for in/out wiring for each leg of associated signal circuit.
3. T tapping of signal device conductors to signal circuit conductors shall NOT be accepted.
4. Alarm horns shall be suitable for rear mounting behind audio-visual assemblies which shall be flush or semi-flush mounted, wherever possible, with manufacturer backboxes and flush trim ring.
5. White Lexan lens shall have word "FIRE" in red lettering on sides.
6. Strobes installed in open areas such as hallways, open office spaces, and assembly areas shall provide 15/75 candela peak power and 110 candela peak power where installed in sleeping areas, bathrooms, and mechanical areas.
7. All strobes shall be in compliance with ADA requirements and be on a separate supervised circuit from horn circuit.

8. Strobes shall be synchronized so all strobes units within sight flash simultaneously.
9. Horns shall be UL listed to provide a minimum sound pressure level of 96 dB at 10 feet.

2.8 PRINTERS AND TERMINALS

A. All multiplex/intelligent systems shall be provided with printer and terminal (keyboard and CRT).

B. PRINTER

1. A desktop 80-column, impact dot matrix printer shall provide a hard copy record of system events.
2. Printer shall receive English language text from the control panel in industry standard ASCII format via an EIA RS-232-C connection.
3. All printed information shall include time, date, status, point number, label, and device type identifier.
4. Printer shall have following features:
 - a. 120 VAC input power.
 - b. 180 characters per second printing speed.
 - c. 3 kilobytes buffer capacity.
 - d. Cartridge type ribbon.
 - e. Friction feed for cut forms.
 - f. Tractor feed for continuous 9 1/2 inch wide pin-to-pin fanfold paper.
 - g. UL 864 listed (UOXX).

C. TERMINAL

1. A desktop terminal (monitor with detachable keyboard) shall provide English language display with time and date of system events.
2. Monitor shall be tilt/swivel, with a 14 inch, green phosphor, non-glare CRT that has capability to display 80 columns by 24 lines of information.
3. All displayed information shall include time, date, status, point number, label, and device type identifier.
4. Information on screen shall not scroll off until an acknowledge key is pressed.
5. Terminal shall include a composite video output to drive slave monitors.
6. Terminals shall provide and/or control following commands:
 - a. Acknowledgment of alarms, troubles and supervisory conditions.
 - b. Alarm silence.
 - c. System Reset.
 - d. Time & Date.
 - e. Alarm, Trouble, and Supervisory service condition summary screens.

2.9 SPECIAL DEVICES

A. SMOKE DETECTOR GUARDS

1. Provide and install a protective guard for each smoke detector installed in **INSERT**

LOCATIONS.

- a. Guards shall be made of 14 gauge meshed steel.
- b. Mesh size shall be 3/16" in diameter, (16-holes/sq. inch).
- c. Guards shall include brackets and Pinned "torx" head type tamper proof screws for either ceiling or wall mounting.
- d. Wall-mounted guard shall have a 45-degree top slant to prevent its use for supporting purposes.

B. TOOLS AND KEYS

1. Contractor shall provide to owner **INSERT NUMBER** tools for insertion and removal of Pinned "torx" head type tamper proof screws.
2. Contractor shall provide two (2) keys per pull station.
3. Keys shall be **INSERT TYPE**, identical and usable in all keyways associated with this project.
4. If required, smoke detector programming devices shall also be provided.

2.10 WIRE AND CABLE

- A. Product Description: Non-power limited fire-protective signaling cable, copper conductor, 150 volt insulation rated 60 degrees C or power limited fire-protective signaling cable, copper conductor, 300 volts insulation rated 105 degrees C.
- B. Plenum Cable: Power limited fire-protective signaling cable classified for fire and smoke characteristics, copper conductor, 300 volts insulation rated 105 degrees C, suitable for use in air handling ducts, hollow spaces used as ducts, and plenums.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Division 01 - Administrative Requirements: Coordination and project conditions.
- B. Verify products and systems receiving devices are ready for installation.

3.2 GENERAL

- A. Complete installation shall be done in a neat, workmanlike manner in accordance with applicable requirements of NFPA 70 - Article 760 and manufacturer's specifications and written requirements.
- B. In a dusty environment such as new construction, smoke detectors shall not be mounted until construction is completed.
- C. Class B circuiting shall be used.

3.3 RACEWAYS

- A. All wiring shall be in a conduit system separate from other building wiring. See Division 26 for specifications.
- B. All wiring shall be in minimum 3/4 inch steel raceway.
- C. Contractor shall size conduit and boxes by circular mil size of each cable in each conduit or box. Circular mil sizing can be found on manufacture's spec sheet, then use NEC codebook to make calculation to follow NEC Table 370-16(a) for box fill and Chapter 9 for conduit fill.
- D. Existing conduit and surface metal raceway that are not 3/4 inch size may be reused if found to have adequate space, in accordance with specification Division 26, for existing and new conductors.
- E. All screws used for anchoring devices and J-boxes in dormitories' public areas such as corridors, lobbies break rooms, etc. shall have Pinned "torx" head type tamper-proof screws.
- F. There shall be no sharp edges with installed materials.

3.4 CONDUCTORS

- A. Fire alarm circuit conductors have insulation color or code as follows:
 - 1. Power Branch Circuit Conductors: Black, red, white.
 - 2. Initiating Device Circuit: Black, red.
 - 3. Detector Power Supply: Violet, brown.
 - 4. Signal Device Circuit: Blue (positive), white (negative).
 - 5. Door Release: Gray, gray.
 - 6. Municipal Trip Circuit: Orange, orange.
 - 7. Municipal Fire Alarm Loop: Black, white.
- B. All cable shall be installed as per NEC Article 760.
- C. All cables and wires shall be No. 14 AWG and larger shall be stranded.
- D. All wiring shall be completely supervised. In event of a primary power failure, disconnected standby battery, disarrangement of any components, any open circuits or grounds in system, an audible and visual trouble signal shall be activated until system is restored to normal.
- E. All conductors shall be color-coded. Coding shall be consistent throughout facility. Green wire shall be used only for equipment ground.
- F. Fire Alarm Control Panel shall be connected to separate dedicated branch circuit from building emergency panel, maximum 20 amperes. Circuit shall be labeled as "FIRE ALARM".

- G. Power wiring for Fire Alarm Control Panel shall be No. 12 AWG.
- H. Fire Alarm Control Panel shall have No. 12 AWG green equipment ground wire.
- I. Where fire alarm circuits enter or leave a building, additional transient 75 to 90 volt gas tube protection shall be provided for each conductor.
- J. Leave 8-inch wire tails at each device box and 36-inch wire tails at Fire Alarm Control Panel and Remote Annunciator Panel(s).
- K. Cable for Intelligent Detector Loops shall be No. 18 to No. 12 AWG twisted pair with a shield jacket installed in 3/4 inch conduit. Shield continuity must be maintained and connected to earth ground only at control panel. Intelligent detector wiring must not be in same conduit with 120/240 VAC power wiring or other high current circuits. T-taps or branch circuit connections are allowed for all class B intelligent loop circuits.
- L. Cable for RS 232-c devices (CRT, PRINTER) shall be dual pair twisted- shielded.
- M. Cable for RS 485 devices (Remote Annunciators) shall be twisted-shielded pair (Belden 9841 or equivalent) for data signal. Power wiring shall be No. 12, or No. 14 AWG.
- N. Wiring of alarm horn circuits and alarm strobe circuits shall be No. 14 AWG minimum.
- O. Fire alarm cables shall be held in place at device box, by means of a two-screw connector, (do not use squeeze or crimp type connectors).
- P. All splices or connections shall be made within approved junction boxes and with approved fittings. Boxes shall be red and/or labeled "FIRE ALARM SYSTEM" by decal or other approved markings.
- Q. Horn and strobe circuits shall have separate conductors, and shall operate independently of each other.
- R. Horn and strobe wiring shall be No. 14 AWG minimum or as recommend by manufacturer.
- S. Tray cable is not acceptable for use as fire alarm systems wiring.

3.5 DEVICE MOUNTING

- A. Unless otherwise noted on drawings, specifications or identified by Architect or Engineer; recommended mounting heights and requirements are as follows:
 - 1. FIRE ALARM CONTROL PANELS
 - a. Mount control panels so all visual indicators and controls at 60 inches above floor level. Install 120-volt AC wiring with green ground wire on a dedicated separate circuit, maximum 20 amperes. Use only identified conduit entries or request approval for other penetrations in cabinets;

(certain areas require clear space for interior components). Cabinet shall be grounded to either a cold water pipe or grounding rod.

2. REMOTE ANNUNCIATORS

- a. Mount panels so all visual indicators and controls at 60 inches above floor level. Install multi-gang box as required by manufacturer, flush or surface mounted. Install wiring conductors in conduit, No. 16 AWG minimum or twisted shielded pairs, to Control Panel quantity as required.

3. AUDIO-VISUAL DEVICES

- a. Install flush, semi-flush or surface mount at 6 inches below finished ceiling or at 80 inches from bottom of device to highest level of finished floor. No devices protruding 4 inches or more shall be installed lower than 80 inches. Audio/Visual devices may be installed on ceilings in accordance with 1996 NFPA Table 6-4.4.1(b). If these requirements are not achievable, consult with Engineer before installation.
- b. All audio/visual devices shall be installed at same height throughout facility.
- c. For surface mounting, use manufacture-supplied backboxes and trim plates. Mark each device with circuit number.

4. MANUAL STATIONS

- a. Operable part of manual stations shall be installed not less than 3 1/2 ft. (42 inches) and not more than 4 1/2 ft. (54 inches) above finished floor. All Manual Stations shall be in unobstructed locations. Mark unit's address on inside and outside of housing. For surface mounting, use manufacture-supplied backboxes and trim plates.

5. HEAT AND SMOKE DETECTORS

- a. Location of detectors shown on drawings is schematic only. Detectors must be located according to code requirements.
- b. Surface mounted detectors shall be installed using back boxes equal to base's size. Standard octagon and square boxes are not acceptable.
- c. Detectors should be located on highest part of a smooth ceiling so that edge of detector is no closer than 4 inches from a sidewall. Ceilings with beams, joists or soffits that exceed 8 inches in depth require special planning and closer spacing. Verify with manufacturer.
- d. If it is necessary to mount a detector upon a sidewall, top of detector shall be located no closer than 4 inches from ceiling and no further away than 12 inches.
- e. Smoke detectors should be installed to favor the air flow towards return openings and not located closer than 3 feet from air supply diffusers which could dilute smoke before it reaches detector. No detectors shall be installed in direct airflow.
- f. Ideally, heat and smoke detectors should be located near center of open area which they are protecting, thus providing coverage generally for 15 foot radius for smoke detectors and a 25 foot radius for heat detectors. Verify location with Architect/ Engineer.
- g. Mark address and loop number on each detector's base.

3.6 IDENTIFICATION

- A. All junction boxes shall be painted red and labeled "Fire Alarm".
- B. All circuits must be labeled with name of circuit and area being served by circuit.
- C. All labels shall be permanent, and be machine generated. NO HANDWRITTEN OR NON-PERMANENT LABELS SHALL BE ALLOWED.
- D. Label size shall be appropriate for conductor or cable size(s) and design. All labels to be used shall be self-laminating, white/transparent vinyl and be wrapped around cable sheath. Flag type labels are not allowed. Labels shall be of adequate size to accommodate circumference of cable being labeled and properly self-laminate over full extent of printed area of label.
- E. Adhesive type labels not permitted except for phase and wire identification.
- F. Wiring color code shall be maintained throughout installation. Green wire shall be used only for equipment ground.

3.7 MANUFACTURER'S SERVICES

- A. Following supervision of installation shall be provided by a trained service technician from manufacturer of fire alarm equipment. This Technician shall be US certified and have had a minimum of two (2) years of service experience in fire alarm industry. Technician's name shall appear on equipment submittals and a letter of certification from fire alarm manufacturer shall be sent to project engineer. Manufacturer's service technician shall be responsible for following items:
 - 1. Pre-installation visit to job site to review equipment submittals and verify method by which system should be wired.
 - 2. During job progress make periodic job site visits to verify installation and wiring of system.
 - 3. Upon completion of wiring, final connections shall be made under supervision of this technician, and final checkout and certification of system.
 - 4. At time of final checkout, technician shall give operational instructions to Owner and his representative on system.
- B. All job site visits shall be dated and documented in writing and signed by electrical contractor. Any discrepancy shall be noted on this document and a copy kept in system job folder, which shall be available to Engineer any time during project.

3.8 TESTING

- A. Manufacturer's authorized representative shall provide on-site supervision of installation of complete fire alarm system installation, perform a complete functional test of each system, and submit a written report to Contractor attesting to proper operation of completed system prior to final inspection.

- B. Contractor shall test each and every device in system before system is considered substantially complete.
- C. Completed fire alarm system shall be fully tested in accordance with NFPA-72 by Contractor in presence of Owner's representative and local Fire Marshal. Upon completion of a successful test, and prior to final request for payment Contractor shall:
 - 1. Certify system to Owner in writing.
 - 2. Complete NFPA 1-7.2.1 (96 edition) record of completion form.
 - 3. Provide as builts and O&M manuals.
- D. Final payment will not be processed unless these documents are on hand and complete.

3.9 WARRANTY

- A. Contractor shall warrant completed fire alarm system wiring and equipment to be free from inherent mechanical and electrical defects for a period of two (2) years from date of substantial completion of project.
- B. At end of project, Contractor shall post warranty period along with company's name and telephone number inside fire alarm panel.
- C. Any occupied facility shall not be without a UL and an NFPA approved and fully operational fire alarm system for a period longer than two (2) hours. Emergency response shall be provided within two (2) hours of notification, to Contractor, of failure of system to perform operationally per UL and NFPA standards. Non-emergency service calls shall be responded to within twenty-four (24) hours of notification to Contractor.
- D. Repairs and/or replacement shall be completed within seventy-two (72) hours of time of notification. Other than emergency, actual repairs and replacement shall be provided during normal working hours, Monday through Friday, excluding holidays.
- E. If repair and replacement cannot be made within prescribed time, then other means and methods of protection shall be provided to insure safety of building occupants during which time system is not in compliance with standards. This may involve up to and include hiring Owner approved qualified personnel to stand a fire watch, all at Contractor's expense.
- F. Warranty service for equipment shall be provided by system supplier's factory trained representative. Further, Warranty shall include all parts, labor and necessary travel.

3.10 TRAINING

- A. Contractor through their supplier shall provide, as part of this contract, a minimum of 8 hours system operation training for owner, Architect/Engineer, and fire department personnel. Training sessions shall be at time to be stipulated by Owner. All training and other indoctrinations shall be completed prior to final inspection.

3.11 MAINTENANCE CONTRACT

- A. Equipment manufacturer shall make available to Owner a maintenance contract proposal to provide a minimum of two (2) inspections and tests per year in compliance with NFPA-72 Codes.

3.12 SPECIAL CONSIDERATIONS

- A. Contractor shall refer to Division 01, General Requirements, item INSERT NUMBER "SPECIAL SITE CONDITIONS".
- B. Contractor shall notify Owner's security officer (24) hours in advance of any zones inoperative for a period of time exceeding (2) hours.
- C. Existing fire alarm systems must be returned to full operation at end of each working day, or notification to Owner's security of what zones are inoperative on a daily basis in writing, hand delivered.

END OF SECTION

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SECTION 28 33 18
GAS DETECTION AND CONTROL SYSTEM

PART 1 GENERAL

1.1 SUMMARY

- A. This section includes specifications for system of gas detection and ventilation system control that monitors for presence of some, or all of the following gasses; Carbon Monoxide (CO), and Nitrogen Dioxide (NO₂), Combustible Gas-Solvents, Combustible Gases-Petro Vapors, and Methane (CH₄).
- B. Related Sections
 - 1. Applicable provisions of Division 01 govern work under this Section.
 - 2. Section 23 05 00 - Basic HVAC Requirements.
 - 3. Section 23 05 13 – Motor Requirements for HVAC Equipment.
 - 4. Section 23 09 14 - Pneumatic and Electric Instrumentation and Control Devices for HVAC.
 - 5. Section 23 09 23 - Direct Digital Control System for HVAC.
 - 6. Section 23 09 93 - Sequence of Operations for HVAC Controls.
 - 7. Division 26 - Electrical Specifications.

1.2 REFERENCE STANDARDS

- A. Underwriters Laboratory (UL)
- B. Canadian Standards Association (CSA)
- C. System shall be arranged to operate automatically upon detection of carbon monoxide at level of 35 parts per million (ppm).
- D. System shall also be arranged to operate automatically upon detection of nitrogen dioxide at level of one part per million (ppm).
- E. Systems equipped with toxic gas, combustible gas, or oxygen level sensors shall be arranged to automatically operate upon detection of gases at the following limits:
 - 1. Combustible Gas-Solvents: 25 percent LEL.
 - 2. Combustible Gas-Petro Vapors: 25 percent LFL.
 - 3. Methane: 25 percent LEL.
- F. Detection system shall allow automatic indexing of ventilation system to high ventilation rate in accordance with automatic control sequences as specified in Section 23 09 93 - Sequence of Operations for HVAC Controls and as indicated in this section.

- G. Automation system shall be arranged to be in compliance with State of Wisconsin Administration Code requirements.

1.3 QUALITY ASSURANCE

- A. Gas detection system supplier shall maintain service office within 100-mile radius of project location, and shall be staffed with trained technicians fully capable of providing instruction, routine maintenance and calibration service for all components of gas detection system.
- B. Manufacturer of gas detection system shall have minimum of five-years experience in design and manufacturer of gas detection systems. System shall ultimately provide full functionality as outlined in these specifications.

1.4 SUBMITTALS

- A. Product submittals shall include the following information:
 - 1. Manufacturer's data sheets indicating model number, components, materials of construction, installation instructions and recommendations and recommended maintenance;
 - 2. Schematic wiring diagrams showing main system controller and all other control and auxiliary devices, identifying each device with setting or adjustable range of control. Indicate all wiring, clearly, differentiating between factory and field installed wiring;
 - 3. Schedule of all sensors indicating sensor location and address (for microprocessor based systems).
- B. Operation and maintenance instructions for equipment and systems provided shall including the following items:
 - 1. Description of recommended replacement parts and materials which owner should stock;
 - 2. Summary of equipment components and parts list indicating replacement parts;
 - 3. Manufacturer's literature indicating features, materials of construction, and operating limits of installed equipment.

1.5 OWNER TRAINING

- A. Provide training to Owner's Representative(s), concerning proper operation and maintenance of system and all sensing, monitoring, and control equipment. Conduct training during normal business hours, after system start-up and acceptance of system by Owner.

1.6 WARRANTY

- A. Complete gas detection and control system shall be warranted for minimum of (2) two years, with parts and labor provided free of charge to Owner.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Approved Manufacturers:
 - 1. Vulcain Model VA-301-D₂.
 - 2. MSA North America.
 - 3. Engwald Corporation
 - 4. Substitutions: In accordance with Division 01 – General Requirements

2.2 DESCRIPTION

- A. Sensors shall be field adjustable and shall be able to be calibrated in field.

2.3 NETWORK CONTROLLER

- A. Network controller shall have the following capabilities and features:
 - 1. Green LED light for power on
 - 2. Red LED indicating first level of detection
 - 3. Red LED indicating second level of detection
 - 4. Yellow LED indicating system failure
 - 5. (2) RS-485 communication channels
 - 6. (1) RS-232 data transmission port
 - 7. (2) Alarm levels each with high and low set points
 - 8. Adjustable time delay before alarm
 - 9. Adjustable time delay after alarm
 - 10. (2) DPDT relays

2.4 LCD DISPLAY AND KEYPAD

- A. Alphanumeric display will indicate precisely status of sensor, type of gas or location of sensor as well as value of reading. Keypad shall facilitate cancellation of alarm, as well as allowing for programming changes on field.

2.5 STAND-ALONE MONITOR

- A. Unit shall have DPDT alarm relays, audible and visual alarms, programmable time delays, self-test capability and calibration status warning.

2.6 SENSORS

- A. Sensors shall be completely self-contained in steel housing complete with control panel and indicating lights.

- B. Sensor shall include digital memory that continuously monitors sensors calibration sequences to maintain sensor accuracy.
- C. Each sensor shall have (4) four LED's to indicate low alarm, high alarm, malfunction and power on. Sensor shall have dry contact outputs to interface to building control system or individual fan relays.
- D. Sensors shall be accurate in operating environment of -10 degrees F to 104 degrees F and 10 percent to 90 percent R.H. (non-condensing).
- E. Sensors must detect gas concentration based on electrochemical detection technology for the following gases:
 - 1. Carbon Monoxide (CO)
 - 2. Nitrogen Dioxide (NO₂)
 - 3. Methane (CH₄)
 - 4. Combustible Gas-Petroleum Vapors
 - 5. Combustible Gas-Solvents
- F. For carbon monoxide (CO) sensors, each sensor shall have capability to cover up to 50-foot radius (approx. 8000 FT² of floor area).
- G. System sensor relay module shall allow operation of auxiliary appliances. It shall contain relays of 1/16 HP, 5A, 24 VDC or 240 VAC and One (1) RS-485 Transmission Port.

2.7 SYSTEM ELECTRICAL

- A. Network Controller
 - 1. Power supply shall be 120 VAC.
 - 2. Furnish 120 VAC to 24 VAC power transformer. Transformer shall be supplied by independent primary feed circuit.
- B. Sensors
 - 1. Power supply shall be 120 VAC.
- C. Relays
 - 1. Gas detection and control system shall be capable of energizing ventilation fans when presence of one of more of the network sensors detects gas levels that reach or exceed field adjustable limits as specified herein. Ventilation fan(s) shall operate for minimum of 15 minutes to prevent short cycling.
 - 2. Furnish system with all required relays to cycle ventilation system fan(s) and make-up air units.
- D. Alarms
 - 1. Furnish system with all required audible and non-audible alarms for proper

system annunciation and control. Provide interface controls for connection to building automation system.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install all control equipment, accessories and wiring in neat and workmanship like manner. All control devices must be installed in accessible locations.
- B. Provide all electrical relays and wiring, line and low voltage for control system including all devices and all components. Install all wiring in metal conduit, in accordance with electrical sections (Division 26) of these specifications.
- C. All wiring shall be in accordance with National Electrical Code.
- D. Install system in strict accordance with manufacturer's recommendations and instructions.
- E. Locate any control relays within 5 feet of fan motor starter that it serves.
 - 1. Carbon Monoxide (CO) sensors shall be installed between 3 to 5 feet above floor.
 - 2. Nitrogen Dioxide (NO₂) sensors shall be installed at 1 foot below ceiling
 - 3. Methane (CH₄) sensors shall be installed at one foot below ceiling.
 - 4. Combustible Gas-Petroleum Vapors sensors shall be installed at one foot above floor.
 - 5. Combustible Gas-Solvents sensors shall be installed between 3 to 5 feet above floor.

3.2 START UP

- A. After completion of installation, test and adjust control equipment. Factory authorized service representative shall supervise installation and test system. Test system and equipment by simulating concentration of gas sufficient to initiate alarm condition. Submit final start-up report showing set points and final adjustments of controls, certifying that system has been installed and is fully operational in accordance with manufacturer's instructions and within functional intent of these specifications.
- B. Adjust and calibrate all sensors to assure proper operation of the system.

3.3 CONTROL SEQUENCES

- A. Carbon Monoxide
 - 1. Upon detection of CO level in excess of 35 PPM for interval of 5 minutes, contactor controlling exhaust fan system shall close, starting fan system and

allowing fan system to operate for minimum of 5 minutes (or longer if levels remain above 35 PPM).

2. If CO level exceeds 100 PPM for interval of 15 minutes or should CO level remain at or above average of 35 PPM for (8) eight hour period, sensor shall signal audible alarm indicating high level. Alarm shall automatically reset should CO level drop below 35 PPM.
3. In addition to above sequence, exhaust ventilation system (and make-up air system) shall operate for minimum of five hours within any 24-hour period.

B. Nitrogen Dioxide

1. Upon detection of NO₂ level in excess of 1 PPM, contactor controlling exhaust fan shall close, starting fan system and allowing fan system to operate for minimum of 5 minutes (or longer if levels remain at or above 1 PPM).
2. If NO₂ level reaches 3 PPM or remains at or above 1 PPM for (8) hour period, sensor shall signal audible alarm indicating high level. Alarm shall automatically reset should NO₂ level drop below 3 PPM.
3. In addition to above sequence, exhaust ventilation system (and make-up air system) shall operate for minimum of five hours within any 24-hour period.

C. Methane and Combustible Gases

1. Upon detection of selected gas level in excess of 25 percent of LEL or LFL value, sensor shall signal audible alarm indicating high level. Shall also indicate alarm condition to DDC control system. Exhaust ventilation system (and make-up air system) shall operate until sensor level drops below 20 percent LEL or LFL of selected gas, resetting alarm as well.

END OF SECTION

SECTION 31 02 00
GENERAL REQUIREMENTS FOR SITEWORK

PART 1 GENERAL

1.1 SUMMARY

- A. This Section governs only technical specifications related to site work construction.
- B. Section Includes:
 - 1. Definitions.
 - 2. Field Engineering.
 - 3. Pre-installation Meeting.
 - 4. Demonstration and Training Meeting.
 - 5. Submittal Procedures.
 - 6. Traffic Control Plan.
 - 7. Quality Control Requirements.
 - 8. Erosion and Sediment Control.
 - 9. Proposed Products List.
 - 10. Product Requirements.
 - 11. Project Closeout Procedures.
- C. Related Sections
 - 1. Section 31 23 16 – Utility Trench Excavation, Backfill, and Compaction.
 - 2. Section 31 25 13 – Erosion Controls.
 - 3. Section 32 11 23 – Aggregate Base Course.

1.2 DEFINITIONS

- A. Field Engineering: Contractor's establishment of elevations, lines, and levels as indicated on Drawings, utilizing recognized engineering survey practices.
- B. Pre-installation Meeting: Meeting to discuss a product or material, typically complex in nature, and review manufacturer's precautions, restrictions, and installation procedures.
- C. Demonstration and Training Meeting: Contractor and/or manufacturer representative administered demonstration and training sessions for Owner for each portion of equipment and products that are required to have training in proper operation and maintenance.
- D. Submittal Procedures: Specified requirements regarding procedures related to submission of product data, Shop Drawings, manufacturer's certificates, and substitutions.
- E. Traffic Control Plan: Plan developed consistent with Manual on Uniform Traffic Control Devices (MUTCD).

- F. Quality Control: Observation, analysis, and other relevant actions taken to provide control over what is being done, manufactured, or fabricated, so that a desirable level of quality is achieved and maintained during duration of the Work.
- G. Erosion and Sediment Control: Enforcement of state law and city or county ordinance for erosion and sediment control including installation, maintenance, and regular Contractor inspection and repair.
- H. Proposed Product List: Prepared listing of all materials and products intended to be used for site work related to sewer and water utilities, aggregates, and soils, and pavement mix designs.
- I. Product Requirements: Product information regarding manufacturer's data, preparation, fabrication, conveying and erection of Work including material, machinery, components, equipment, fixtures, and systems incorporated in Work.
- J. Project Closeout Procedures: Process that provides acceptance of project by Owner and Engineer/Architect including verification and documentation of required project records, and retention of other essential project documentation.

1.3 FIELD ENGINEERING

- A. Employ Land Surveyor registered in State of Wisconsin and acceptable to Owner.
- B. Owner will locate and protect survey control and reference points. Promptly notify Engineer of discrepancies discovered.
- C. Control datum for survey is that established by Owner provided survey.
- D. Verify setbacks and easements; confirm drawing dimensions and elevations.
- E. Provide required field engineering services. Establish elevations, lines, and levels, utilizing recognized engineering survey practices.
- F. Submit copy of site drawing and certificate signed by Land Surveyor certifying elevations and locations of the Work are in conformance with Contract Documents.
- G. Maintain complete and accurate log of control and survey work as Work progresses.
- H. Protect survey control points prior to starting site work; preserve permanent reference points during construction.
- I. Promptly report to Owner loss or destruction of reference point or relocation required because of changes in grades or other reasons.

- J. Replace dislocated survey control points based on original survey control. Make no changes without prior written notice to Owner.
- K. A Registered Land Surveyor shall replace damaged property corners at Contractor's expense.

1.4 PREINSTALLATION MEETING

- A. When required in individual specification sections, convene preinstallation meeting at Project site prior to commencing work of specific section.
- B. Require attendance of parties directly affecting, or affected by, Work of specific section.
- C. Notify Owner four (4) days in advance of meeting date.
- D. Prepare agenda and preside at meeting:
 - 1. Review conditions of installation, preparation and installation procedures.
 - 2. Review coordination with related work.
- E. Record minutes and distribute copies within two (2) days after meeting to participants, with two (2) copies to Owner and those affected by decisions made.

1.5 DEMONSTRATION AND TRAINING MEETING

- A. Contractor shall schedule and administer demonstration and training sessions for Owner for each portion of equipment and products that are required to have training in proper operation and maintenance.
- B. Contractor shall schedule representatives of equipment manufacturer to attend demonstration and training sessions to provide additional information as necessary.

1.6 SUBMITTAL PROCEDURES

- A. Contractor shall provide Engineer/Architect specific submittal information regarding products and materials of this specification section with extended permission of Architect.
- B. Submit Shop Drawings and product data covering identified equipment and materials that will become a permanent part of Work to Engineer/Architect for review.
- C. Shop Drawings and product data shall include drawings, descriptive information, and sufficient detail to show kind, size, arrangement, and operation of component materials and devices needed for installation and coordination with other materials and equipment.
- D. All submittals, regardless of origin, shall be stamped with approval of Contractor and identified with name of the Project, Contractor's name, and references to applicable specification sections and Drawings.

- E. Each submittal shall indicate intended use of item in Work. When manufacturer data sheets are submitted, clearly identify applicable items and cross out inapplicable data.
- F. Manufacturer's data sheets shall be current and include issue number and date.
- G. Contractor's stamp of approval is a representation to Engineer/Architect that Contractor accepts full responsibility for determining and verifying all quantities, dimensions, field construction criteria, materials, catalog numbers, and similar data, and that Contractor reviewed and coordinated each submittal with requirements of the Work.
- H. Contractor shall accept full responsibility for completeness of each submission. When an item consists of components from several sources, Contractor shall submit a complete initial submittal including all components.
- I. Identify deviations from Specifications and Drawings on each submittal and tabulate in Contractor's letter of transmittal. Such submittals shall indicate details of proposed changes, including modifications to other facilities that may result from deviation, and required piping and wiring diagrams.
- J. Submit six (6) copies of each drawing and necessary data to Engineer/Architect. Engineer/Architect will return two marked copies to Contractor. Electronic copies will not be acceptable.
- K. Engineer/Architect will not accept submittals from anyone but Contractor.
- L. Submittals shall be consecutively numbered in direct sequence of submittal and without division by subcontracts or trades.
- M. Review of Shop Drawings and Product Data:
 - 1. Engineer/Architect's review of Shop Drawings and product data will cover only general conformity to Drawings and Specifications, external connections, and dimensions that affect layout. Engineer/Architect's review does not indicate a thorough review of all dimensions, quantities, and details of material, equipment, device, or item shown.
 - 2. Engineer/Architect's review shall not relieve Contractor of Contractor's responsibility for errors, omissions, or deviations in drawings and data, nor of sole responsibility for compliance with the Work.
 - 3. Engineer/Architect's submittal review period shall be a maximum of fifteen (15) calendar days from date of submittal or resubmittal.
 - 4. When Shop Drawings and data are returned marked "NOT ACCEPTABLE" or "RETURNED FOR CORRECTION", make corrections as noted thereon and as instructed by Engineer/Architect and resubmit six (6) corrected copies. Electronic copies will not be acceptable.
 - 5. When Shop Drawings and data are returned marked "EXCEPTIONS NOTED" or "APPROVED AS SUBMITTED", no additional copies need be submitted unless

requested by Engineer/Architect at time of review.

- N. Re-submittal of Shop Drawings And Data:
1. Contractor shall accept full responsibility for completeness of each re-submittal.
 2. Contractor shall verify that resubmittal provides all corrected data and additional information previously requested by Engineer/Architect.
 3. When corrected copies are re-submitted, Contractor shall indicate in writing revisions made.
 4. Requirements specified for initial submittals also apply to re-submittals.
 5. Re-submittals shall bear number of first submittal followed by a letter (A, B, etc.) to indicate sequence of re-submittal.
 6. Make re-submittals within fifteen (15) days of date of letter returning material to be modified or corrected.
- O. Substitutes and "Or-Equal" Items:
1. Whenever a material or article is specified or described by using a single name of a proprietary product or a single name of a particular manufacturer or vendor, specified item mentioned shall be understood as establishing type, function, and quality desired.
 2. Whenever two or more names of proprietary products or particular manufacturers or vendors are used, it shall be understood that products of one named supplier shall be furnished with no options or substitutions allowed.
 3. Products, materials, or equipment not specified by proprietary name and submitted as a proposed substitute shall be reviewed and approved or rejected by Owner.
 4. Cost of proposed substitution review is subject to financial reimbursement from Contractor to Engineer/Architect for time taken for review and verification in the amount of \$200.00 dollars for each hour of review and verification.
 5. Contractor shall be liable for all costs incurred by Engineer/Architect related to each substitution review, including proposed substitutions which are rejected.

1.7 TRAFFIC CONTROL PLAN

- A. Submit a traffic control plan for construction in public right-of-way in accordance with Part VI of "Manual on Uniform Traffic Control Devices."
- B. Data to be included on a traffic control plan will vary depending upon complexity of project, volume of traffic affected, and roadway geometrics where construction is being performed.
- C. Traffic control plan must clearly depict exact sequence of construction operation(s), construction to be performed, and traveled way that will be utilized by all movements of traffic during each phase of construction.
- D. Multiple phases of construction will require a separate traffic control plan for each different construction phase or operation.

1.8 QUALITY CONTROL REQUIREMENTS

- A. Construction Notification:
 - 1. Contractor shall be responsible for locating existing underground installations in advance of excavating or trenching by contacting local utility identification agency.
- B. Licenses, Permits, and Certificates:
 - 1. All licenses, permits, and certificates, required for, and in connection with site and utility work shall be secured by Contractor at their sole cost and expense.
 - 2. Contractor will be required to pay any permit fees for required for utility work.
 - 3. Contractor shall comply with all requirements and recommendations of authority or authorities issuing license, permit, or certificate.
- C. Easements and Rights-of-Way:
 - 1. Contractor will confine construction operations to areas designated on Drawings or identified by Owner's Representative.
 - 2. Contractor shall use care in placement of construction tools, equipment, excavated materials, pipe materials, and supplies so as to minimize damage to property and minimize interference with the public.
- D. Protection of Property:
 - 1. Contractor shall protect from damage or injury all property including survey monuments, property markers, and benchmarks. Items damaged shall be replaced or repaired at Contractor's expense.
 - 2. Locate existing utilities and utility services in advance of excavation and protect against damage. Changes in grade and alignment may be made to Work to avoid conflicts with existing structures if approved by Owner's Representative.
- E. Reference Standards:
 - 1. Reference to standards, specifications, manuals, or codes of any technical society, organization, or association, or to laws or regulations of any governmental authority, whether such reference be specific or by implication, shall mean latest edition of appropriate standard, specification, manual, code, law, or regulation in effect on date of first advertisement for the Work, unless specifically stated otherwise in Contract Documents.
 - 2. Should there be a conflict in Reference Standards, Contractor shall request clarification from Owner's Representative before proceeding.
- F. Compaction and Gradation Testing
 - 1. Contractor shall provide and pay for compaction and gradation testing by an Owner approved independent testing laboratory.
 - a. Make two initial gradation tests for each type of bedding and backfill material, and make one additional gradation test for each additional 500 tons of each material.

- b. Moisture-density (Proctor) tests and relative density tests on materials, and in-place field density tests, shall be made at intervals determined by Owner's Representative.
- c. Perform compaction testing in accordance with procedures specified in Section 31 23 16 - Utility Trench Excavation, Backfill, and Compaction, and Section 32 11 23 – Aggregate Base Course.

G. Traffic Control - General:

- 1. Protect streets, roads, highways, and other public thoroughfares that are to be temporarily closed or restricted for traffic flow by effective barricades equipped with operational warning signals.
- 2. Locate barricades at nearest intersecting public highway or street on each side of blocked section.
- 3. Cover open trenches and other excavations with steel plates and have suitable barricades, signs, and lights to provide adequate protection to the public. Provide obstructions such as material piles and equipment with similar warning signs and lights.

H. Maintenance of Traffic:

- 1. Maintain effected traffic areas throughout duration of construction, in accordance with local, state, or federal requirements which govern Work area.
- 2. Contractor is responsible for maintaining traffic.
- 3. Contractor shall conduct work to minimize interference with traffic, vehicular or pedestrian.
- 4. Contractor shall obtain and pay for any permit required by local authority for areas where traffic will be obstructed.
- 5. Contractor shall provide and maintain suitable and safe bridges, detours, or other temporary measures for accommodating public and private travel.
- 6. Contractor shall provide at least twenty-four (24) hours notice to owners of private drives before performing Work which would obstruct safe passage by drive owner.
- 7. Illuminate barricades and obstructions with warning lights from sunset to sunrise.
- 8. Store material storage and perform Work on or alongside public streets and highways to minimize obstruction and inconvenience to public.

I. Traffic Control Devices:

- 1. Contractor shall provide barricades, cones, construction warning signs, flagmen, and incidental devices to protect personnel and equipment on the Work site.

1.9 EROSION AND SEDIMENT CONTROL

- A. Comply with requirements specified in Section 31 25 13 – Erosion Controls, and as indicated on Drawings.

1.10 PROPOSED PRODUCTS LIST

- A. Within fifteen (15) days after date of Owner-Contractor Agreement, submit list of major products proposed for use, with name of manufacturer, trade name, and model number of each product.
- B. For products specified only by reference standards, give manufacturer, trade name, model or catalog designation, and reference standards.

1.11 PRODUCT REQUIREMENTS

- A. Products include material, equipment, and systems.
- B. Comply with specifications and referenced standards as minimum requirements.
- C. Components required to be supplied in quantity within a Specification section shall be same, and shall be interchangeable.
- D. Do not use materials and equipment removed from existing structure, except as specifically required or allowed by Contract Documents.
- E. Products Specified by Reference Standards or by Description Only: Furnish any product meeting those standards.
- F. Products Specified by Naming Two or More Manufacturers: Furnish products of one named manufacturer meeting specifications; no options or substitutions allowed.
- G. Products Specified by Naming One or More Manufacturers or with a Provision for Substitutions: Submit a request for substitution of a proposed equal.

1.12 PROJECT CLOSEOUT PROCEDURES

- A. Project Records Documents:
 - 1. Contractor shall maintain, on site, one set of the following record documents:
 - a. Drawings.
 - b. Specifications.
 - c. Approved Shop Drawings.
 - d. Product data.
 - e. Samples.
 - 2. Contractor shall store Record Documents separate from documents used for construction.
 - 3. Contractor shall record actual revisions to the Work and maintain information concurrent with construction progress.
 - 4. Contractor shall legibly mark each item to record actual construction including:
 - a. Measured horizontal and vertical locations of new utilities and existing

- underground utilities and appurtenances referenced to permanent surface improvements.
- b. Field changes of dimensions and Drawing details.
- c. Details not on original Drawings.
- 5. Submit Record Documents to Owner at Final Inspection, including:
 - a. Project Drawings.
 - b. Survey notes.
 - c. Approved submittals.
 - d. Operation and Maintenance Manuals.

END OF SECTION

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SECTION 31 05 13

SOILS FOR EARTHWORK

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Subsoil materials.
 - 2. Topsoil materials.

- B. Related Sections:
 - 1. Applicable provisions of Section 31 02 00 – General Requirements for Sitework shall govern Work under this Section.
 - 2. Section 31 05 16 - Aggregates for Earthwork.
 - 3. Section 31 10 00 - Site Clearing.
 - 4. Section 31 22 13 - Rough Grading.
 - 5. Section 31 23 15 - Excavation, Backfill, and Compaction for Buildings and Structures.
 - 6. Section 31 23 16 - Utility Trench Excavation, Backfill, and Compaction.
 - 7. Section 31 25 13 - Erosion Controls: Slope protection and erosion control.
 - 8. Section 32 90 00 - Planting.
 - 9. Section 32 91 19 - Landscape Grading.

1.2 REFERENCES

- A. State of Wisconsin Department of Transportation
 - 1. Standard Specifications for Highway and Structure Construction, Current Edition. (WISDOT)

- B. ASTM International (American Society for Testing and Materials)
 - 1. ASTM D2487 - Classification of Soils for Engineering Purposes (Unified Soil Classification System).
 - 2. ASTM D5268 – Topsoil Used for Landscaping Purposes.

1.3 SUBMITTALS

- A. Section 31 02 00 – General Requirements for Sitework: Requirements for submittals.

- B. Samples: Submit, in airtight containers, a sample of each type of fill to testing laboratory. Size of sample to be per testing laboratory recommendations.

- C. Materials Source: Submit name of source of imported materials.

1.4 QUALITY ASSURANCE

- A. Perform Work in accordance with Wisconsin Department of Transportation standards.

PART 2 PRODUCTS

2.1 SUBSOIL MATERIALS

- A. Subsoil Type S1:
 - 1. Excavated and re-used material.
 - 2. Graded.
 - 3. Free of lumps larger than 3 inches, rocks larger than 2 inches, and debris.
 - 4. Contractor shall provide 10 lb sample of existing site material to laboratory for soil classification analysis conforming to ASTM D2487.
- B. Subsoil Type S2:
 - 1. On-site fill material subject to approval by Geotechnical Engineer.
 - 2. Graded.
 - 3. Free of lumps larger than 3 inches, rocks larger than 2 inches, and debris.
 - 4. Imported subsoil and borrow shall be similar in composition when compared to existing site subsoil.
 - 5. Contractor shall provide 10 lb sample of proposed imported borrow material to laboratory for soil classification analysis conforming to ASTM D2487.

2.2 TOPSOIL MATERIALS

- A. Topsoil Type T1:
 - 1. Excavated and reused material.
 - 2. Graded.
 - 3. Soil shall be free of roots, twigs, stones, subsoil, debris, weeds, and foreign matter larger than 1/2 inch.
 - 4. Topsoil shall be evaluated in accordance with ASTM D5268.
 - 5. Contractor shall provide 10 lb sample of excavated and reused material to laboratory for soil classification analysis conforming to ASTM D2487.
- B. Topsoil Type T2:
 - 1. Imported borrow.
 - 2. Friable loam.
 - 3. Soil shall be free of roots, twigs, stones, subsoil, debris, weeds, and foreign matter larger than 1/2 inch.
 - 4. Acidity range (pH) of 5.5 to 7.5.
 - 5. Containing minimum of 4 percent and maximum of 25 percent inorganic matter.
 - 6. Limit decaying matter to 5 percent of total content by volume.
 - 7. Topsoil shall be evaluated in accordance with ASTM D5268.
 - 8. Contractor shall provide 10 lb sample of proposed imported borrow material to

laboratory for soil classification analysis conforming to ASTM D2487.

2.3 SOURCE QUALITY CONTROL.

- A. Section 31 02 00 – General Requirements for Sitework: Testing and analysis of soil material.
- B. Testing and Analysis of Topsoil Material designated for Landscaping Purposes: Perform in accordance with ASTM D5268.
- C. When tests indicate materials do not meet specified requirements, change material and retest.
- D. Furnish materials of each type from same source throughout the Work.

PART 3 EXECUTION

Not Used

END OF SECTION

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SECTION 31 05 16

AGGREGATES FOR EARTHWORK

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Aggregate materials and designations for structure aggregate base course.
 - 2. Aggregate materials and designations for pavement aggregate base course.
 - 3. Aggregate materials and designations for backfill.
 - 4. Materials and designations for drainage aggregate.
 - 5. Aggregate materials and designations for grading purposes.

- B. Related Sections:
 - 1. Applicable provisions of Section 31 02 00 – General Requirements for Sitework shall govern Work under this Section.
 - 2. Section 31 05 13 – Soils for Earthwork.
 - 3. Section 31 22 13 - Rough Grading.
 - 4. Section 31 23 15 - Excavation, Backfill, and Compaction for Buildings and Structures.
 - 5. Section 31 23 16 - Utility Trench Excavation, Backfill, and Compaction.
 - 6. Section 31 25 13 - Erosion Controls: Slope protection and erosion control.
 - 7. Section 32 11 23 - Aggregate Base Course.

1.2 REFERENCES

- A. ASTM International
 - 1. ASTM C33 – Specification for Concrete Aggregates.
 - 2. ASTM C136 - Test Method for Sieve Analysis of Fine and Coarse Aggregates.

- B. State of Wisconsin Department of Transportation
 - 1. Standard Specifications for Highway and Structure Construction, Current Edition. (WISDOT).

1.3 SUBMITTALS

- A. Section 31 02 00 – General Requirements for Sitework: Requirements for submittals.

- B. Samples: Submit, in airtight containers, 10 lb. sample of each type of fill to testing laboratory.

- C. Materials Source: Submit name of source of imported materials.

1.4 QUALITY ASSURANCE

- A. Perform Work in accordance with Wisconsin Department of Transportation standards.

PART 2 PRODUCTS

2.1 AGGREGATE MATERIALS

- A. Aggregate Type A1 (Gravel): Crushed Gravel: free of organic matter and debris; graded in accordance with:
1. WISDOT 3/4-Inch Gradation.
B. Aggregate Type A2 (Gravel): Crushed Gravel: free of organic matter and debris; graded in accordance with:
1. WISDOT 1-1/4-Inch Gradation.
C. Aggregate Type A3 (Recycled): Crushed Concrete; free of from wood, steel, roots, bark or other extraneous material; graded in accordance with:
1. WISDOT 1-1/4-Inch Gradation.
D. Aggregate Type A4 (Recycled): Crushed Asphaltic Concrete; free of from wood, steel, roots, bark or other extraneous material; graded in accordance with:
1. WISDOT 1-1/4-Inch Gradation.
E. Aggregate Type A5 (Stone): Crushed Stone; free of clay, shale, organic matter; graded in accordance with:
1. WISDOT Open-Graded Gradation.
F. Aggregate Type A6 (3/8-Inch Stone Chips): Crushed stone; free of clay, shale, organic matter; graded in accordance with the following limits:

Table with 2 columns: Sieve Size, Percent Passing. Rows include 1/2-inch, 3/8-inch, No. 8, and No. 30.

- G. Aggregate Type A7 (3/4-Inch Stone Chips): Crushed stone; free of clay, shale, organic matter; graded in accordance with the following limits:

Table with 2 columns: Sieve Size, Percent Passing. Rows include 1-inch, 3/4-inch, 3/8-inch, No. 4, and No. 8.

- H. Aggregate Type A8 (Pea Gravel): Fractured, washed, free of clay, shale, organic matter; graded in accordance with the following limits:
 1. Minimum Size: 1/4-inch.
 2. Maximum Size: 3/8-inch.
- I. Aggregate Type A9 (Granular Fill): Natural gravel/stone; free of clay, shale, organic matter; graded in accordance with:
 1. WISDOT 3-Inch Gradation.
- J. Aggregate Type A10 (Bank Run Sand/Gravel): Natural river or bank sand; free of silt, clay, loam, friable or soluble materials, and organic matter; graded in accordance with following limits:

<u>Sieve Size</u>	<u>Percent Passing</u>
2-inch	95 - 100
No. 4	35 - 60
Finer Than No. 200	5 - 15

- K. Aggregate Type A11 (Drainage Aggregate): Crushed stone; free of clay, shale, organic matter; graded in accordance with the following limits:

<u>Sieve Size</u>	<u>Percent Passing</u>
1-inch	100 - 75
3/4-inch	50 - 75
No. 4	0 - 60
No. 40	0 - 50
No. 200	0 - 5

- L. Aggregate Type A12 (Bedding Sand): Unwashed bank-run sand or rejected concrete sand; approximately 6 percent fine clay or loam particles but free of silt and clay or loam lumps consisting of durable particles ranging in size from fine to coarse in uniform combinations; maximum moisture content shall be 10 percent, graded within following limits:

<u>Sieve Size</u>	<u>Percent Passing</u>
1-inch	100
No. 16	45 - 80
No. 200	2 - 10

- M. Aggregate Type A13 (Sand Fill): Natural river or bank sand; free of silt, clay, or loam, friable or soluble materials, or organic matter; consisting of durable particles ranging in size from fine to coarse in uniform combinations; maximum moisture content shall be 10 percent, graded within following limits:

<u>Sieve Size</u>	<u>Percent Passing</u>
3/8-inch	100
No. 4	95 - 100
No. 8	75 - 90
No. 16	55 - 75
No. 30	30 - 50
No. 50	10 - 25
No. 100	2 - 10
No. 200	0

- N. Aggregate Type A14 (Stone): Crushed Stone; free of clay, shale, organic matter; graded in accordance with ASTM C33, Size No. 2.

2.2 SOURCE QUALITY CONTROL

- A. Section 31 02 00 – General Requirements for Sitework: Testing and analysis of aggregates.
- B. When tests indicate materials do not meet specified requirements, change material or material source and retest.
- C. Furnish materials of each type from same source throughout the Work.

PART 3 EXECUTION

Not Used

END OF SECTION

SECTION 31 10 00
SITE CLEARING

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Removal of grass and vegetation.
 - 2. Removal of trees, shrubs, and other plant life.
 - 3. Herbicide application.
 - 4. Removal of site debris.
 - 5. Clearing activities near existing permanent utilities and structures.
 - 6. Protection of project entrances and exits.

- B. Related Sections:
 - 1. Applicable provisions of Section 31 02 00 - General Requirements for Sitework shall govern Work under this Section.
 - 2. Section 31 22 13 - Rough Grading: Removal of topsoil and subsoil.
 - 3. Section 31 23 16 – Utility Trench Excavation, Backfill, and Compaction: Backfill and compaction of cleared areas.
 - 4. Section 32 90 00 - Planting.
 - 5. Section 32 91 19 - Landscape Grading.

1.2 REFERENCES

- A. State of Wisconsin Department of Transportation
 - 1. Standard Specifications for Highway and Structure Construction, Current Edition. (WISDOT)

- B. State of Wisconsin Department of Natural Resources (WDNR)
 - 1. Construction Site Erosion & Sediment Control.
<http://www.dnr.state.wi.us/runoff/stormwater/techstds.htm>

- C. U.S. Environmental Protection Agency
 - 1. Developing Your Stormwater Pollution Prevention Plan, A Guide for Construction Sites.
http://www.epa.gov/npdes/pubs/sw_swppp_guide.pdf

1.3 DEFINITIONS

- A. Tree - Woody perennial plant, single main stem with trunk, diameter of 6 inches or greater. Multiple-stem trees with forks up to 4 feet from ground elevation shall be considered a cluster of trees. Trees that fork above 4 feet shall be considered a single tree.

- B. Sapling - Woody perennial plant with single stem with trunk less than 6 inches in diameter.
- C. Root Zone - Area around a tree extending as far from tree base as longest horizontal branches.
- D. Surface Water - Soil water that flows through ditch lines, creeks, and streams by gravity.
- E. Grubbing - To clear project site by removing roots and stumps.
- F. Clearing - Cutting down of bushes and trees and the digging and removal of their roots and stumps.
- G. Clearing Limits - Area designated on Drawings scheduled for clearing operations within project site or right-of-way.
- H. Herbicide - Post emergence type, used to kill entire plant or vegetation, including root system.

1.4 SUBMITTALS

- A. Section 31 02 00 – General Requirements for Sitework: Requirements for submittals.
- B. Submit product data for herbicide, including manufacturer's instructions, usage, and hazardous materials sheets.

1.5 REGULATORY REQUIREMENTS

- A. Contractor shall comply with local, state, and federal regulations applicable to Work of this Section.
- B. Contractor shall comply with and be solely responsible for compliance with U.S. Department of Labor OSHA Part 1926 Safety and Health Regulations for Construction for this Work.
- C. Contractor performing Work of this Section shall be solely responsible for identifying, furnishing, installing and maintaining equipment and materials required by State and Federal regulations to establish safe working conditions during Work of this Section.
- D. Conform to applicable code for environmental requirements, disposal of debris, burning debris on site and use of herbicides.
- E. Coordinate clearing Work with utility companies.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Herbicide:
 - 1. Pre-emergence Herbicide: Liquid or wettable powder form; type which controls

plants emerging from seed, but has no harmful effect on established plants when applied at recommended rates; resist leaching, and remain effective throughout one growing season.

PART 3 EXECUTION

3.1 NOTIFICATION

- A. Contractor, prior to any excavation work, shall notify (1) a designated locating service; (2) all utilities, governmental agencies, entities, known to, or which can reasonably be assumed to, have above or below ground pipe, conduit cables, structures, or similar items within limits of project; to locate and mark location of such items.
- B. In accordance with Wisconsin Statute 182.0175, "Damage to Transmission Facilities," Excavator, as defined in 182.0175(1)(bm), shall be solely responsible to provide advance notice to "Diggers Hotline, Inc." (800-242-8511) not less than three working days prior to commencement of any Excavation, as defined in the statute, required to perform work contained in this Project, and further, Excavator shall comply with all other requirements of this Statute relative to Excavation.

3.2 PREPARATION

- A. Verify erosion control is in place prior to start of Work.
- B. Verify that existing plant life designated to remain is tagged or identified and protected.

3.3 PROTECTION

- A. Maintain and repair damaged erosion control items throughout Work.
- B. Protect utilities that remain, from damage.
- C. Do not divert or relocate surface water without prior written approval from Owner's Representative.
- D. Protect trees, plant growth, and features designated to remain as final landscaping.
- E. Protect benchmarks, survey control points, and existing structures from damage or displacement.
- F. Keep entrances and exits, and adjacent roadways affected, free of debris from clearing operations.

3.4 CLEARING

- A. Clear area required for access to site and execution of Work.

- B. Remove surface rock larger than 2 inches.
- C. Clear undergrowth and deadwood, without disturbing subsoil.
- D. Apply herbicide to remaining stumps to inhibit growth.

3.5 REMOVAL

- A. Remove debris, rock, and extracted plant life from site.
- B. Notify Owner's Representative if underground storage tanks and piping is uncovered during Work.
- C. Cease work in immediate area of tanks until direction is given to proceed.

END OF SECTION

SECTION 31 22 13
ROUGH GRADING

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Removal of topsoil and subsoil
 - 2. Cutting, grading, filling, rough contouring and compacting site for site structures, and pavements.

- B. Related Sections:
 - 1. Applicable provisions of Section 31 02 00 – General Requirements for Sitework shall govern Work under this Section.
 - 2. Section 31 05 13 – Soils for Earthwork.
 - 3. Section 31 05 16 – Aggregates for Earthwork.
 - 4. Section 31 10 00 - Site Clearing.
 - 5. Section 31 23 15 - Excavation, Backfill, and Compaction for Buildings and Structures: Building excavation and building area backfill.
 - 6. Section 31 23 16 - Utility Trench Excavation, Backfill, and Compaction.
 - 7. Section 31 25 13 – Erosion Controls.
 - 8. Section 32 90 00 - Planting.
 - 9. Section 32 91 19 - Landscape Grading.

1.2 REFERENCES

- A. State of Wisconsin Department of Transportation.
 - 1. Standard Specifications for Highway and Structure Construction, Current Edition. (WISDOT)

- B. ASTM International (American Society for Testing and Materials)
 - 1. ASTM C136 – Test Method For Sieve Analysis of Fine and Coarse Aggregates.
 - 2. ASTM D698 – Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort 12,400 ft.-lbf/ft³.
 - 3. ASTM D1557 - Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort 56,000 ft.-lbf/ft³.
 - 4. ASTM D6938 – Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).

1.3 CLOSEOUT SUBMITTALS

- A. Section 31 02 00 – General Requirements for Sitework: Requirements for project closeout submittals.

1.4 QUALITY ASSURANCE

- A. Perform Work in accordance with Wisconsin Department of Transportation standards.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Topsoil: Type T1 or T2 as specified in Section 31 05 13 – Soils for Earthwork.
- B. Subsoil Fill: Type S1 or S2 as specified in Section 31 05 13 – Soils For Earthwork.
- C. Granular Fill: Type A1 or A2 as specified in Section 31 05 16 – Aggregates for Earthwork.
- D. Geotextile, Type 1, Mirafi 600X or equal.

PART 3 EXECUTION

3.1 NOTIFICATION

- A. Contractor, prior to any excavation work, shall notify (1) a designated locating service; (2) all utilities, governmental agencies, entities, known to, or which can reasonably be assumed to have above or below ground pipe, conduit cables, structures, or similar items within limits of project; to locate and mark location of such items.
- B. In accordance with Wisconsin Statute 182.0175, "Damage to Transmission Facilities," Excavator, as defined in 182.0175(1)(bm), shall be solely responsible to provide advance notice to "Diggers Hotline, Inc." (800-242-8511) not less than three working days prior to commencement of any Excavation, as defined in the statute, required to perform work contained in this Project, and further, Excavator shall comply with all other requirements of this Statute relative to Excavation.

3.2 EXAMINATION

- A. Section 31 02 00 – General Requirements for Sitework: Verification of existing conditions before starting work.
- B. Verify project survey benchmarks and intended elevations are as indicated on Drawings.

3.3 PREPARATION

- A. Identify required lines, levels, contours, and datum.
- B. Stake and flag locations of known utilities.
- C. Locate, identify, and protect utilities, indicated to remain, from damage.

- D. Notify utility company to remove and relocate utilities.
- E. Protect above and below grade utilities indicated to remain.
- F. Protect plant life, lawns, and other features remaining as portion of final landscaping.
- G. Protect benchmarks, survey control points, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.

3.4 TOPSOIL EXCAVATION

- A. Excavate topsoil from areas to be further excavated, re-landscaped, or re-graded, without mixing with foreign materials.
- B. Do not excavate wet topsoil.
- C. Stockpile in area designated on site to depth not exceeding 8 feet and protect from erosion.
- D. Protect stockpiled material from erosion. Provide silt fencing or other approved erosion prevention method.
- E. Remove excess topsoil from site.
- F. Excess topsoil removed from project site shall be delivered and stockpiled at another location on the landfill property.

3.5 SUBSOIL EXCAVATION

- A. Excavate subsoil from areas to be further excavated, re-landscaped, or re-graded.
- B. Do not excavate wet subsoil or excavate and process wet material to obtain optimum moisture content.
- C. When excavating through roots, perform Work by hand and cut roots with sharp ax.
- D. Remove excess subsoil not intended for reuse, from site.
- E. Benching Slopes: Horizontally bench existing slopes greater than 1:4 to key placed fill material to slope to provide firm bearing.
- F. Stability: Replace damaged or displaced subsoil as specified for fill.

3.6 FILLING

- A. Install Work in accordance with Wisconsin Department of Transportation Standards.
- B. Fill areas to contours and elevations with unfrozen materials.

- C. Place fill material on continuous layers and compact in accordance with schedule at end of this section.
- D. Maintain optimum moisture content of fill materials to attain required compaction density.
- E. Slope grade away from building minimum 2 inches in 10 feet, unless noted otherwise.
- F. Make grade changes gradual. Blend slope into level areas.
- G. Remove surplus fill materials from site.
- H. Install Geotextile, Type 1 at locations shown on Drawings.

3.7 TOLERANCES

- A. Section 31 02 00 – General Requirements for Sitework: Tolerances.
- B. Top Surface of Subgrade: Plus or minus 1/10-foot from required elevation.

3.8 FIELD QUALITY CONTROL

- A. Section 31 02 00 – General Requirements for Sitework: Testing and inspection services.
- B. Section 31 02 00 – General Requirements for Sitework: Testing, adjusting, and balancing at project closeout.
- C. Testing and Analysis of Fill Material: In accordance with ASTM D1557.
- D. Density and Moisture Testing: In accordance with ASTM D6938.
- E. When tests indicate Work does not meet specified requirements, remove Work, replace, and retest.
- F. Frequency of Tests: As determined by Owner’s Representative.

3.9 SCHEDULES

- A. Granular Fill:
 - 1. Fill Type A1 or A2: Maximum 7-inch loose lifts.
 - 2. Compact each lift to minimum 95 percent of modified Proctor density.
- B. Subsoil Fill:
 - 1. Fill Type S1 or S2: Maximum 12-inch loose lifts.
 - 2. Compact each lift to minimum 95 percent of modified Proctor density.

- C. Topsoil Fill:
1. Fill Type T1 or T2: Maximum 12-inch loose lifts.
 2. Compact each lift to minimum 85 percent of modified Proctor density.

END OF SECTION

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SECTION 31 23 15

EXCAVATION, BACKFILL, AND COMPACTION
FOR BUILDINGS AND STRUCTURES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Verification of subsurface conditions and utilities prior to excavation.
2. Excavation for building foundation.
3. Excavation for structure foundation.
4. Excavation for pile caps.
5. Excavation for slabs-on-grade.
6. Building backfilling to subgrade elevations.
7. Structure backfilling to subgrade elevations.
8. Fill under slabs-on-grade.
9. Backfill for over-excavation corrections.
10. Consolidation and compaction.

B. Related Sections:

1. Applicable provisions of Section 31 02 00 – General Requirements for Sitework shall govern Work under this Section.
2. Section 31 05 16 – Aggregates for Earthwork: Aggregate backfill materials.
3. Section 31 22 13 - Rough Grading: Topsoil and subsoil removal from site surface.
4. Section 31 23 16 - Utility Trench Excavation, Backfill, and Compaction: Excavation and backfill for utility trenches.
5. Section 33 46 00 - Subdrainage: Filter aggregate over piping and filter fabric.

1.2 REFERENCES

A. State of Wisconsin Department of Transportation

1. Standard Specifications for Highway and Structure Construction, Current Edition. (WISDOT)

B. ASTM International (American Society for Testing and Materials)

1. ASTM D698 - Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft.-lbf/ft³ (600 kN-m/m³)).
2. ASTM D1557 - Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft.-lbf/ft³ (2,700 kN-m/m³)).
3. ASTM D6938 – Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).

1.3 REGULATORY REQUIREMENTS

- A. Contractor shall comply with all local, state, and federal regulations applicable to Work of this Section.
- B. Contractor shall comply with and be solely responsible for compliance with U.S. Department of Labor OSHA Part 1926 Safety and Health Regulations for Construction for this Work.
- C. Contractor performing Work of this Section shall be solely responsible for identifying, furnishing, installing, and maintaining equipment and materials required by state and federal regulations to establish safe working conditions during Work of this Section.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.1 NOTIFICATION

- A. Contractor, prior to any excavation work, shall notify (1) a designated locating service; (2) all utilities, governmental agencies, entities, known to, or which can reasonably be assumed to have above or below ground pipe, conduit cables, structures, or similar items within limits of project; to locate and mark location of such items.
- B. In accordance with Wisconsin Statute 182.0175, "Damage to Transmission Facilities," Excavator, as defined in 182.0175(1)(bm), shall be solely responsible to provide advance notice to "Diggers Hotline, Inc." (800-242-8511) not less than three working days prior to commencement of any Excavation, as defined in the statute, required to perform work contained in this Project, and further, Excavator shall comply with all other requirements of this Statute relative to Excavation.

3.2 SITE VERIFICATION

- A. Verify that survey benchmark and intended elevations for Work are as indicated.

3.3 PREPARATION FOR EXCAVATION

- A. Identify required lines, levels, contours, and datum.
- B. Stake and flag locations of known utilities.
- C. Notify utility company to remove and relocate utilities that interfere with Work.
- D. Protect above and below grade utilities indicated to remain.

- E. Protect plant life, lawns, and other features remaining as portion of final landscaping.
- F. Protect benchmarks, survey control points, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.

3.4 EXCAVATION

- A. Underpin adjacent structures that may be damaged by excavation work, including utilities and pipe chases.
- B. Excavate subsoil required to accommodate building foundation, slabs-on-grade and construction operations.
- C. Excavate to working elevations for piling work.
- D. Machine slope banks to angle of repose or less, until shored.
- E. Excavate cut to not interfere with normal 45 degree bearing splay of foundation.
- F. Grade top perimeter of excavation to prevent surface water from draining into excavation.
- G. Hand trim excavation. Remove loose matter.
- H. Remove lumped subsoil, boulders, and rock.
- I. Notify Engineer/Architect of unexpected subsurface conditions and discontinue affected Work in area until notified to resume work.
- J. Correct unauthorized excavation at no extra cost to Owner.
- K. Correct areas over-excavated in error.
- L. Stockpile excavated material in area designated on site and remove excess material not being reused, from site.

3.5 FIELD QUALITY CONTROL FOR EXCAVATION

- A. Field inspection will be performed under provisions of Section 31 02 00 – General Requirements for Sitework.
- B. Provide for visual inspection of bearing surfaces.

3.6 PROTECTION

- A. Protect excavations by methods required to prevent cave-in or loose soil from falling into excavation.

- B. Protect bottom of excavations and soil adjacent to and beneath foundation from freezing.

3.7 EXAMINATION PRIOR TO BACKFILLING

- A. Verify fill material to be reused are acceptable.
- B. Verify foundation perimeter drainage installation has been inspected.

3.8 PREPARATION FOR BACKFILLING

- A. Generally, compact subgrade to density requirements for subsequent backfill materials.
- B. Cut out soft areas of subgrade not capable of establishing compaction. Backfill with Type A2 fill as specified in Section 31 05 16 – Aggregates for Earthwork, and compact to density equal to or greater than requirements for subsequent backfill material.
- C. Where side wall material is loose or unstable, place geotextile cloth material over sidewall prior to backfilling.

3.9 BACKFILLING

- A. Backfill areas to contours and elevations with unfrozen materials.
- B. Systematically backfill to allow maximum time for natural settlement. Do not backfill over porous, wet, frozen or spongy subgrade surfaces.
- C. Employ a placement method that does not disturb or damage utilities in trenches.
- D. Maintain optimum moisture content of backfill materials to attain required compaction density.
- E. Backfill against supported foundation walls. Do not backfill against unsupported foundation walls.
- F. Slope grade away from building minimum 2 inches in 10 feet, unless noted otherwise.
- G. Make grade changes gradual. Blend slope into level areas.
- H. Leave fill material stockpile areas completely free of excess fill materials.
- I. Remove surplus backfill materials from site.

3.10 TOLERANCES FOR BACKFILL

- A. Top Surface of Backfilling under Paved Areas: Plus or minus 1 inch from required elevations.

3.11 FIELD QUALITY CONTROL FOR BACKFILL

- A. Field inspection and testing will be performed under provisions of Section 31 02 00 – General Requirements for Sitework.
- B. Testing and analysis of fill material will be performed in accordance with ASTM D1557 and Section 31 02 00 – General Requirements for Sitework.
- C. Compaction testing will be performed in accordance with ASTM D6938 and Section 31 02 00 – General Requirements for Sitework.
- D. If tests indicate Work does not meet specific requirements, remove Work, replace, and retest at no cost to Owner.

3.12 PROTECTION OF FINISHED BACKFILL

- A. Protect finished Work under provisions of Section 31 02 00 – General Requirements for Sitework.
- B. Re-compact fills disturbed by vehicular traffic.

3.13 SCHEDULE OF BACKFILL

- A. Section 31 05 16 – Aggregates for Earthwork defines “A” designated fill materials and Section 31 05 13 – Soils for Earthwork defines “S” designated fill materials.
- B. Foundations, Below Grade Slabs, Interior Slabs-On-Grade, Tipping Slab to Underside of Floor Insulation, and Fill to Correct Over Excavation:
 - 1. Approved fill material from landfill site stockpile as discussed in Soils Report documentation (see Appendix 1).

END OF SECTION

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SECTION 31 23 16

UTILITY TRENCH EXCAVATION, BACKFILL AND COMPACTION

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Verification of subsurface conditions and utilities prior to excavation.
2. Sawcutting of pavements prior to excavation.
3. Excavation of trenches for sanitary sewer collection system.
4. Excavation of trenches for storm sewer collection system.
5. Excavation of trenches for water distribution system.
6. Compacted bedding and cover material for utility piping system.
7. Backfill Requirements.
8. Consolidation and compaction Requirements.

B. Related Sections:

1. Applicable provisions of Section 31 02 00 – General Requirements for Sitework shall govern Work under this Section.
2. Section 31 05 13 – Soils for Earthwork: Subsoil backfill.
3. Section 31 05 16 – Aggregates for Earthwork: Aggregate backfill materials.
4. Section 31 23 15 – Excavation, Backfill, and Compaction for Buildings and Structures.
5. Section 33 11 00 – Site Water System: Installation of site water lines for private use.
6. Section 33 31 00 – Site Sanitary Sewer System: Installation of sanitary sewer system.
7. Section 33 41 00 – Site Storm Sewer System: Installation of storm sewer system.
8. Section 33 42 23 – Concrete Box Culverts: Installation of box culverts.

1.2 REFERENCES

A. ASTM International (American Society for Testing and Materials)

1. ASTM C518 - Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
2. ASTM C578 – Specification for Rigid, Cellular Polystyrene Thermal Insulation.
3. ASTM D1557 - Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort 56,000 ft.-lbf/ft³.
4. ASTM D1621 - Test Method for Compressive Properties Of Rigid Cellular Plastics.
5. ASTM D2842 - Test Method for Water Absorption of Rigid Cellular Plastics.
6. ASTM D6938 – Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).

- B. State of Wisconsin Department of Transportation
 - 1. Standard Specifications for Highway and Structure Construction, Current Edition. (WISDOT)

1.3 SUBMITTALS

- A. Section 31 02 00 – General Requirements for Sitework: Requirements for submittals.
- B. Samples: Submit a sample of each type of specified fill to testing laboratory, in airtight containers. Size of sample per testing laboratory recommendations.
- C. Provide certified analysis of material(s) to Owner’s Representative prior to any use on Work.

1.4 REGULATORY REQUIREMENTS

- A. Contractor shall comply with local, state, and federal regulations applicable to Work of this Section.
- B. Contractor shall comply with and be solely responsible for compliance with U.S. Department of Labor OSHA Part 1926 Safety and Health Regulations for Construction for this Work.
- C. Contractor performing Work of this Section shall be solely responsible for identifying, furnishing, installing and maintaining equipment and materials required by State and Federal regulations to establish safe working conditions during Work of this Section.

PART 2 PRODUCTS

2.1 BEDDING AND BACKFILL MATERIALS

- A. Water Main Bedding: Type A12, as defined in Section 31 05 16 – Aggregates for Earthwork.
- B. Sewer Bedding, 18 Inches in Diameter and Less: Type A6, as defined in Section 31 05 16 – Aggregates for Earthwork.
- C. Sewer Bedding, Greater than 18 Inches in Diameter: Type A7, as defined in Section 31 05 16 – Aggregates for Earthwork.
- D. Crushed Stone Backfill: Type A1 or A2 as defined in Section 31 05 16 – Aggregates for Earthwork.
- E. Site Excavated Material (Spoil) Backfill: Type S1 or S2 as defined in Section 31 05 13 – Soils for Earthwork.

2.2 AGGREGATE SLURRY BACKFILL

- A. Place materials in a clean cement mixer truck and thoroughly mixed in following quantities:

1,350 lbs.	sand
775 lbs.	1-1/4-inch stone
1,150 lbs.	3/4-inch stone
25 gals.	(+0 to -0.5) water/cu.yd.

- B. Lean concrete backfill shall conform to above with addition of a minimum of one bag of cement per cubic yard.

2.3 PIPE INSULATION

- A. Extruded polystyrene board to ASTM C578, Type V, rigid, closed cell type, with integral high density skin.
 - 1. Thermal Resistance: Typical 5 year aged value of R-5 per 1 inch of thickness per ASTM C518.
 - 2. Board Size: 24 x 96 x 2-inch thick. Square edges.
 - 3. Compressive Strength: Minimum 100 psi per ASTM D1621.
 - 4. Water Absorption: 0.7 percent by volume maximum per ASTM D2842.
- B. Insulation shall be Dow Chemical Company STYROFOAM™ Highload 100 or an approved equal.

PART 3 EXECUTION

3.1 NOTIFICATION

- A. Contractor, prior to any excavation work, shall notify (1) a designated locating service; (2) all utilities, governmental agencies, entities, known to, or which can reasonably be assumed to have above or below ground pipe, conduit cables, structures, or similar items within limits of project; to locate and mark location of such items.
- B. In accordance with Wisconsin Statute 182.0175, "Damage to Transmission Facilities," Excavator, as defined in 182.0175(1)(bm), shall be solely responsible to provide advance notice to "Diggers Hotline, Inc." (800-242-8511) not less than three working days prior to commencement of any Excavation, as defined in the statute, required to perform work contained in this Project, and further, Excavator shall comply with all other requirements of this Statute relative to Excavation.

3.2 EXAMINATION

- A. Verify fill materials to be reused are acceptable.

3.3 SITE VERIFICATION AND FIELD MEASUREMENTS

- A. Verify that survey benchmark and intended elevations for the Work are as shown on Drawings.

- B. Contractor shall employ a Registered Land Surveyor, registered in the State of Wisconsin to perform all survey work related to primary line and grade for project utilities.
- C. Contractor shall check accuracy of line and grade stakes by means of visual and taping checks and shall be responsible for protection and preservation of such stakes established by Registered Land Surveyor.
- D. Contractor shall bear sole responsibility for correct transfer of all construction lines and grades from primary line and grade points and for correct alignment and grade of finished structure, based upon primary line and grade established by Registered Land Surveyor.
- E. Except for those lot corners and survey monuments that fall within trench excavation, Contractor shall be solely responsible for protection and/or replacement of all survey corners that exist throughout work area.
- F. A Registered Land Surveyor shall replace damaged corners at Contractor's expense.

3.4 SAWING AND BREAKING PAVEMENT

- A. Saw concrete pavement, slabs, or bases to a minimum 1/2 of depth of existing pavement, slab, or base prior to removal.
- B. Saw Cut asphalt surface course and asphalt binder course full depth before removal.
- C. Cut pavements evenly along edges of excavation prior to their removal in such a way as to avoid excessive removal or ragged, uneven edges.
- D. A drop weight or other type of machinery for breaking pavement, when approved by Owner's Representative, may be used when such usage does not become a nuisance or a source of damage to underground or adjacent structures.
- E. Prior to employing a drop weight, Contractor shall verify that there are no nearby underground structures that would be injured by its use.
- F. Contractor shall be solely responsible for any damage caused thereby.
- G. Owner's Representative reserves right to order discontinuance of use of such drop weight at any time.

3.5 PREPARATION

- A. Identify required lines, levels, contours, and datum.
- B. Maintain and protect existing utilities remaining, which pass through work area.

- C. Protect plant life, lawns, rock outcropping, and/or features remaining as a portion of final landscaping.
- D. Protect benchmarks, existing structures, fences, sidewalks, paving, and curbs from excavation equipment and vehicular traffic.
- E. Protect above and below grade utilities that are to remain.
- F. Cut out soft areas of subgrade not capable of in situ compaction. Backfill with Type A9 fill, as specified in Section 31 05 16 – Aggregates for Earthwork, and compact to density equal to or greater than requirements for subsequent backfill material.

3.6 EXPOSING EXISTING SANITARY SEWER, STORM SEWER, AND WATER MAIN

- A. Before excavation of trench is begun, Contractor shall uncover stub end of existing utility to which new utility is to be connected. This will permit adjustments in line and grade and verify connection required.
- B. Securely plug existing terminations in manholes to which new utilities are to be connected to prevent entry of construction water and debris into active system.
- C. Contractor shall be responsible to verify that plug(s) are in place at end of each workday.
- D. Contractor shall remove any water or debris from terminal manhole as required but not less than once a week.

3.7 TRENCH EXCAVATION

- A. Excavate subsoil required for installation of utility. Equip backhoe with cleaning bucket to minimize disturbance of soils at base of excavation.
- B. Excavate trenches at top of pipe to a maximum width based on dimension of outside diameter of pipe plus 24 inches to enable installation of pipe and to allow inspection.
- C. Width at top of pipe may be increased with prior approval of Owner's Representative to allow for stringers and sheathing when required.
- D. Provide pipe laid in open-cut trench with 6-inch minimum clearance between outside face of pipe barrel and face of sheathing or sidewall of trench.
- E. Maximum width of trench at ground surface shall not exceed width of trench at top of pipe by more than 2 feet without prior request to Owner's Representative, unless it is specifically allowed on Drawings.
- F. Place excavated material stored along trench excavation a minimum distance back from edge of trench. Determine distance by angle of repose of trench material to prevent surcharging of

trench wall material leading to potential shearing of trench wall and collapse of trench.

- G. Store excavated material to be used for trench backfilling so that it will not interfere with:
 - 1. Public travel.
 - 2. Adjacent property owners or tenants.
 - 3. Other Contractors.
- H. Contractor shall immediately remove and dispose of excavated material which is not to be used as trench backfill, unless directed otherwise by Contract Documents.
- I. Owner reserves right to order up to 10 percent of surplus excavated material to be delivered to Owner's streets, alleys, public properties, or locations designated by Owner.
- J. Cost of delivering and leveling such surplus material to any point within a driving distance of two miles from site of work shall be include in unit prices bid for work.
- K. After delivery to designated location, material shall be leveled off at direction of Owner's Representative.
- L. Contractor shall maintain all finished excavations free of water or sewage during Work.
- M. Hand trim excavation. Remove loose matter.
- N. Remove lumped subsoil, boulders, and rock up to 1/3 cubic yard, measured by volume.
- O. Correct unauthorized excavation and over-excavated areas at no cost to Owner.
- P. Excavate no more trench in advance of completed pipe laying operations than can be completed and backfilled by end of workday.
- Q. Do not obstruct more than one street crossing by same trench at any one time.

3.8 TRENCH BEDDING

- A. Keep trench bottom free of water prior to placement of bedding and laying of pipe.
- B. Place and shape bedding material to pipe, to a minimum depth of three inches under bell and four inches under spigot and compact to 95 percent modified Proctor density.
- C. Support pipe during placement and compaction of bedding material.
- D. Bring bedding and cover material over top of pipe to a minimum compacted depth of 12 inches, compact to specified density.
- E. Where sand is used for cover material, compact sand with portable plate compactor to a depth of twelve inches in two lifts of six inches each for initial cover over pipe.

3.9 PIPE INSULATION

- A. Insulate pipes with less than 6 foot of cover with a minimum of one 2-inch thick sheet of extruded polystyrene insulation.
- B. Laterals with less than 42-inch cover shall have a minimum 4-inch thick sheet of extruded polystyrene insulation.
- C. Extend insulation a minimum of 2 feet each side of pipe centerline.
- D. Sheet insulation shall be minimum two feet each side of pipe centerline and in addition shall have 4-inch thick insulation board placed vertically at end of horizontal board to bottom of excavated trench.

3.10 TRENCH BACKFILLING

- A. Backfill trenches with materials and to contours and elevations shown on Drawings.
- B. Place specified backfill in loose lift layers. Use compaction equipment that will achieve desired compaction requirements.
- C. Systematically backfill to allow for natural settlement. Do not backfill over porous, wet, frozen, or spongy subgrade surfaces.
- D. Employ a placement method that does not disturb or damage pipe in trench.
- E. Maintain optimum moisture content of backfill materials to attain required compaction density.
- F. Remove surplus backfill materials from site.
- G. Leave fill material stockpile areas completely free of excess fill materials.

3.11 MECHANICAL COMPACTION

- A. Mechanically compact backfill by means of a tamping roller, sheepsfoot roller, pneumatic tire roller, vibrating roller, or other mechanical tampers. Impact, free-fall, or "stomping" type compaction equipment shall not be allowed.
- B. Flooding or jetting of backfill for compaction purposes shall not be allowed.
- C. Contractor shall furnish written notification to Owner's Representative prior to start of work as to size and type of mechanical compaction equipment to be used.
- D. Place material for mechanically compacted backfill in lifts, which, prior to compaction, shall not exceed thickness specified below for type of compaction equipment used:

1. Vibratory equipment including vibratory plate, vibratory smooth-wheel rollers, and vibratory pneumatic-tired rollers: maximum lift thickness two (2) feet.
2. Rolling equipment, including sheepsfoot (both vibratory and non-vibratory), grid, smooth-wheel (non-vibratory), pneumatic-tired (non-vibratory), and segmented wheels: maximum lift thickness one (1) foot.
3. Hand-directed mechanical tampers: maximum lift thickness of six (6) inches.

3.12 TOLERANCES

- A. Top Surface of Backfill: Plus or minus one inch from required elevations.

3.13 COMPACTION REQUIREMENTS

- A. Granular Material shall be compacted to 95 percent of modified Proctor density.
- B. Excavated Material to be used for backfill shall be compacted to a density equal to adjacent undisturbed trench wall or as specified.

3.14 FIELD QUALITY CONTROL

- A. Field observation and testing will be performed under provisions of Section 31 02 00 - General Requirements for Sitework.
- B. Testing and analysis of fill material will be performed in accordance with ASTM D1557 and Section 31 02 00 - General Requirements for Sitework.
- C. Compaction and moisture testing will be performed in accordance with ASTM D6938 and Section 31 02 00 - General Requirements for Sitework.
- D. If tests indicate Work does not meet specified requirements, remove Work, replace, and retest at no cost to Owner.

3.15 PROTECTION OF FINISHED WORK

- A. Reshape and recompact fills subjected to vehicular traffic.
- B. Contractor shall have available a supply of steel plates with minimum dimensions of four (4) feet by eight (8) feet by one (1) inch.
- C. Use plates to bridge open trenches crossing roadways and secure against possibility of shifting or dropping into excavation.
- D. During winter months, do not leave plates in roadway over night.

3.16 SCHEDULE OF BACKFILL

- A. Section 31 05 16 – Aggregates for Earthwork defines “A” designated fill materials and Section 31 05 13 – Soils for Earthwork defines “S” designated fill materials.
- B. Fill to Correct Over-Excavation:
 - 1. Aggregate Type A2 fill, flush to required elevation, compacted to 90 percent modified Proctor density.
 - 2. Lean concrete to minimum compressive strength of 1000 psi.
- C. Utility Piping - Stone Bedding and Cover:
 - 1. Aggregate Type A6 or A7 fill depending on pipe size. Place materials in continuous loose lifts layers not exceeding 9-inch depth, compacted to 95 percent modified Proctor density.
- D. Utility Piping - Sand Bedding and Cover:
 - 1. Aggregate Type A11 fill. Place materials in continuous loose lifts layers not exceeding 12-inch depth, compacted to 95 percent modified Proctor density.
- E. Utility Trench – Backfill in Paved Areas:
 - 1. Aggregate Type A1 or A2 fill. Place materials in continuous loose lifts layers not exceeding 12-inch depth, compacted to 95 percent modified Proctor density.
- F. Utility Trench – Backfill in Non-paved Areas:
 - 1. Subsoil Type S1 or S2 fill, to 6 inches below finish grade. Place materials in continuous loose lifts layers not exceeding 12-inch depth, compacted to 90 percent modified Proctor density.

END OF SECTION

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SECTION 31 25 13
EROSION CONTROLS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Equipment and materials for erosion and sediment control to minimize erosion and siltation during construction.
 2. Erosion and sediment control provisions detailed on Drawings and specified herein are minimum requirements for erosion control program.
 3. Contractor to provide additional erosion and sediment control materials and methods required by state or local ordinances, whichever is more stringent.
- B. Related Sections:
1. Applicable provisions of Section 31 02 00 - General Requirements for Sitework shall govern Work under this Section.
 2. Section 31 05 13 - Soils for Earthwork: Existing topsoil and subsoil.
 3. Section 31 05 16 - Aggregates for Earthwork: Drainage stone.
 4. Section 31 10 00 - Site Clearing: Clearing and grubbing.
 5. Section 31 22 13 - Rough Grading: Rough grading and contouring of project site including stripping of existing site soils.
 6. Section 31 23 15 - Excavation, Backfill, and Compaction for Buildings and Structures.
 7. Section 31 23 16 - Utility Trench Excavation, Backfill, and Compaction.
 8. Section 32 90 00 - Planting.
 9. Section 32 91 19 - Landscape Grading.

1.2 REFERENCES

- A. ASTM International (American Society for Testing and Materials)
1. ASTM D3786 – Test Method for Hydraulic Bursting Strength of Textile Fabrics-Diaphragm Bursting Strength Tester Method.
 2. ASTM D4355 – Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture and Heat in a Xenon Arc Type Apparatus.
 3. ASTM D4491 – Test Methods for Water Permeability of Geotextiles by Permittivity.
 4. ASTM D4533 – Test Method for Trapezoid Tearing Strength of Geotextiles.
 5. ASTM D4632 - Test Method for Grab Breaking Load and Elongation of Geotextiles.
 6. ASTM D4751 - Test Method for Determining Apparent Opening Size of a Geotextile.
 7. ASTM D4833 - Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products.

- B. State of Wisconsin Department of Natural Resources (WDNR)
 - 1. Construction Site Erosion & Sediment Control.
<http://www.dnr.state.wi.us/runoff/stormwater/techstds.htm>
- C. State of Wisconsin Department of Transportation
 - 1. Standard Specifications for Highway and Structure Construction, Current Edition. (WISDOT).
 - 2. Erosion Control Product Acceptability Lists for Multi-Modal Applications. (PAL)
- D. U.S. Environmental Protection Agency
 - 1. Developing Your Stormwater Pollution Prevention Plan: A Guide for Construction Sites.
http://www.epa.gov/npdes/pubs/sw_swppp_guide.pdf
- E. City of Madison
 - 1. Ordinance for Construction Site Erosion Control.

1.3 SUBMITTALS

- A. Section 31 02 00 – General Requirements for Sitework: Requirements for submittals.
- B. Provide erosion control plan indicating proposed methods, materials, and schedule for effecting erosion and siltation control to prevent erosion damage to site and adjacent area.
- C. Plan shall include following:
 - 1. Proposed methods for erosion and siltation control.
 - 2. Erosion plan scale of 1 inch equals 40 feet, indicating location of erosion control materials, siltation basins, etc.
 - 3. Schedule for implementation of plan.
 - 4. Provision for maintenance and upkeep of erosion control and siltation materials, identifying persons responsible for said maintenance.

1.4 REGULATORY REQUIREMENTS

- A. Comply with City of Madison ordinance for construction site erosion control.
- B. Comply with applicable state and federal rules and regulations governing erosion and siltation on construction sites.
- C. Permit
 - 1. Apply for, pay fee, and obtain State stormwater discharge permit.
 - 2. Prepare construction site erosion control plan, Consolidated Permit form, and submit form and current fee to Wisconsin Department of Natural Resources at least 14 working days prior to commencing land disturbing construction activities.
 - 3. At completion of construction activity, file Notice of Termination.

1.5 EROSION CONTROL PRINCIPLES

- A. Keep disturbed area small.
- B. Stabilize disturbed areas with mechanical or structural and vegetative methods.
- C. Keep runoff low through use of short slopes, low gradients, and preservation of natural vegetative cover.
- D. Protect disturbed areas from storm water runoff.
- E. Retain sediment within site boundaries.
- F. Implement a thorough maintenance and follow-up program.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Sand Bags:
 - 1. Sandbag shall be woven polypropylene, polyethylene, or polyamide fabric, with minimum unit weight 4 oz/sq.yd., Mullen burst strength exceeding 300 psi in conformance with requirements in ASTM D3786, and ultraviolet stability exceeding 70 percent in conformance with requirements in ASTM D4355. Use of burlap is not acceptable.
 - 2. Each sand-filled bag shall have a length of 18 inches, width of 12 inches, thickness of 3 inches, and a mass of approximately 35 lb. Bag dimensions are nominal, and may vary based on locally available materials.
 - 3. Sandbag fill material shall be non-cohesive, permeable material free from clay and deleterious materials. Fill bag approximately half full.
- B. Soil Bags
 - 1. Bags shall be polypropylene, staple fiber, needle-punched non-woven geotextile of 50-mil thickness. Needle fibers to form a stable network that retains dimensional stability relative to each other. Geotextile shall be resistant to ultraviolet degradation and to biological and chemical environments not normally found in soils.
 - 2. Geotextile shall have the following minimum properties:

<u>Property</u>	<u>Test</u>	<u>Value</u>
Grab Tensile Strength	ASTM D4632	115 lbs
Puncture Strength	ASTM D4833	65 lbs
Mullen Burst	ASTM D3786	210 psi
Trapezoidal Tear	ASTM D4533	50 lbs
Apparent Opening Size	ASTM D4751	70 US Sieve
Water Flow Rate	ASTM D4491	140 gpm

3. Soil bags shall have a filled volume greater than 1 cubic foot and shall be furnished with a tie and a connecting spike
 4. Soil bags shall be similar and equal to Envirolok™ as manufactured by Agrecol Corporation or an approved equal.
- C. Erosion Bales: Tightly compacted bales of grain straw, hay, or other suitable material with approximate dimensions of 14 inches high, 18 inches deep, and 36 inches long, secured by a minimum of two strings.
- D. Sediment Tubes
1. Use sediment tubes for ditch checks with the following properties:
 - a. Produced by a manufacturer experienced in sediment tube manufacturing.
 - b. Composed of compacted geotextiles, curled excelsior wood, natural coconut fibers, hardwood mulch, or a mix of these materials enclosed by a flexible netting material.
 - c. Outer netting consists of seamless, high-density polyethylene photodegradable material treated with ultraviolet stabilizers or a seamless, high-density polyethylene, non-degradable material.
 - d. Curled excelsior wood or natural coconut rolled erosion control products that are rolled up to create a sediment tube are not acceptable.
 - e. Sediment tubes for ditch check applications shall meet the following minimum performance requirements.

<u>Property</u>	<u>Test Method</u>	<u>Value</u>
Diameter	Field Measured	18.0-inch minimum, 24.0-inch maximum
Mass per Unit Length	Field Measured	3.0 lbs/ft ±10% for 18-inch diameter 4.0 lbs/ft ±10% for 24-inch diameter
Fiber Length	Field Measured	80 percent of fiber materials at least 4-inches in length
Length per Tube	Field Measured	10-foot minimum
Netting Unit Weight	Certified	0.35 oz/ft minimum

2. Each sediment tube shall include complete identification including the following:
 - a. Manufacturer name and location
 - b. Manufacturer telephone number and fax number,
 - c. Manufacturer e-mail address and web address, and
 - d. Sediment tube name, model and/or serial number.

3. Manufacturers
 - a. American Excelsior Company, Arlington, TX.
 - b. Kristar Enterprises, Inc., Santa Rosa, CA.
 - c. Western Excelsior Corporation, Loveland, CO.

E. Silt Fence:

1. Geotextile Fabric: Textile shall be polyethylene fabric with properties as follows:

<u>Property</u>	<u>Test Method</u>	<u>Value</u>
Grab Tensile Strength	ASTM D4632	120 lb. minimum
Elongation	ASTM D4632	15% x 15% maximum
Mullen Burst Strength	ASTM D3786	260 psi minimum
Puncture	ASTM D4833	60 lb minimum
Trapezoidal Tear	ASTM D4833	60 lb minimum
Apparent Size Opening	ASTM D4751	U.S. 30 sieve
Water Flow Rate	ASTM D4491	10 gal/min/sq.ft. maximum
Ultra violet radiation stability	ASTM D4355	70 percent minimum

2. Fabric with support netting shall be reinforced with an industrial polypropylene netting with 3/4-inch spacing and heavy-duty nylon top support cord or equivalent.
3. Support Posts: Wood or steel construction, minimum length 5 feet, supply staple, cord or other suitable means to attach geotextile to support posts.

F. Riprap and Breaker Run Stone: Riprap and breaker run stone shall conform to the following classifications:

1. Heavy Riprap Rock:

<u>Given Size</u>	<u>Percent Total Weight of Smaller Size Stones</u>
500 lbs.	100
400 lbs.	90
150 lbs.	50
40 lbs.	20

2. Light Riprap Rock:

<u>Given Size</u>	<u>Percent Total Weight of Smaller Size Stones</u>
150 lbs.	100
60 lbs.	80
20 lbs.	20
2 lbs.	10

3. Breaker Run Rock or 6-inch Crushed Rock:

<u>Sieve Size</u>	<u>Percent Passing by Weight</u>
7-inch	100
6-inch	90
4-inch	75
3-inch	10

G. Construction Entrance:

1. Aggregate: Type A9 – Granular Fill as specified in Section 31 05 16 – Aggregates for Earthworks, minimum 12 inches thick, compacted
2. Geotextile: Woven polypropylene, TenCate Geosynthetics North America Mirafi 600X or approved equal.

H. Erosion Mats and Blankets

1. Only mats listed in WISDOT PAL will be accepted for use. Use Class I, short-term duration, light duty, organic erosion control mats with biodegradable netting, Type B, suitable for slope application materials. Plastic netting is not allowed.
2. Select erosion mats that last long enough for grass or other vegetation to become densely established.
3. Documentation of materials used, monitoring logs, project diary, and weekly inspection forms including erosion and stormwater management plans, should be submitted to Owner’s Representative.
4. Use U-shaped wire staples, metal pins or wooden stakes to anchor mats and blankets to ground surface. Staples shall be made of 0.12 inch steel wire and shall be U-shaped with 8-inch legs and 2-inch crown. Wire staples shall be minimum of 11 gauge. Metal stake pins shall be 0.188-inch diameter steel with a 1.5 inch steel washer at head of pin. Staples or stakes shall be driven flush to soil surface. Anchors shall have sufficient ground penetration to resist pullout by wind. Loose soils may require longer anchors.

I. Temporary Vegetative Cover: Temporary seed mixture components as follows:

Species	Minimum Percent Purity	Minimum Percent Germination	Pounds per Acre
Oats	98	90	80
Annual Rye	98	85	100

1. Use rye grass when permanent seeding is to follow within one (1) year.

PART 3 EXECUTION

3.1 INSTALLATION

A. Sand Bags

1. Install along a level contour. Turn ends of sandbag row up slope to prevent flow around ends.
2. Stack sandbags to required height using a pyramid approach. Upper rows of sandbags shall overlap joints in lower rows.
3. Construct sandbag barriers with a setback of at least 3 feet from toe of slope. Where it is determined to be not practicable due to specific site conditions, sandbag barrier may be constructed at toe of slope, but shall be constructed as far from toe of slope as practicable.

B. Soil Bags

1. Stack soil bags to create wall. Extend wall to one bag above design flow depth. Anchor bags together with spikes.
2. Plant two shrub cuttings in each soil bag and apply soil bag seed at rates of 10 lbs/acre for grasses, 3 lbs/acre for forbs, and 10 lbs/acre for cover crop.
3. Install seed as a 50/50 blend with bonded-fiber matrix filler.

C. Erosion Bales Fencing

1. Place bales end to end across ditches or other location as designated on Drawings.
2. Place bales at right angles to direction of water flow with bandings oriented around sides.
3. Tightly abut ends of bales and fill gaps between bales with bale material wedged in.
4. Embed straw bales a minimum 4 inches into ground.
5. Securely anchor bales with at least two wood or steel stakes driven a minimum 8 inches into ground.

D. Straw Bale Barrier

1. Install straw bale barriers in same manner as erosion bale fences.
2. Place bales such that one full bale length on either side of drainage way is above anticipated flow line.
3. Where heavy flows are anticipated, supplement bales with a filter fabric fence installed on downstream side of bales.

E. Sediment Tubes

1. Install sediment tubes by laying them flat on ground. Construct a small trench to a depth that is 20 percent of sediment tube diameter. Lay sediment tube in trench and compact upstream sediment tube/soil interface. Do not completely bury sediment tubes during installation. Install sediment tubes so no gaps exist between soil and bottom of sediment tube. Lap ends of adjacent sediment tubes a minimum of 6 inches to prevent flow and sediment from passing through field joint. Never stack sediment

tubes on top of one another.

2. Avoid damage to sediment tubes during installation. Should sediment tube become damaged during installation, place a stake on both sides of damaged area terminating tube segment and install a new tube segment. Perform field monitoring to verify that installation procedures do not damage sediment tubes. Replace sediment tubes damaged during installation as directed by Owner's Representative or manufacturer's representative at Contractor's expense.
3. Install sediment tubes in swales or drainage ditches perpendicular to water flow and extend them up side slopes a minimum of 1-foot above design flow depth. Space sediment tubes according to the following table.

<u>Slope (percent)</u>	<u>Maximum Sediment Tube Spacing</u>
Less than 2	150-feet
2	100-feet
3	75-feet
4	50-feet
5	40-feet
6	30-feet
Greater than 6	25-feet

4. Install sediment tubes using wooden stakes (1-inch x 1-inch) or steel posts (1.25 lbs/linear ft.) a minimum of 4 feet in length placed on 2-foot centers. Intertwine stakes with outer mesh on downstream side, and drive stakes into ground to a minimum depth of 2.0-feet leaving less than 1-foot of stake above exposed sediment tube.
5. An acceptable alternative installation is driving stakes on 2-foot centers on each side of sediment tube and connecting them with natural fiber twine or steel wire to inhibit non-weighted sediment tube from moving vertically. Sediment tubes can also be secured by installing stakes on 2-foot centers in a crossing manner to ensure direct soil contact.
6. Select sediment tube length to minimize number of sediment tubes needed to span width of drainage conveyance. If required ditch check length, perpendicular to water flow, is 15-feet, use one 15-foot sediment tube rather than two overlapping 10-foot sediment tubes.
7. Install sediment tubes for ditch checks over bare soil, mulched areas, or erosion control blankets. Keep sediment tubes for ditch checks in place until fully established vegetation and root systems have completely developed and can survive on their own.

F. Catch Basin and Inlet Protection on Soil

1. Install inlet barrier, a combination of filter fabric fencing and bale fencing, around entire perimeter of inlet.
2. Install filter fabric fence as specified below except posts shall have a maximum spacing of 4 feet.

3. Install bale fence on exterior of filter fence as specified in paragraph C above.
- G. Catch Basin and Inlet Protection on Paved Area
1. Remove inlet grate from basin.
 2. Place filter fabric over inlet opening and push down in center to form a basket.
 3. Install fabric such that it extends minimum 12 inches beyond inlet casting edges.
 4. Re-install inlet grate to hold filter fabric in place.
 5. Verify that fabric is retained in place by grate.
 6. Place bales around perimeter of inlet and secure with a minimum of two perimeter rope or cable restraints.
- H. Filter Fabric Fencing
1. Install filter fence to maximum height of 24 inches.
 2. Install support posts on downstream side of fencing to depth that is adequate to insure stability of fence and at maximum spacing of 8 feet.
 3. Excavate 4-inch by 4-inch trench up-slope along line of support posts to anchor fabric.
 4. Staple filter material to up-slope side of posts and extend fabric into trench.
 5. Backfill and compact filter fabric in trench.
 6. Provide silt fence surrounding existing catch and inlet basins affected by site work.
- I. Riprap
1. Furnish and install riprap to thickness and area necessary to prevent erosion and control sedimentation.
- J. Construction Entrance
1. Grade area minimum of 50 feet long and 20 feet wide with slope into construction site.
 2. Install geotextile fabric over entire area of entrance.
 3. Place aggregate to a minimum depth of 12 inches.
- K. Mulch
1. Install mulch within seven days of active disturbance of soil surface.
 2. Area to be mulched shall be reasonably free of sticks, stones larger than 3 inches in diameter, and rills and gullies.
 3. Apply mulch at following rates:
 - a. Straw: 70-90 pounds per 1,000 sq. ft.
 - b. Wood Chips: 275-425 pounds per 1,000 sq. ft.
 - c. Wood Fiber: 35-50 pounds per 1,000 sq. ft.
 4. Anchor mulch by one of following methods at time of spreading or immediately after spreading.
 - a. Punch mulch into soil with weighted disc of similar implement to a depth of 2 inches.
 - b. Application of emulsified asphalt or synthetic binder material intended for mulch retention purposes. Emulsified asphalt shall be placed at a rate of 75-100 gallons per ton of mulch.

- c. Apply synthetic materials in accordance with manufacturer's instructions.

L. Erosion Mats and Blankets

1. Install erosion mats and blankets in accordance with manufacturer's instructions.
2. Begin at top of slope and anchor mat or blanket in a 12-inch deep trench. Backfill trench, tamp earth firmly, and anchor every 12 inches. Unroll material downslope in direction of water flow.
3. Overlap edges of adjacent parallel rolls 4 inches and anchor every 12 inches. When rolls must be spliced, place ends in common trench as described above with 6-inch overlap. Anchor through overlapped area, approximately 6 inches apart.
4. Lay material loosely and maintain direct contact with soil. Do not stretch.
5. Staple or stake material sufficiently to anchor blanket and maintain contact with soil. Place anchors down center and stagger with anchors placed along edges.
6. Staple or Stake Spacing
 - a. Steep Slopes, 1V:1H to 1V:2H: Minimum of 2 per square yard.
 - b. Moderate Slopes, 1V:2H to 1V:3H: minimum of 1-1/2 per square yard, placing 1 per yard on centers.
 - c. Gentle Slopes: Minimum of 1 per square yard.

M. Vegetative Cover.

1. Install vegetative cover in accordance with manufacturer's instructions.

3.2 MAINTENANCE

- A. Inspect erosion control devices within 24 hours after each rainfall or daily during periods of prolonged rainfall.
- B. Repair or replace damaged or defective materials or installation immediately.
- C. Remove sediment deposits within 24 hours after each storm event or when deposits reach one-half height of fence or barrier, whichever occurs first.
- D. Apply replacement bales or additional mulch, netting, or matting immediately to maintain suitable cover.
- E. Where vegetative cover has been placed, inspect until vegetative cover is established and functioning as intended.

3.3 REMOVAL OF EROSION CONTROL DEVICES

- A. Maintain erosion control measures disturbed earth has been paved or vegetated.
- B. Remove erosion control devices prior to final inspection and acceptance of Project site by Owner.

- C. Restore or replace areas disturbed or damaged by removal of erosion control devices to satisfaction of Owner's Representative.

END OF SECTION

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SECTION 32 11 23

AGGREGATE BASE COURSE

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Aggregate Materials.
 2. Sub-grade Preparation.
 3. Test Rolling Equipment and Procedures.
 4. Aggregate Installation Requirements.
 5. Aggregate Shoulder.
 6. Base Course Schedule.
- B. Related Sections:
1. Applicable provisions of Section 31 02 00 – General Requirements for Sitework shall govern Work under this Section.
 2. Section 31 05 16 – Aggregates for Earthwork.
 3. Section 31 22 13 - Rough Grading: Preparation of site for base course.
 4. Section 31 23 15 - Excavation, Backfill, and Compaction for Buildings and Structures.
 5. Section 31 23 16 - Utility Trench Excavation, Backfill, and Compaction.
 6. Section 32 12 16 – Asphalt Paving: Binder and surface asphalt courses.
 7. Section 32 13 13 - Concrete Paving: Finish concrete pavement and curb and gutter.
 8. Section 33 11 00 - Site Water System: Adjustment of valve boxes and valve vaults.
 9. Section 33 31 00 - Site Sanitary Sewer System: Adjustment of manhole frames in preparation for paving.
 10. Section 33 41 00 - Site Storm Sewer System: Adjustment of drainage structure frames in preparation for paving.

1.2 REFERENCES

- A. State of Wisconsin Department of Transportation
1. Standard Specifications for Highway and Structure Construction, Current Edition. (WISDOT)
- B. ASTM International (American Society for Testing and Materials)
1. ASTM D698 – Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort 12,400 ft.-lbf/ft³.
 2. ASTM D1557 – Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort 56,000 ft.-lbf/ft³.
 3. ASTM D6938 – Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).

PART 2 PRODUCTS

2.1 AGGREGATE MATERIALS

- A. Aggregate Material: Types A1, A2, A3, A4, A5, A6, A12, A14 as specified in Section 31 05 16 – Aggregates for Earthwork.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify substrate is dry and has been inspected, and gradient and elevation are correct.

3.2 SUBGRADE PREPARATION

- A. Correct irregularities in substrate gradient and elevation by scarifying, reshaping, and recompacting.
- B. Do not place fill on soft, muddy, or frozen surfaces.

3.3 TEST ROLLING SUBGRADE

- A. Test rolling shall be used to verify stability and uniformity of subgrade. Perform this Work in presence of Owner's Representative.
- B. Use test rolling equipment conforming to following description:
 - 1. Tandem axle, dual wheel dump truck.
 - 2. Tire pressure shall be no less than 90 percent of manufacturer's recommended maximum inflation.
 - 3. Minimum gross weight of loaded truck shall be 60,000 pounds.
 - 4. Provide weigh slip to Owner's Representative.
- C. Perform test rolling procedure as follows:
 - 1. Operate equipment at a rate not to exceed 3 to 5 mph or a comfortable walking pace. Adjust speed to allow Owner's Representative to measure any deflections and areas of rutting.
 - 2. Operate test rolling equipment in a pattern so that affected areas are loaded with at least one pass.
 - 3. After test rolling, check subgrade for conformance to drawings, and correct any surface irregularities. Re-shape subgrade within tolerances specified.
- D. Test Rolling Evaluation:
 - 1. Rutting up to 1-inch is acceptable. Rutting in excess of 1-inch but not more than 6 inches, shall be considered a failure and requires reworking soil and compaction to required density.

2. Deflection (pumping) up to 1-inch is acceptable. Deflection in excess of 1-inch but not more than 2 inches shall be acceptable if there is not substantial cracking or lateral movement of soil. Deflection in excess of 2 inches but not more than 6 inches shall be considered a failure, and requires reworking soil and compaction to required density.
3. Rutting and deflection in excess of 6 inches will require review and recommendation for corrective action by an approved Geotechnical Engineer.
4. After remedial work is performed, a final test roll shall be performed upon completion of work. If remedial work is performed as directed, second test roll may be waived at discretion of Owner's Representative.

3.4 AGGREGATE INSTALLATION REQUIREMENTS

- A. Spread aggregate over prepared substrate to a total compacted thickness as indicated on Drawings.
- B. Place aggregate in maximum 7-inch loose lifts and compact to specified density.
- C. Level and contour surfaces to elevations and gradients indicated.
- D. Add small quantities of fine aggregate to coarse aggregate as appropriate to assist compaction.
- E. Add water to assist compaction. If excess water is apparent, remove aggregate and aerate to reduce moisture content.
- F. Use mechanical tamping equipment in areas inaccessible to compaction equipment.

3.5 AGGREGATE SHOULDERS

- A. Construct aggregate shoulders to elevations and typical sections shown on Drawings, except for minor modifications needed to conform to other work.
- B. Use equipment that does not damage or mar pavement surface, curbs, or appurtenances.
- C. Place aggregate directly on shoulder area between pavement edge and outer shoulder limits.
- D. Recover uncontaminated material deposited outside limits and place within limits.
- E. Do not deposit aggregate on pavement during placement, unless Engineer specifically allows. Do not leave aggregate on pavement overnight. After placing shoulder aggregate, keep pavement surface free of loose aggregate.
- F. Spread and compact aggregate in compacted layers of 6 inches or less.

- G. Compact aggregate until there is no appreciable displacement, either laterally or longitudinally, under compaction equipment. Route hauling equipment uniformly over previously placed base. Compact each layer before placing a subsequent layer. If material is too dry to readily attain required compaction, add water as necessary to achieve compaction.
- H. After final compaction, shape shoulders to remove all longitudinal ridges to ensure proper drainage.

3.6 TOLERANCES

- A. Section 31 05 16 – Aggregates for Earthwork defines “A” designated base course materials.
- B. Flatness: Maximum variation of 1/4-inch measured with 10-foot straight edge.
- C. Scheduled Compacted Thickness: Within 1/4-inch.
- D. Variation from Design Elevation: Within 1/4-inch.

3.7 FIELD QUALITY CONTROL

- A. Section 31 02 00 – General Requirements for Sitework: Field inspection.
- B. Perform compaction testing in accordance with ASTM D1557, ASTM D6938, and Section 31 02 00 – General Requirements for Sitework.
- C. Perform moisture content testing in accordance with ASTM D6938 and Section 31 02 00 – General Requirements for Sitework.
- D. If tests indicate Work does not meet specified requirements, remove Work, replace, and retest.
- E. Frequency of Tests: As determined by Owner’s Representative.

3.8 BASE COURSE SCHEDULE

- A. Section 31 05 16 – Aggregates for Earthwork defines “A” designated base course materials.
- B. Under Asphalt Pavement:
 - 1. Aggregate Type A1 or A2, compact to 95 percent modified Proctor density.
- C. Under Concrete Pavement and Curb and Gutter:
 - 1. Aggregate Type A1 or A2, compact to 95 percent modified Proctor density.

END OF SECTION

SECTION 32 12 16

ASPHALT PAVING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Asphalt Paving Mix.
2. Asphalt Materials.
3. Aggregate Base Course.
4. Primer Preparation.
5. Tack Coat Preparation.
6. Asphalt Pavement - Single Course Installation.
7. Placing Asphalt Pavement - Two Course Installation.

B. Related Sections:

1. Applicable provisions of Section 31 02 00 - General Requirements for Sitework shall govern Work under this Section.
2. Section 31 05 16 – Aggregates for Earthwork: Product requirements for aggregate for placement by this section.
3. Section 31 22 13 - Rough Grading: Preparation of site for paving and base.
4. Section 32 11 23 - Aggregate Base Course: Compacted granular base for paving.
5. Section 32 13 13 – Concrete Paving: Concrete pavement and curb and gutter.
6. Section 33 11 00 - Site Water System: Final adjustment of valve boxes.
7. Section 33 31 00 - Site Sanitary Sewer System: Final elevation adjustment of manhole frames.
8. Section 33 41 00 – Site Storm Sewer System: Final elevation adjustment of drainage structure frames.

1.2 REFERENCES

A. State of Wisconsin Department of Transportation

1. Standard Specifications for Highway and Structure Construction, Current Edition. (WISDOT)

1.3 SUBMITTALS

- A. Section 31 02 00 – General Requirements for Sitework: Requirements for submittals.
- B. Product Data: Submit product information and mix design.

- C. Certification: Provide Manufacturer's Certification Report that indicates Products and Materials meet or exceed all specified requirements.

1.4 QUALITY ASSURANCE

- A. Perform Work in accordance with Wisconsin Department of Transportation Standards.
- B. Mixing Plant: Conform to
 - 1. WISDOT Section 450.
- C. Obtain materials from same source throughout.

1.5 QUALIFICATIONS

- A. Installer: Company specializing in performing Work of this section with minimum five years experience.

1.6 ENVIRONMENTAL REQUIREMENTS

- A. Section 31 02 00 – General Requirements for Sitework: Environmental conditions affecting products on site.
- B. Do not place asphalt when ambient air or base surface temperature is less than 40 degrees F, or if surface is wet or frozen.
- C. Install Work in accordance with WISDOT Section 450.
- D. Place bitumen mixture when mixture temperature is not more than 15 degrees F below bitumen supplier's bill of lading and not more than maximum specified temperature.

PART 2 PRODUCTS

2.1 ASPHALT PAVING MIX

- A. Use dry material to avoid foaming. Mix uniformly.
- B. Provide Asphaltic Concrete Leveling Course Mixtures as specified below:
 - 1. Asphaltic Concrete Base Course: WISDOT Section 315, in accordance with Table 460-1, Aggregate Gradation Master Range, 25.0 mm. PG 58-22.
- C. Provide Asphaltic Concrete Binder Course Mixtures as specified below:
 - 1. Asphaltic Concrete Binder Course: WISDOT Section 460, Mix E-1.0, in accordance with Table 460-1, Aggregate Gradation Master Range, 19.0 mm, and Table 460-2, Mixture Requirements, PG 64-22.

- D. Provide Asphaltic Concrete Surface Course Mixtures as specified below:
 - 1. Asphaltic Concrete Surface Course: WISDOT Section 460, Type E-1.0, in accordance with Table 460-1, Aggregate Gradation Master Range, 12.5 mm, and Table 460-2, Mixture Requirements, PG 64-22.
- E. Recycled Asphalt Pavement (RAP) may be used.
 - 1. Contractor may use up to 25 percent RAP for base, binder, and intermediate course mixtures.
 - 2. Contractor may use up to 20 percent RAP in surface course mixtures.

2.2 ASPHALT MATERIALS

- A. Tack Coat: SS-1, SS-1h, CSS-1, or CSS-1h in accordance with:
 - 1. WISDOT Section 455.

2.3 SOURCE QUALITY CONTROL AND TESTS

- A. Section 31 02 00 – General Requirements for Sitework: Testing, inspection and analysis requirements.
- B. Submit proposed mix design for each mixture for review prior to beginning of Work.
- C. Provide test samples in accordance with Section 31 02 00 – General Requirements for Sitework.
- D. Perform Asphaltic Concrete Testing in accordance with:
 - 1. WISDOT Section 460.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 31 02 00 – General Requirements for Sitework: Verification of existing conditions before starting work.
- B. Verify compacted subgrade and aggregate base are acceptable and ready to support paving and imposed loads.
- C. Verify gradients and elevations of base are correct.

3.2 AGGREGATE BASE COURSE

- A. Section 32 11 23 - Aggregate Base Course forms base course construction for Work of this section.

3.3 TACK COAT APPLICATION

- A. Apply tack coat in accordance with:
 - 1. WISDOT Section 455.
- B. Apply tack coat on asphalt or concrete surfaces over subgrade surface at uniform rate of 1/2 gal/sq yd.
- C. Apply tack coat to contact surfaces of curbs, gutters, medians, and concrete.
- D. Coat surfaces of manhole, catch basin, inlet, and utility frames with oil to prevent bond with asphalt pavement. Do not tack coat these surfaces.

3.4 PLACING ASPHALT PAVEMENT - TWO COURSE INSTALLATION

- A. Install asphalt pavement in accordance with:
 - 1. WISDOT Section 450.
- B. Place asphalt binder course within 24 hours of applying primer or tack coat.
- C. Place binder course to thickness shown on Drawings.
- D. Place surface course within 24 hours of placing and compacting binder course. When binder course is placed more than 24 hours before placing surface course, clean surface and apply tack coat before placing surface course.
- E. Place surface course to thickness shown on Drawings.
- F. Install utility grilles and frames in correct position and elevation prior to installation of pavement.
- G. Compact pavement by rolling to specified density. Do not displace or extrude pavement from position. Hand compact in areas inaccessible to rolling equipment.
- H. Perform rolling with consecutive passes to achieve even and smooth finish, without roller marks.

3.5 TOLERANCES

- A. Section 31 02 00 – General Requirements for Sitework: Tolerances.
- B. Flatness: Maximum variation of 1/8-inch measured with 10-foot straight edge.
- C. Scheduled Compacted Thickness: Within 1/4-inch.
- D. Variation from Indicated Elevation: Within 1/4-inch.

3.6 FIELD QUALITY CONTROL

- A. Section 31 02 00 – General Requirements for Sitework: Field inspecting, testing, adjusting, and balancing.
- B. Provide two 4-inch diameter disks, 2-1/2 inches high, each day that asphalt pavement is placed.

3.7 PROTECTION OF FINISHED WORK

- A. Section 31 02 00 – General Requirements for Sitework: Protecting finished work.
- B. Immediately after placement, protect pavement from mechanical injury for 12 hours or until surface temperature is less than 140 degrees F, whichever occurs first.

END OF SECTION

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SECTION 32 12 18

POROUS ASPHALTIC CONCRETE PAVEMENT

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Asphalt Paving Mix.
 - 2. Asphalt Materials.
 - 3. Aggregate Base Course.
 - 4. Primer Preparation.
 - 5. Tack Coat Preparation.
 - 6. Placing Asphalt Pavement

- B. Related Sections:
 - 1. Section 31 02 00 - General Requirements for Sitework.
 - 2. Section 31 05 16 – Aggregates for Earthwork: Product requirements for aggregate for placement by this section.
 - 3. Section 31 22 13 - Rough Grading: Preparation of site for paving and base.
 - 4. Section 32 11 23 - Aggregate Base Course: Compacted granular base for paving.
 - 5. Section 32 13 13 – Concrete Paving: Concrete pavement and curb and gutter.

1.2 REFERENCES

- A. State of Wisconsin Department of Transportation
 - 1. Standard Specifications for Highway and Structure Construction, Current Edition and latest supplements. (WISDOT)

- B. American Association of State Highway and Transportation Officials (AASHTO)
 - 1. AASHTO T103 – Soundness of Aggregates by Freezing and Thawing.
 - 2. AASHTO T104 – Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate.

- C. ASTM International
 - 1. ASTM C131 – Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
 - 2. ASTM D4791 - Standard Test Method for Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate.
 - 3. ASTM D4867 - Standard Test Method for Effect of Moisture on Asphalt Concrete Paving Mixtures.
 - 4. ASTM D5821 - Standard Test Method for Determining the Percentage of Fractured Particles in Coarse Aggregate.

1.3 SUBMITTALS

- A. Section 31 02 00 - General Requirements for Sitework - Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit product information and mix design.
- C. Certification: Provide Manufacturer's Certification Report that indicates Products and Materials meet or exceed all specified requirements.

1.4 QUALITY ASSURANCE

- A. Perform Work in accordance with State of Wisconsin Department of Transportation standards.
- B. Mixing Plant: Conform to State of Wisconsin Department of Transportation standards. WISDOT Section 450.
- C. Obtain materials from same source throughout.

1.5 QUALIFICATIONS

- A. Supplier: Company specializing in supplying material for this section with minimum five (5) years documented experience.
- B. Installer: Company specializing in performing work of this section with minimum five (5) years documented experience and three projects, each with at least 1/2 dollar volume of this project.

1.6 ENVIRONMENTAL REQUIREMENTS

- A. Section 31 02 00 - -General Requirements for Sitework: Environmental conditions affecting products on site.
- B. Do not place asphalt when ambient air or base surface temperature is less than 40 degrees F, or if surface is wet or frozen.
- C. Do not place binder course when temperature in the shade is below 40 degrees F, surface course when the temperature in the shade is below 45 degrees F, or any course if surface is wet or frozen.
- D. Install Work in accordance with State of Wisconsin Department of Transportation Standards; WISDOT Section 450.

- E. Place bitumen mixture when mixture temperature is not more than 15 degrees F below bitumen supplier's bill of lading and not more than maximum specified temperature.

PART 2 PRODUCTS

2.1 POROUS ASPHALT PAVING MIX

- A. Use dry material to avoid foaming. Mix uniformly.
- B. Asphalt Mix Aggregate:
 - 1. LA Wear: ASTM C131.
 - a. Maximum 13 percent loss in 100 revolutions.
 - b. Maximum 15 percent loss in 500 revolutions.
 - 2. Soundness: Maximum 12 percent loss in sodium sulfate per AASHTO T104.
 - 3. Freeze Thaw: Maximum 18 percent loss per AASHTO T103.
 - 4. Fractured Faces: 75 percent one face/60 percent two face per ASTM D5821.
 - 5. Thin or Elongated Pieces: Maximum 5 percent by weight per ASTM D4791.
 - 6. Voids in Mineral Aggregate (VMA): 25 percent minimum.
 - 7. Gradation:

Sieve Size	Percent Passing by Weight
3.4 inch	100
1/2 inch	85-100
3/8 inch	55-75
No. 4	10-25
No. 10	5-10
No. 200	2-4

- C. Asphalt Mix:
 - 1. Asphalt Binder Grade: PG 58-28 with fibers.
 - 2. Air Voids: 18 percent Va at 50 gyrations.
 - 3. Tensile Strength Ratio: 0.8 in accordance with ASTM D4867.
 - 4. Draindown at Production Temperature: Maxim 0.3 percent.

2.2 ASPHALT MATERIALS

- A. Tack Coat: Homogeneous, medium curing, liquid asphalt in accordance with Wisconsin Department of Transportation standards; WISDOT Section 455.

2.3 SOURCE QUALITY CONTROL AND TESTS

- A. Section 31 02 00 - General Requirements for Sitework: Testing, inspection and analysis requirements.

- B. Submit proposed mix design for each mixture for review prior to beginning of Work.
- C. Provide test samples in accordance with Section 31 02 00 - General Requirements for Sitework. Perform testing in accordance with WISDOT Section 460.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 31 02 00 - -General Requirements for Sitework: Verification of existing conditions before starting work.
- B. Verify compacted subgrade and granular base is acceptable and ready to support paving and imposed loads.
- C. Verify gradients and elevations of base are correct.

3.2 AGGREGATE BASE COURSE

- A. Section 32 11 23 - Aggregate Base Course, forms base course construction for Work of this section.

3.3 TACK COAT PREPARATION

- A. Apply tack coat in accordance with Wisconsin Department of Transportation standards; WISDOT Section 455.
- B. Apply tack coat to contact surfaces of curbs and gutters.
- C. Coat surfaces of manhole, catch basin, inlet and other utility frames with oil to prevent bond with asphalt pavement. Do not tack coat these surfaces.

3.4 PLACING ASPHALT PAVEMENT

- A. Install Work in accordance with Wisconsin Department of Transportation standards; WISDOT Section 450.
- B. Place asphalt within 24 hours of applying primer or tack coat.
- C. Place to thickness shown on Drawings.
- D. Install manhole frames in correct position and elevation.
- E. Compact pavement by rolling to specified density. Do not displace or extrude pavement from position. Hand compact in areas inaccessible to rolling equipment.

- F. Perform rolling with consecutive passes to achieve even and smooth finish without roller marks.

3.5 TOLERANCES

- A. Section 31 02 00 - -General Requirements for Sitework: Tolerances.
- B. Flatness: Maximum variation of 1/4 inch measured with 10-foot straight edge.
- C. Scheduled Compacted Thickness: Within 1/4 inch.
- D. Variation from Indicated Elevation: Within 1/4 inch.

3.6 FIELD QUALITY CONTROL

- A. Section 31 02 00 - -General Requirements for Sitework: Field inspecting, testing, adjusting, and balancing.
- B. Take samples and perform tests in accordance with WisDOT Standards.

3.7 PROTECTION OF FINISHED WORK

- A. Section 31 02 00 - -General Requirements for Sitework: Protecting finished work.
- B. Immediately after placement, protect pavement from mechanical injury until surface temperature is less than 140 degrees F.

END OF SECTION

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SECTION 32 13 13

CONCRETE PAVING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Materials and Installation requirements for exterior concrete components as follows:
 - a. Curb and combination curb and gutter.
 - b. Loading dock ramps and entrances.
 - c. Aggregate base course.
2. Exterior Concrete Design Requirements as follows:
 - a. Concrete mix design.
 - b. Reinforcement.
 - c. Concrete curing and sealing.
 - d. Jointing.
 - e. Quality control and testing.
 - f. Concrete placement and finishing.

B. Related Sections:

1. Applicable provisions of Section 31 02 00 – General Requirements for Sitework shall govern Work under this Section.
2. Section 31 22 13 - Rough Grading: Preparation of site for paving and base.
3. Section 31 23 16 - Utility Trench Excavation, Backfill, and Compaction: Compacted subbase for paving.
4. Section 32 11 23 - Aggregate Base Course: Compacted granular base for paving.
5. Section 33 12 16 - Asphalt Paving: Asphalt surface course.

1.2 REFERENCES

A. American Concrete Institute (ACI)

1. ACI 301 – Structural Concrete.
2. ACI 304 - Guide for Measuring, Mixing, Transporting and Placing Concrete.
3. ACI 305 – Hot Weather Concreting.
4. ACI 306 – Cold Weather Concreting.
5. ACI 308 – Standard Practice for Curing Concrete.
6. ACI 309 – Guide for Consolidation of Concrete.
7. ACI 325 – Guide for Construction of Concrete Pavements and Concrete Bases.
8. ACI 330 – Guide for Design and Construction of Concrete Parking Lots.
9. ACI 347 – Guide to Formwork for Concrete.

- B. ASTM International (American Society for Testing and Materials)
1. ASTM A82 – Specification for Steel Wire, Plain, for Concrete Reinforcement.
 2. ASTM A184 - Specification for Fabricated Deformed Steel Bar Mats for Concrete Reinforcement.
 3. ASTM A185 - Specification for Steel Welded Wire Reinforcement, Plain, for Concrete.
 4. ASTM A497 - Specification for Steel Welded Wire Reinforcement, Deformed, for Concrete.
 5. ASTM A615 - Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
 6. ASTM A767 – Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement.
 7. ASTM A775 - Specification for Epoxy-Coated Reinforcing Steel Bars.
 8. ASTM A884 - Specification for Epoxy-Coated Steel Wire and Welded Wire Fabric for Reinforcement.
 9. ASTM A934 - Specification for Epoxy-Coated Prefabricated Steel Reinforcing Bars.
 10. ASTM C31 – Practice for Making and Curing Concrete Test Specimens in the Field.
 11. ASTM C33 - Specification for Concrete Aggregates.
 12. ASTM C39 – Test Method for Compressive Strength of Cylindrical Concrete Specimens.
 13. ASTM C94 - Specification for Ready-Mixed Concrete.
 14. ASTM C143 – Test Method for Slump of Hydraulic-Cement Concrete.
 15. ASTM C150 - Specification for Portland Cement.
 16. ASTM C172 - Practice for Sampling Freshly Mixed Concrete.
 17. ASTM C231 – Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
 18. ASTM C260 - Specification for Air-Entraining Admixtures for Concrete.
 19. ASTM C309 - Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
 20. ASTM C494 - Specification for Chemical Admixtures for Concrete.
 21. ASTM C618 - Specification for Fly Ash as Admixture for Concrete.
 22. ASTM C1116 - Specification for Fiber-Reinforced Concrete and Shotcrete.
 23. ASTM C1193 - Guide for Use of Joint Sealants.
 24. ASTM C1602 – Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete.
 25. ASTM D1751 - Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction Nonextruding and Resilient Bituminous Types.
 26. ASTM D1752 - Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction.
 27. ASTM D5249 - Backer Material for Use with Cold- and Hot-Applied Joint Sealants in Portland-Cement Concrete and Asphalt Joints.
 28. ASTM D6690 – Specification for Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements.

- C. United States Access Board
 - 1. ADA Accessibility Guidelines for Buildings and Facilities.(ADAAG)

1.3 SUBMITTALS

- A. Section 31 02 00 – General Requirements for Sitework: Requirements for submittals.
- B. Product Data: Submit data on joint filler, reinforcement, admixtures, and curing compounds.

1.4 QUALITY ASSURANCE

- A. Perform Work in accordance with specified ACI requirements.
- B. Maintain one copy of each document on site.
- C. Obtain cementitious materials from same source throughout.

1.5 QUALIFICATIONS

- A. Supplier: Company specializing in supplying material for this section with minimum ten (10) years documented experience.
- B. Installer: Company specializing in performing work of this section with minimum ten (10) years documented experience.

1.6 ENVIRONMENTAL REQUIREMENTS

- A. Conform to requirements of Section 31 02 00 – General Requirements for Sitework.
- B. Do not place concrete when base surface temperature is less than 40 degrees F, or surface is wet or frozen.

PART 2 PRODUCTS

2.1 FORM MATERIALS

- A. Form Materials: Conform to ACI 301 and 347.

2.2 REINFORCEMENT

- A. Reinforcing Steel: ASTM A615; 40 ksi yield grade; deformed billet steel bars; with ASTM A775 epoxy coated finish.

2.3 FIBER REINFORCEMENT

- A. Synthetic Fiber: Fibrillated polypropylene fibers engineered and designed for use in concrete,

complying with ASTM C1116, Type III, 1/2 to 1-1/2 inches long.

- B. Manufacturers - Fibrillated Fibers:
 - 1. Fibrasol F; Axim Concrete Technologies.
 - 2. Fibermesh; Fibermesh, Div. of Synthetic Industries.
 - 3. Forta; Forta Corporation.
 - 4. Grace Fibers; W. R. Grace & Co., Construction Products Div.

- C. Synthetic Fiber: Fibrillated or monofilament polypropylene fibers engineered and designed for use in concrete, complying with ASTM C1116, Type III, 1/2 to 1-1/2 inches long.

- D. Manufacturers - Monofilament Fibers:
 - 1. Fibrasol IIP; Axim Concrete Technologies.
 - 2. Fiberstrand 100; Euclid Chemical Co.
 - 3. Fibermix Stealth; Fibermesh, Div. of Synthetic Industries.
 - 4. Forta Mono; Forta Corporation.
 - 5. Grace MicroFiber; W. R. Grace & Co., Construction Products Div.
 - 6. Hi-Tech PPM Fiber; Hi-Tech Fibers, Div. of Martin Color-Fi, Inc.
 - 7. Polystrand 1000; Metalcrete Industries.

2.4 CONCRETE MATERIALS

- A. Cement: ASTM C150 Normal – Type 1, gray color.
- B. Fine and Coarse Mix Aggregates: ASTM C33.
- C. Water: ASTM C1602, potable, not detrimental to concrete.
- D. Air Entrainment: ASTM C260.
- E. Flyash: ASTM C618. Class C.

2.5 CHEMICAL ADMIXTURES

- A. Chemical admixtures shall be in accordance with ASTM C494.
- B. Concrete may contain Type A Water-reducing admixture and Type D Water-reducing and retarding admixture.
- C. Admixtures are to be used in accordance with manufacturer's recommendations.
- D. Chemical admixtures containing chlorides, sulfides, or nitrides are not permitted.
- E. A single manufacturer shall supply permitted admixtures.

- F. Admixture manufacturer's are to be approved in writing by Owner's Representative prior to use.

2.6 ACCESSORIES

- A. Joint Filler: ASTM D1751, Bituminous fiber, 1/2-inch wide by depth of concrete less 1/8-inch.
- B. Form Release Agent: Colorless material which will not stain concrete, absorb moisture or impair natural bonding or color characteristics of coating, intended for use on concrete.
 - 1. Manufacturers:
 - a. Symons Corporation; Series: Magic Kote.
 - b. W. R. Meadows; Series; Duogard.
 - c. BASF Building Products – Sonneborn; Series Sonocrete Castoff.
 - d. Dayton Superior; Series: Clean Strip C&M (J-1-A).
 - e. Substitutions: Not Permitted.

2.7 CURING AND TREATMENT MATERIALS

- A. Water: Potable and clean.
- B. Membrane Curing Compound: ASTM C309, Type II, white pigmented.
 - 1. Manufacturers:
 - a. BASF Building Products – Sonneborn; Type: Sonocrete Kure-N-Seal.
 - b. W. R. Meadows – Sealtight; Type CS-309-1315.
 - c. Dayton Superior – Type: General Purpose Cure & Seal (J20).
 - d. BASF Building Products – MasterBuilders; Type: Masterkure N-Seal-W.
 - e. L & M Construction Chemicals; Type: L&M Cure R.
 - f. Symons Corporation; Type: Resi-Chem Clear Cure.
 - g. Substitutions: Not Permitted.
- C. Hot-Applied Joint Sealants
 - 1. Sealant for Concrete and Asphalt: Single-component formulation complying with ASTM D3405.
 - 2. Products: Subject to compliance with requirements, provide one of the following:
 - a. ROADS AVER 221; Crafc0, Inc.
 - b. Product #9005; Koch Materials Company.
 - c. Product #9030; Koch Materials Company.
 - d. SEALTIGHT HI-SPEC; W.R. Meadows, Inc.
 - 3. Round Backer Rod for Cold- and Hot-Applied Sealants: ASTM D5249, Type 1, of diameter and density required to control sealant depths and prevent bottom-side adhesion of sealant.

2.8 CONCRETE MIX - BY PERFORMANCE CRITERIA

- A. Mix concrete in accordance with ACI 304. Deliver concrete in accordance with ASTM C94.
- B. Provide concrete to the following criteria:
 - 1. Compressive Strength: 2,500 psi at 7 days.
 - 2. Compressive Strength: 4,500 psi at 28 days.
 - 3. Slump: 3 to 4 inches.
 - 4. Air Entrained: 6 ± 1 percent.

2.9 CONCRETE MIX

- A. Mix concrete in accordance with ASTM C94.
- B. Schedule of Mixes:

<u>Class</u>	<u>Name</u>	Maximum Aggregate Size (<u>inch</u>)	Maximum Slump** (<u>inch</u>)	Minimum Cement <u>Sacks/cu.yd.</u>	Minimum Compressive Strength (<u>psi/28 days</u>)	Maximum Water Cement <u>Ratio</u>
9*	Exterior Concrete Pavement	3/4	3	6.25	4000	0.45

* Air Entrained Concrete Mix. Normal Acceptable range of air content is 5-7 percent.

** Slump Tolerances Maximum slump of 4-inch plus 1-inch minus 1/2-inch.

- C. Prepare and submit concrete mix designs in accordance with Section 31 02 00 – General Requirements for Sitework, and include as part of cost of this Work.
- D. A qualified agency acceptable to Owner’s Representative shall prepare mix designs. Submit six (6) copies of mix designs for Owner’s Representative’s review prior to placing any concrete.
- E. Mix design shall indicate brands, types, and quantities of admixtures included, compressive strength, slump, sieve analysis for fine and coarse aggregate, quantities of all ingredients, type and brand of cement, source of aggregate, and whether fine aggregate is natural or manufactured.
- F. Use accelerating admixtures in cold weather only when approved by Owner’s Representative in writing. Use of admixtures will not relax cold weather placement requirements.
- G. Use calcium chloride only when approved by Owner’s Representative in writing.

- H. Use set retarding admixtures during hot weather only when approved by Owner's Representative in writing.

2.10 DETECTABLE WARNING PANELS

- A. Design shall comply with ADAAG guidelines.
- B. Each handicap ramp shall have nominal 24 x 48-inch truncated dome detectable warning panels. Material shall be ASTM A240 stainless steel, 5/16-inch thick. Panels shall be as manufactured by MetaDome, LLC or an approved equal.
- C. Finish:
 - 1. Powder coat finish, safety yellow, slip resistant.
 - 2. Plain stainless steel finish.
- D. Tolerances:
 - 1. Squareness: 1/8-inch maximum difference in diagonal measurements.
 - 2. Maximum Deviation From Plane: 1/16-inch in 48 inches.

2.11 SOURCE QUALITY CONTROL AND TESTS

- A. Section 31 02 00 – General Requirements for Sitework: Provide mix design for Class each class of concrete.
- B. Submit proposed mix design of each class of concrete to appointed firm for review prior to commencement of Work.
- C. Tests on cement, aggregates, and mixes will be performed to ensure conformance with specified requirements.
- D. Test samples in accordance with ACI 301.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 31 02 00 – General Requirements for Sitework: Coordination and project conditions.
- B. Verify compacted subgrade is acceptable and ready to support paving and imposed loads.
- C. Verify gradients and elevations of base are correct.

3.2 SUBBASE

- A. Section 32 11 23 - Aggregate Base Course, forms base construction for Work of this section.

3.3 PREPARATION

- A. Moisten base to minimize absorption of water from fresh concrete.
- B. Coat surfaces of manhole, catch basin, inlet, and utility frames with oil to prevent bond with concrete pavement.
- C. Notify Owner's Representative minimum 24 hours prior to commencing concrete operations.

3.4 FORMING

- A. Place and secure forms to correct location, dimension, profile, and gradient.
- B. Assemble formwork to permit easy stripping and dismantling without damaging concrete.
- C. Place joint filler vertical in position, in straight lines. Secure to formwork during concrete placement.

3.5 REINFORCEMENT

- A. Place reinforcement as indicated.
- B. Place reinforcement to achieve pavement and curb alignment as detailed.
- C. Provide doweled joints at locations shown on Drawings with one end of dowel set in capped sleeve to allow longitudinal movement.

3.6 PLACING CONCRETE

- A. Coordinate installation of snow melting components.
- B. Place concrete in accordance with specified ACI Requirements.
- C. Concrete may be placed using slip form technique.
- D. Ensure reinforcement, inserts, embedded parts, and formed joints are not disturbed during concrete placement.
- E. Place concrete continuously over full width of panel and between predetermined construction joints.

3.7 JOINTS

- A. Place joints as indicated on Drawings.
- B. Place expansion joints using joint filler as follows for identified entities:

1. As indicated on Drawings.
 2. Area Paving: Areas next to building foundation and fixed components with separate foundations.
- C. Recess top of joint filler 1/2-inch for sealant placement.
- D. Provide keyed joints as indicated.
- E. Jointing shall be performed by saw cutting. Jointing tools and equipment must provide minimum joint depth as specified by ACI requirements.
- F. If method of jointing is saw cutting, Contractor shall perform saw cutting operations as soon as possible following curing process, without damaging new concrete.

3.8 INSTALLING DETECTABLE WARNING PANELS

- A. Set panels into wet concrete at locations shown on Drawings. Press panels into concrete to match top of concrete elevation. Do not over depress.
- B. Clean any wet concrete off panel surface.

3.9 FINISHING

- A. Drive and Parking Lot Paving: Broom finish.
- B. Curbs and Gutters: Broom finish.
- C. Direction of Texturing: Transverse to pavement direction.
- D. Inclined Vehicular Ramps: Broomed perpendicular to slope.
- E. Place curing compound on exposed concrete surfaces immediately after finishing.

3.10 JOINT SEALING

- A. Separate pavement from vertical surfaces with 1/2-inch thick joint filler.
- B. Place joint filler in pavement pattern placement sequence. Set top to required elevations. Secure to resist movement by wet concrete.
- C. Extend joint filler from bottom of pavement to within 1/2-inch of finished surface.
- D. Comply with joint sealant manufacturer's written installation instructions applicable to products and applications indicated, unless requirements that are more stringent apply.

- E. Comply with recommendations of ASTM C1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- F. Install backer materials of type indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
 - 1. Do not leave gaps between ends of backer materials.
 - 2. Do not stretch, twist, puncture, or tear backer materials.
 - 3. Remove absorbent backer materials that become wet before sealant application and replace them with dry materials.
- G. Install sealants by the following techniques at same time backer material is installed:
 - 1. Place sealants so they directly contact and fully wet joint substrates.
 - 2. Completely fill recesses provided for each joint configuration.
 - 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- H. Tooling of Non-Sag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified below forming smooth, uniform beads; eliminating air pockets; and ensuring contact and adhesion of sealant with sides of joint.
 - 1. Remove excess sealants from surfaces adjacent to joint.
 - 2. Use tooling agents approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
- I. Provide joint sealant configuration complying with sealant manufacturer requirements and of depth and at locations indicated.

3.11 TOLERANCES

- A. Section 31 02 00 – General Requirements for Sitework: Tolerances.
- B. Maximum Variation of Surface Flatness: 1/4-inch in 10 feet.
- C. Maximum Variation from True Position: 1/4-inch.

3.12 FIELD QUALITY CONTROL

- A. Section 31 02 00 – General Requirements for Sitework: Testing and inspection services.
- B. Concrete testing shall be paid for by Contractor.
- C. Take three concrete test cylinders for every 75 or fewer cubic yards of each class of concrete placed each day.

- D. Take one additional test cylinder during cold weather and cure on site under same conditions as concrete it represents.
- E. Take one slump test for each set of test cylinders taken.
- F. Maintain records of placed concrete items. Record date, location of pour, quantity, air temperature, and test samples taken.

3.13 PROTECTION

- A. Immediately after placement, protect pavement from premature drying, excessive hot or cold temperatures, and mechanical injury.
- B. Do not permit pedestrian traffic over pavement for 2 days minimum after finishing and vehicular traffic over pavement for 7 days minimum after finishing.

END OF SECTION

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SECTION 32 90 00

PLANTING

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Plant Materials.
 - 2. Soil Amendment Materials.
 - 3. Planting Soil Preparation.
 - 4. Plant Material Schedule.
 - 5. Planting Operations.
 - 6. Native Grass Seed Mix.
 - 7. Fertilizing.
 - 8. Inspection and Approvals.
 - 9. Maintenance Service.

- B. Related Sections:
 - 1. Applicable provisions of Section 31 02 00 – General Requirements for Sitework shall govern Work under this Section.
 - 2. Section 31 05 13 – Soils for Earthwork: Subsoil and topsoil materials.
 - 3. Section 31 05 16 – Aggregates for Earthwork: Aggregate types.
 - 4. Section 31 22 13 - Rough Grading: Rough grading of site to topsoil subgrade elevations.
 - 5. Section 32 91 19 – Landscape Grading: Final grading for landscaping features.

1.2 DEFINITIONS

- A. Plants: Living trees, shrubs, ground cover, grasses, flowers, and bulbs specified in this Section, and described in ANSI Z60.1.

- B. Weeds: Includes Dandelion, Quack Grass, Morning Glory, Mustard, Chickweed, Crabgrass, Canadian Thistle, and otherwise plants not specified for this project.

- C. Salvaged Topsoil: Surface soil previously excavated from site and stockpiled elsewhere on site, for reuse. Type T1 as specified in Section 31 05 13 – Soils for Earthwork. Salvaged topsoil is subject to approval by Landscape Architect prior to use.

- D. Topsoil: Imported or salvaged surface soil composed of a mixture consisting of humus, clay and sand, rich in nutrients and capable of supporting plant growth. Topsoil shall be free of debris, and rocks larger than 3/4-inch, with a pH range of 5.5 to 7.5. Type T2 as specified in Section 31 05 13 – Soils for Earthwork.

- E. Black Dirt: A form of surface soil, black in color, extremely rich in humus and nutrients capable of supporting germination and plant growth. Black dirt shall be free of debris, and rocks larger than 1/2-inch, with a pH range of 5.5 to 6.5, conforming to ASTM D2487, group symbol OH.
- F. Subsoil: Imported or salvaged subsoil previously excavated from site, containing no more than 5 percent topsoil. Subsoil shall be free of debris, roots, clods, and rocks greater than 2 inches. Type S1 as specified in Section 31 05 13 – Soils for Earthwork.
- G. Sand: Imported gravel pit or crushed product free of silt, clay and loam or soluble materials, graded in accordance with ASTM C136, within the following limits:

Sieve Size	Percent Passing
No. 4	100
No. 14	10 - 100
No. 50	5 - 90
No. 100	4 - 30
No. 200	0

- H. Pea Gravel: Imported gravel pit or crushed stone product, free of silty, clay, loam or soluble materials and fines, Type A8 as specified in Section 31 05 16 – Aggregates for Earthwork.
- I. No. 1 Stone: Imported crushed stone product, free of silt, clay, loam or soluble materials and fines, Type A1 as specified in Section 31 05 16 – Aggregates for Earthwork.
- J. No. 2 Stone: Imported crushed stone product, free of silt, clay, loam or soluble materials and fines, Type A2 as specified in Section 31 05 16 – Aggregates for Earthwork.
- K. Mushroom Compost: Natural compost consisting of a combination of composted straw, horse manure, and supplemental nutrients.

1.3 QUALITY ASSURANCE

- A. All seed and related landscape materials and operations included in this Section shall be awarded as "one contract" to Contractor, who will be responsible for implementation.
- B. Qualifications of Workmen: Landscape work is to be provided by a single firm specializing in Landscape work having not less than 5 years successful experience in Landscape projects of similar scope and location to this one. Provide at least one person (with a minimum of 4 years similar experience) who shall be present on site at all times during execution of this portion of the work, who shall be thoroughly familiar with the type of materials being installed and the proper methods for their installation, and who shall direct all work performed under this section. Employ only qualified personnel familiar with required work.

- C. A maintenance program is required for this project, for protection of Owner and Contractor whereas adequate time and monies may be scheduled to properly establish hardy, vigorous growth and to provide pleasant visual environment envisioned by design and construction documents. This is more clearly defined later in this Section.

1.4 SUBMITTALS

- A. Following items required prior authorization; submit to Landscape Architect for approval:
 - 1. Miscellaneous Landscape Submittals:
 - a. Soil preparation literature.
 - b. Final topsoil gradients.
 - c. Proposed seed blend(s).
 - d. Use of soil amendments (except water).
- B. Certification:
 - 1. File Certificates of Inspection of plant materials required by State, County and Federal authorities and copy Owner's Authorized Representative, if required.
 - 2. Submit in accordance with Federal Seed Act, seed vendor's certified statement for each grass seed mixture required, stating botanical and common name, percentage by weight, and percentages of purity, germination, and weed seed for each grass seed species.
 - 3. Submit fertilizer, vendor's information, guarantees, and present labels on containers.
 - 4. Submit certificates of inspection as required by governmental authorities.
- C. Topsoil Report:
 - 1. Submit Soils Test Analysis Report for proposed or amended topsoil whether from on-site or remote sources in accordance with "Method of Soil Analysis - Agronomy #9" as published by the American Society of Agronomy.
 - 2. Before amendment of on-site topsoil, furnish Landscape Architect with a soil analysis made by an acceptable soil testing laboratory stating percentages of silt, clay, sand or organic matter, pH and mineral and plant nutrient content of topsoil for both plant and lawn growth compatible with material specified. Report to include fertilizer analysis stating recommended quantities for nitrogen, phosphorus, potash and trace elements; and any limestone, aluminum sulfate or other soil amendments to be added to make topsoil suitable for trees/shrubs, for lawn and for planters. Demonstrate compliance with laboratory recommendations for all preparations/procedures to be provided.

1.5 REGULATORY REQUIREMENTS

- A. Comply with regulatory agencies for fertilizer and herbicide application.
- B. Plant Materials shall be certified by State of Wisconsin Department of Agriculture, as described by ANSI Z60.1, be true to habit, and be free of insects and disease.

1.6 DELIVERY, HANDLING, AND STORAGE

- A. Deliver, handle and store products under provisions of Section 31 02 00 – General Requirements for Sitework – Product Requirements.
- B. Deliver fertilizer in waterproof bags showing weight, chemical analysis, and name of manufacturer.

1.7 JOB CONDITIONS

- A. Planting Restrictions:
 - 1. Soil Condition: Neither planting nor other site work shall be carried out in saturated or muddy ground conditions or under other climatic conditions which will inhibit proper execution. No planting shall occur until an acceptable time has expended beyond all application of herbicides or other vegetative controls.
- B. Protection:
 - 1. Do not move equipment over existing or newly placed structures without approval of Owner's Representative.
 - 2. Provide board-roading as required to protect paving.
 - 3. Protect other improvements from damage, with protection boards, ramps and protective sheeting.
 - 4. Protection of Plant Material: Contractor shall maintain all plant material in a healthy growing condition prior to and during planting operation. Contractor shall be responsible for vandalism, theft or damage to plant materials until completion of the maintenance period. Create/provide barricades, snow fencing, hire watchmen or whatever means are deemed necessary to totally protect all plantings.
- C. Utilities:
 - 1. Determine locations of all underground utilities and perform work in a manner that will avoid possible damage. Hand Excavate, if required, to minimize possibility of damage to underground utilities.
 - 2. Should obstructions be found, the Contractor shall submit written notification to Owner's Representative of all discrepancies in the drawings, or existing conditions which may interfere with work in this section.

1.8 CLEANUP

- A. Organize delivery, handling, and storage of materials and equipment to facilitate ease of construction sequencing and daily cleanup.
- B. During landscape work, keep pavements clean and open to traffic, construction vehicles, and persons employed by project. Moisten or stabilize topsoil to prevent water and wind erosion.

- C. Protect landscape work and materials from damage due to landscape operations, operations by other contractors and trades, and trespassers.
- D. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged landscape work as directed.
- E. Contractor shall ensure uninterrupted normal business operations at site during planting operations, and maintain a clean, orderly, and safe work area during every stage of construction.
- F. At end of each day, properly remove spoil of materials and packaging generated by operations of this contractor from site.

1.9 WARRANTY

- A. Warrant all seed installations for a period of one year after date identified in certificate 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. Warranty shall include one continuous growing season. Temperature fluctuations in the weather, natural hazards, or other climatic conditions will not waive the Contractor's warranty requirements.
- B. Remove and replace trees, shrubs or other plants found to be dead or in unhealthy condition during warranty period. Make final replacements during growth season following end of warranty period. Replace trees and shrubs which are in doubtful condition at end of warranty period; unless, in opinion of Owner's Representative, it is advisable to extend warranty period for a full growing season. Another warranty inspection will be conducted at end of extended warranty period, if any, to determine acceptance or rejection.
- C. During warranty period, ensure seeded areas remain in a healthy, vigorous condition and renew, treat, or replace any unsightly plants in a timely manner.
- D. At end of warranty period, Owner, Landscape Architect, and Contractor shall make a joint inspection. Renew, treat, or replace plants and lawn areas not in healthy growing condition.
- E. Replacement of native grasses shall be of original seed blend and species indicated, and shall be replaced within initial growing season, with a new warrantee commencing on date of replacement.
- F. All replacement stock is subject to same warranty requirements as original stock. Repair any damage to adjacent site features due to replacement operations.

PART 2 PRODUCTS

2.1 PLANT MATERIALS

- A. Native Grass Seed Mix: Provide fresh, clean, new-crop seed complying with tolerance for priority and germination established by Official Seed analysis of North America. Provide seed mixture composed of species, at proportions and percentages of purity and germination. Seed blend shall be Permanent Grasses/sedges and temporary cover only from "Basic Prairie Seed Mix" (omit all Forbs), as distributed by JF New or prior approved equal. See Plant List on site and landscape drawing.

2.2 SOIL AMENDMENT MATERIALS

- A. Provide the following chemical or organic amendments to topsoil at site if recommended and in the proportions as stated in the "Soils Test Analysis Report" and as direct by the Owner's Representative.
1. Lime: Natural dolomitic limestone containing not less than 85 percent of total carbonates with a minimum of 30 percent magnesium carbonates, ground so that not less than 90 percent passes a 10-mesh sieve and not less than 50 percent passes a 100-mesh sieve.
 2. Aluminum Sulfate: Commercial grade.
 3. Humus: Decomposed animal and plant matter, rich in nutrients with no identifiable fibers and within pH range suitable for intended use.
 4. Peat Moss: Shredded, loose, sphagnum moss free of lumps, roots, inorganic or acidic materials, with a minimum of 85 percent organic material measured by weight.
 5. Bone Meal: Commercial, raw, finely ground; 4 percent nitrogen and 20 percent phosphoric acid.
 6. Fertilizer: 50 percent of elements derived from organic sources, of proportion necessary to eliminate inherent deficiencies of topsoil being not less than 10 percent total nitrogen, 10 percent available phosphoric acid, and 5 percent soluble potassium.
 7. Herbicide: Pre-emergence type herbicide applied per manufacturer's specifications.
 8. Pesticide: Commercial grade, used at minimum concentrations as recommended by manufacturer and administered only by experienced technical personnel familiar with safe use and handling.
 9. Water: Clean, fresh, and free of substances or matter that could inhibit vigorous growth of plants. Contractor shall supply and pay for water.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that a fully prepared subsoil base is ready to receive topsoil and other work of this Section.

- B. Verify that required underground utilities are available, in proper location, and ready for use.
- C. Saturate soil with water to test drainage.
- D. Report conditions detrimental to plant growth or implementation to Owner's Representative prior to planting.
- E. Beginning of installation means acceptance of existing site conditions.

3.2 PROTECTION

- A. Prior to start of any work of this Section, make contact with buried and overhead utility locating services or agencies to determine depth, location, clearances, and other precautions to avoid damage to existing facilities, equipment, and those employed at site.
- B. Hand excavate as required.
- C. Maintain grade stakes set by others.
- D. Secure, encircle, or otherwise protect Work from intrusion by trespassers, equipment, or others employed at site.

3.3 PLANTING SOIL PREPARATION

- A. Preparation of Planting Soil:
 1. Before mixing, clean topsoil of roots, plants, sod, stones, clay lumps and other extraneous materials harmful or toxic to plant growth.
 2. Mix soil amendments and fertilizers with topsoil at rates specified in soils test analysis report. Delay mixing of fertilizer if planting will not follow placing of planting soil within 48 hours.
 3. Refer to schedule at the end of this section for planting soil mixture requirements.
 4. Mix soil amendments and fertilizer by suitable means to assure complete mixing and uniform texture using proportions for each use as recommended by soils test analysis report.
 5. For pit and trench type backfill, mix planting soil prior to backfilling, and stockpile at site.
 6. For planting seeded areas, mix planting soil either prior to planting or apply on surface of topsoil and mix thoroughly before planting.
 7. Apply phosphoric acid fertilizer (other than that constituting a portion of complete fertilizers) directly to subgrade before applying planting soil and tilling.
- B. Preparation for Native Grass Seed Areas:
 1. Provide soil preparation for all areas to be seeded or sodded.
 2. Loosen subgrade of lawn areas to a minimum depth of 6 inches by rototilling. Remove stones over 1.5 inches in any dimension and sticks, roots, rubbish, and other

- extraneous matter. Limit preparation to areas which will be planted immediately.
3. Provide herbicide treatment to all Prairie and Wildflower Seed Planting areas as a part of seed planting price. For all seed planting areas, apply "Roundup" or equal short term herbicide to inhibit unwanted plant growth. Apply in accordance with the manufacturer's recommendation for this purpose and sufficiently in advance of planting to avoid damage to new lawns. Obtain approval in advance by Owner's Representative. After topsoil has been tilled into the existing topsoil, and irrigation system is installed (if used), apply water for a period of three weeks to maintain consistent soil moisture in order to promote weed growth. After weed seeds have germinated apply a non soil-residual herbicide that controls annual and perennial broadleaves and grasses on all graded areas where seeding will occur. Active ingredients and rates of application are as follows.
 - a. Active Ingredient: Isopropylamine salt of glyphosate.
 - b. Rate of Application: As per manufacturer recommendation.
 - c. Recommended Total Spray Volume: As per manufacturer recommendation, apply by handgun on backpack sprayer.
 - d. Do not apply herbicide treatment when rain is forecast within 24 hours after application. Do not water treated areas until seeding is to occur. Allow a minimum 7 days after treatment before seeding. Do not retill soil after treatment is completed.
 4. Spread soil amendment mixture (after topsoil is spread under separate Section) and till in thoroughly to a depth of 6 inches, and bring to minimum depth required to meet lines, grades and elevations shown, after natural settlement.
 5. Where new topsoil is required, add soil amendments and place approximately 1/2 of total amount of topsoil required. Work into top of loosened subgrade to create a transition layer and then place remainder.
 6. Grade seeding areas to smooth, even surface with loose, uniformly fine texture. Roll, rake, drag seeding areas and remove ridges and fill depressions as required to meet finish grades. Finish grade to 1 inch below top of adjacent curb or sidewalk. Limit fine grading to areas that can be immediately planted.
 7. Moisten prepared seeding areas before planting if soils is dry. Water thoroughly and allow surface moisture to dry before planting grass. Do not create a muddy soil condition. Restore seeding areas to specified condition if eroded or otherwise disturbed after fine grading and prior to planting.

C. Preparation of Unchanged Grades:

1. Where manicured turf, Prairie and Wildflower Plantings are to be planted in areas that have not been altered or disturbed by excavating, grading or stripping operations, prepare soil for planting as follows: Till to a depth of not less than 6 inches. Apply soil amendments and initial fertilizers as specified in soils test analysis report. Remove high areas and fill in depressions. Till soil to a homogenous mixture of fine texture, free of lumps, clods, stones, roots and other extraneous matter.
 - a. Prior to preparation of unchanged areas, remove existing grass, vegetation and turf. Dispose of such material outside of Owner's property. Do not turn

- existing vegetation over into soil being prepared for lawns.
- b. Apply commercial fertilizer and thoroughly mix into upper 2 inches of topsoil. Delay application of fertilizer if lawn planting will not follow within 48 hours.
 - c. Refer to "Schedule of Planting Soil Mixture" at the end of this section.

3.4 PLANT MATERIAL SCHEDULE

- A. Plant Material Schedule is a detailed plant listing indicating static design usage, common and scientific names, minimum size and symbols, and shall be used in conjunction with landscape construction details.
- B. Provide trees, shrubs, and plants of size and species shown and scheduled for landscape work, nursery-grown under similar climatic conditions, and complying with definitions, requirements, and sizing of ANSI Z60.1.
- C. All quantities listed are assembled for convenience of landscape bidding. Successful contractor shall develop lawn areas and install plant material shown on Drawings. Any discrepancies between quantities of plants listed and the quantities shown on the Drawings, the Drawing shall govern.
- D. Sizes of planting stock listed is minimum acceptable size for each plant introduced to site. Additionally, when excessive pruning reduces crown, replace plant.
- E. Substitutions: No Substitutions shall be accepted without written permission of the Landscape Architect. This applies to the genus, species, and variety of all plants and miscellaneous landscape items.
- F. All plants shall be true to name and in all cases, botanical names shall take precedence over common names. All plants of each clone, species, or cultivar shall be delivered to the site labeled with their full botanical name.
- G. The Contractor shall review the Drawings and Specifications to coordinate the work indicated in this section with all other related work. In case of any discrepancy, Contractor shall notify Owner's Representative. However, Specifications take precedence over the Drawings.

3.5 PLANTING OPERATIONS

- A. Prior to beginning of Work specified in this Section, verify that site grading and preparation have been properly completed where necessary for this work.
- B. Proceed with complete landscape work as rapidly as portions of site become available, working within seasonal limitations for each kind of landscape work required.

- C. Plant seeded areas after final grades are established and prior to planting of lawns, unless otherwise acceptable to Owner's Representative.
- D. Contractor shall include cost per square yard for additional seed/sod operations required to re-establish adjacent lawn areas which may become damaged during construction process or to repair damage done by others.
- E. Recommended Schedule of Implementation:
 - 1. Spring: Mid-April through June
 - 2. Autumn: Mid-August through November
- F. Make every effort to install plant materials during normal planting season for each type of landscape work required.
- G. If for any reason installation cannot be completed during these times, take extra care to insure healthy growth of plant material.
- H. Correlate planting with specified maintenance periods to provide maintenance from date of completion.
- I. Work specified in this Section will be postponed until next planting season if other work under this Contract is completed too late in year for planting work to be performed properly.

3.6 NATIVE GRASS SEEDING

- A. Apply seed by use of approved "to till" drill type seed planter. Planting equipment shall deposit seed mix a minimum of 1/4-inch into soil surface and shall keep materials in an agitated state and be so designed to insert seed uniformly at specified rate.
- B. Broadcast 50 percent of seeds in north-south direction and complete operations in an east-west direction to ensure equal distribution of seed.
- C. Planting equipment shall be so designed that when solution is deposited over an area, resulting deposits of seed are equal in quantity to required rates.
- D. Completely flush and clean planting machinery each day before seeding is to be started and thoroughly flush residues after completion of every 5 acres.
- E. Moisten prepared topsoil surface immediately prior to seeding.
- F. Prepare seed mixture accurately and indoors at percentages specified, or provide quality seed mixture of blend specified earlier in this Section, and construction details.
- G. Plant Prairie Seed Blend at rate as recommended by seed supplier.
- H. Irrigate planted areas as required for sixty days following installation.

3.7 FERTILIZING

- A. In order to fully satisfy requirements of seed planting operations, provide fertilizer of neutral character, with some elements derived from organic sources and containing a percentage of nitrogen, phosphorous, and potassium in a form that will be available to plants during initial period of growth.
- B. Apply fertilizer immediately after time of planting and other application just prior to end of 60-day maintenance period.
- C. Prepare and execute fertilizer operations per manufacturer's recommendations and at rates and varieties specified earlier within this Section.
- D. Lightly water to aid dissipation of fertilizer.

3.8 INSPECTION AND APPROVALS

- A. Design scope, character, color composition, detailing, texture, dynamism, and Contract Documents have been created to satisfy specific site requirements of Owner and governmental agencies. Any modification not set forth and approved at time of pre-installation meeting must be denied.
- B. When inspected landscape work does not comply with requirements, replace rejected work and continue specified maintenance until Work is re-inspected and found to be acceptable.
- C. Final acceptance shall include fertilization and maintenance required to establish vigorous, healthy plantscape as set forth by standard landscape practices and contract documents.
- D. At end of maintenance/acclimatization period and compliance with contract documents is established, Owner's Representative will issue a "Certificate of Final Acceptance" to Owner, which includes a request for a release of 95 percent payment of total planting contract.
- E. Remaining 5 percent of planting contract will be issued by Owner at a date specified by Owner's Representative following plant installation and final acceptance.

3.9 MAINTENANCE SERVICE

- A. Contractor shall perform maintenance services for a period two years beyond date of substantial completion.
- B. Maintain plant life immediately after planting to establish vigorous growing conditions.
- C. During "maintenance period" provide an ongoing, pleasant visual environment where any plant which is not responding to transplanting is immediately replaced, lawns are repaired, and weeds are constantly removed without exception.

- D. Maintain Native Seed areas as recommended by seed distributor.
- E. Adequate germination of seeded areas shall be not less than 15 seedlings per square foot or 95 percent of area seeded with native grass or prairie plantings.
- F. Installer will inspect work at 30 days and 60 days following the end of the maintenance period and notify Owner in writing (copy to Owner's Representative) of any deficiencies in irrigation or other maintenance procedures.
- G. Maintenance to also include:
 - 1. Irrigate as necessary to supplement seasonal rainfall. Landscape Contractor shall dictate to Irrigation Contractor any modifications to water application rates and cycling times beyond recommendations shown on Drawings.
 - 2. Cultivation and weeding of seeded areas.
 - 3. Application of herbicides for weed control in accordance with manufacturer's instructions. Remedy damage resulting from use of herbicides.
 - 4. Application of pesticides in accordance with manufacturer's instructions. Remedy damage resulting from use of pesticides.
 - 5. Application of fertilizer as specified.
 - 6. Disease control.
 - 7. Mowing/burning of Native Grass areas.

3.10 SCHEDULE OF PLANTING SOIL MIXTURE

- A. (Subject to the recommendation of the Soils Test Analysis Report and Owner's Representative Approval).
- B. Native Grass Seed Areas:
 - 1. Provide soil amendments per the soils test analysis report but not less than the following quantities of specified materials.
 - 2 cu. yd. of compost per 1,000 sq. ft.
 - 2 cu. yd. of manure per 1,000 sq. ft.
 - * lbs. of lime per 1,000 sq. ft.
 - * lbs. of bone meal per 1,000 sq. ft.
 - 10 lbs. of superphosphate per 1,000 sq. ft.
 - * lbs. of potash per 1,000 sq. ft.
 - 15 lbs. of commercial fertilizer per 1,000 sq. ft. (18-46-0)

*Note: all quantities subject to determination pending soils test analysis.
 (The pH range should be 5.5-6.5 and the electrical conductivity range should not exceed 4.0 mmhos/cm.)

END OF SECTION

SECTION 32 91 19

LANDSCAPE GRADING

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Final grading requirements.
 - 2. Topsoil for finish landscaping.
- B. Related Sections:
 - 1. Applicable provisions of Section 31 02 00 – General Requirements for Sitework shall govern Work under this Section.
 - 2. Section 31 05 13 – Soils for Earthwork.
 - 3. Section 31 22 13 - Rough Grading: Site contouring.
 - 4. Section 32 90 00 - Planting.

1.2 REFERENCES

- A. ASTM International (American Society for Testing and Materials)
 - 1. ASTM D5268 – Topsoil Used for Landscaping Purposes.

1.3 SUBMITTALS

- A. Section 31 02 00 – General Requirements for Sitework – Submittal Procedures: Requirements for submittals.
- B. Samples: Submit, in airtight containers, 10 lb. sample of topsoil to testing laboratory.
- C. Materials Source: Submit name of source of imported materials.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Topsoil: As specified in Section 32 90 00 – Planting.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 31 02 00 – General Requirements for Sitework - Administrative Requirements: Coordination and project conditions.
- B. Verify building and trench backfilling have been inspected.

- C. Verify substrate base has been contoured and compacted.

3.2 SUBSTRATE PREPARATION

- A. Eliminate uneven areas and low spots.
- B. Remove debris, roots, branches, stones, in excess of 2-inch in size. Remove contaminated subsoil.
- C. Scarify surface to depth of 3 inches where topsoil is scheduled. Scarify in areas where equipment used for hauling and spreading topsoil has compacted subsoil.

3.3 PLACING TOPSOIL

- A. Place topsoil in areas where seeding is required to nominal depth of 6 inches. Place topsoil during dry weather.
- B. Fine grade topsoil to eliminate rough or low areas. Maintain profiles and contour of subgrade.
- C. Remove roots, weeds, rocks, and foreign material while spreading.
- D. Manually spread topsoil close to plant material and structures to prevent damage.
- E. Lightly compact placed topsoil.
- F. Remove surplus subsoil and topsoil from site.
- G. Leave stockpile area and site clean and raked, ready to receive landscaping.

3.4 TOLERANCES

- A. Section 31 02 00 – General Requirements for Sitework - Quality Requirements: Tolerances.
- B. Top of Topsoil: Plus or minus 1/2-inch.

3.5 PROTECTION OF INSTALLED WORK

- A. Section 31 02 00 – General Requirements for Sitework - Execution and Closeout Requirements: Protecting installed Work.
- B. Protect landscaping and other features remaining as final Work.
- C. Protect existing structures, fences, sidewalks, utilities, paving, and curbs.
- D. Prohibit construction traffic over topsoil.

END OF SECTION

SECTION 33 11 00

SITE WATER SYSTEM

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Site Piping.
 - 2. Pipe Fittings.
 - 3. Valves.
 - 4. Fire Hydrants.
 - 5. Domestic Water Services.

- B. Related Sections:
 - 1. Applicable provisions of Section 31 02 00 – General Requirements for Sitework shall govern Work under this Section.
 - 2. Section 31 05 16 - Aggregates for Earthwork.
 - 3. Section 31 23 16 - Utility Trench Excavation, Backfill, and Compaction.
 - 4. Section 33 13 00 – Water Main Disinfection: Disinfection of site water piping.
 - 5. Section 33 17 00 - Water Main Testing.
 - 6. Division 22 – Plumbing.

1.2 REFERENCES

- A. State of Wisconsin Administrative Code, Department of Commerce, Plumbing Code, Chapters 82 and 84.

- B. ASME (American Society of Mechanical Engineers)
 - 1. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.

- C. ASTM International (American Society for Testing and Materials)
 - 1. ASTM A276 – Specification for Stainless Steel Bars and Shapes.
 - 2. ASTM A563 - Specification for Carbon and Alloy Steel Nuts.
 - 3. ASTM A575 - Specification for Steel Bars, Carbon, Merchant Quality, M-Grades.
 - 4. ASTM B88 - Specification for Seamless Copper Water Tube.
 - 5. ASTM C33 - Specification for Concrete Aggregates.
 - 6. ASTM C150 - Specification for Portland Cement.
 - 7. ASTM D2774 – Practice for Underground Installation of Thermoplastic Pressure Piping.
 - 8. ASTM D3139 - Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.
 - 9. ASTM D 3350 – Specification for Polyethylene Plastics Pipe and Fittings Materials.

10. ASTM F477 - Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
11. ASTM F594 - Specification for Stainless Steel Nuts.

D. AWS (American Welding Society)

1. AWS A5.8 - Brazing Filler Metal.

E. AWWA (American Water Works Association)

1. AWWA C104 - Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water.
2. AWWA C105 - Polyethylene Encasement for Ductile Iron Pipe Systems.
3. AWWA C110 - Ductile Iron and Grey Iron Fittings 3-In. Through 48-In., for Water.
4. AWWA C111 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
5. AWWA C150 - Thickness Design of Ductile-Iron Pipe.
6. AWWA C151 - Ductile-Iron Pipe, Centrifugally Cast, for Water or Other Liquids.
7. AWWA C153 - Ductile-Iron Compact Fittings, 3-In. Through 24-In., for Water Service.
8. AWWA C502 - Dry Barrel Fire Hydrants.
9. AWWA C504 - Rubber Seated Butterfly Valves.
10. AWWA C508 - Swing-Check Valves for Waterworks Service, 2 In. through 24 In. NPS.
11. AWWA C509 - Resilient Seated Gate Valves for Water Supply Service.
12. AWWA C600 - Installation of Ductile-Iron Water Mains and Their Appurtenances.
13. AWWA C605 - Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water.
14. AWWA C900 - Polyvinyl Chloride (PVC) Pressure Pipe, 4 In. Through 12 In., for Water Distribution.
15. AWWA C901 - Polyethylene (PE) Pressure Pipe and Tubing, 1/2 In. Through 3 In., for Water Service.
16. AWWA C905 - Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 14 In. Through 48 In., for Water Transmission and Distribution.
17. AWWA C906 - Polyethylene (PE) Pressure Pipe and Fittings, 4 In. Through 63 In., for Water Distribution and Transmission.

F. NSF International (National Sanitary Foundation)

1. NSF 14 - Plastics Piping System Components and Related Materials.
2. NSF 61 - Drinking Water System Components - Health Effects.

1.3 SUBMITTAL DEFINITIONS

- A. Product Data: Product manufacturer's data regarding material, machinery, components, equipment, fixtures, and systems incorporated in Work. Does not include machinery and equipment used for preparation, fabrication, conveying and erection of Work.
- B. Shop Drawings: Submit drawings, diagrams, illustrations, brochures, schedules, and other data which are prepared by Contractor, a subcontractor, manufacturer, supplier, or distributor

which illustrates equipment, material, machinery, or some portion of Work to Engineer for review prior to incorporation into Work.

1.4 SUBMITTALS FOR REVIEW

- A. Section 31 02 00 – General Requirements for Sitework: Requirements for submittals.
- B. Product Data: Provide data on pipe materials, pipe fittings, valves and accessories.

1.5 SUBMITTALS FOR INFORMATION

- A. Section 31 02 00 – General Requirements for Sitework: Requirements for submittals.
- B. Manufacturer's Instructions: Indicate special procedures required to install Products specified.
- C. Certificates: Certify that products meet or exceed specified requirements.

1.6 SUBMITTALS AT PROJECT CLOSEOUT

- A. Section 31 02 00 – General Requirements for Sitework: Requirements for submittals.

1.7 REGULATORY REQUIREMENTS

- A. Perform Work in accordance with requirements of:
 - 1. State of Wisconsin Administrative Code, Department of Commerce, Plumbing Code, Chapters 82 and 84 and local code if more stringent for materials and installation of the Work of this Section.

1.8 QUALITY ASSURANCE

- A. Perform work in accordance with requirements of City of Madison Water Utility for public connections and modifications where applicable.
- B. Valves and Hydrants: Mark manufacturer's name and pressure rating on body.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect, and handle products to site under provisions of Section 31 02 00 – General Requirements for Sitework.
- B. Deliver and store valves and gaskets in shipping containers with labeling in place.

PART 2 PRODUCTS

2.1 GENERAL

- A. An acceptable certifying organization shall evaluate, test, and certify products intended for contact with potable water for conformance with NSF 61 and health effects portion of NSF 14.
- B. Pipe, fittings, valves, hydrants, and valve boxes shall be manufactured in the United States of America.
- C. Provide materials in accordance with:
 - 1. State of Wisconsin Administrative Code, Department of Commerce, Plumbing Code, Chapters 82 and 84 and local code if more stringent for materials for the Work of this Section.

2.2 WATER PIPE

- A. PVC Pipe: AWWA C900, Class 100, DR 25:
 - 1. PVC Pipe and Fitting Manufacturers:
 - a. Diamond Plastics Corporation.
 - b. JM Eagle Company.
 - c. North American Pipe Corporation.
 - d. Substitutions in accordance with Section 31 02 00 – General Requirements for Sitework.
 - 2. Fittings: Ductile iron, AWWA C110 Standard or AWWA C153 Compact.
 - 3. Joints: In accordance with ASTM D3139 using ASTM F477 elastomeric gaskets.

2.3 GATE VALVES

- A. Manufacturers:
 - 1. American Flow Control.
 - 2. Kennedy Valve Company, division of McWane, Inc.
 - 3. Mueller Company, division of Mueller Water Products, Inc.
 - 4. U.S. Pipe and Foundry Company, division of Mueller Water Products, Inc.
 - 5. Substitutions in accordance with Section 31 02 00 – General Requirements for Sitework.
- B. AWWA C509, Iron body, bronze trim, non-rising stem with square nut, single resilient wedge, flanged mechanical joint ends, control rod, extension box and valve key.

2.4 CAST IRON VALVE BOXES

- A. Manufacturers:
 - 1. Bingham & Taylor Corporation.

2. Tyler Pipe Company.
 3. Substitutions in accordance with Section 31 02 00 – General Requirements for Sitework.
- B. Cast Iron Valve Box: 5-1/4 inch diameter shaft; round base; 5-1/4 inch drop lid marked "WATER"; length of assembly sized to span top of main to finished grade with a minimum adjustment remaining for an additional 3 inches.

2.5 VALVE BOX ADAPTERS

- A. Gate Valve Adaptor: Epoxy-coated, 1/4-inch steel with 1/2-inch rubber gasket, size to fit valve. Similar and equal to adaptors manufactured by Adaptor, Inc., West Allis, WI.

2.6 HYDRANTS

- A. Manufacturers:
1. American Flow Control - Waterous Pacer WB-67-250.
 2. Clow Division of McWane Corporation – Medallion.
 3. Kennedy Valve – Guardian K-81D.
 4. Mueller Company division of Mueller Water Products, Inc. – Super Centurion A423.
 5. U.S. Pipe and Foundry Company division of Mueller Water Products, Inc. – Metropolitan/ M-94.
 6. Substitutions in accordance with Section 31 02 00 – General Requirements for Sitework.
- B. Hydrant: Type as required by Municipal Utility.
- C. Hydrant Extensions: Fabricate in multiples of 6 inches with rod and coupling to increase barrel length. Maximum of one (1) extension per hydrant may be used. If additional extension is necessary on hydrant with existing extension, remove existing extension and replace with single, adequate extension.
- D. Hose and Streamer Connection: Match sizes with municipal utility, two hose nozzles.
- E. Finish: Primer and two coats of enamel in color required by Municipal Utility.

2.7 ACCESSORIES

- A. Thrust Restraint:
1. Concrete: ASTM C150 Portland cement and ASTM C33 aggregates, air-entrained concrete with minimum compressive strength of 3000 psi.
 2. Wedge-Action Joint Restraints: Cast iron, circular or a pair of semi-circles with wedges that grip ductile iron or PVC pipe. Product shall be Megalug as manufactured by EBAA Iron Sales, Eastland, TX, Uni-Flange as manufactured by Ford Meter Box Company, Inc., Wabash, IN, or an approved equal.

3. Rod Restraints: ASTM A575 carbon steel, threaded rods with bitumastic coating and ASTM A563 nuts.
 4. Anchor Pipe: Ductile iron, thickness class 53, mechanical joint.
- B. Backflow Preventer:
1. FEBCO, CMB Industries, Inc., Fresno, CA.
 2. Watts Regulator Company, North Andover, MA.
 3. Zurn/Wilkins Water Control Products, Paso Robles, CA.
 4. Substitutions in accordance with Section 31 02 00 – General Requirements for Sitework.
- C. Meter:
1. Badger Meter, Inc., Milwaukee, WI.
 2. ABB Water Meter, Inc., Ocala, FL.
 3. Sensus Technologies, Inc., Uniontown, PA.
 4. Substitutions in accordance with Section 31 02 00 – General Requirements for Sitework.
- D. Pipe Location Materials.
1. Identification Warning Tape: Aluminum underground warning tape, 2-inch width. Color-Bright Blue, warning message "Caution Buried WATER MAIN Below" to repeat every 30 inches.

2.8 TRACER WIRE MATERIALS

- A. Mark non-conductive lateral pipes with a locating wire system.
- B. Locating wire system consists of the following:
1. Tracer Wire: 45-mil solid copper, No. 12 HMW-PE yellow jacket coating. Install to enable electronic locating of underground utility.
 2. Tracer Wire Locating Box: 2-1/2-inch diameter, minimum, ABS pipe with 2 point terminal box and cast iron cover.
 - a. Manufacturer: Valco, Inc. Model C.P. Mini Box, or an approved equal.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that building service connection and municipal utility water main size, location, and invert are as indicated.

3.2 PREPARATION

- A. Hand trim excavations to required elevations. Correct over excavation with Type A2 aggregate as specified in Section 31 05 16 – Aggregates for Earthwork.

- B. Remove large stones or other hard matter that could damage pipe or impede consistent backfilling or compaction.
- C. Cut pipe ends square, ream pipe and tube ends to full pipe diameter, remove burrs.
- D. Remove scale and dirt on inside and outside before assembly.
- E. Prepare pipe connections to equipment with flanges or unions.

3.3 BEDDING

- A. Excavate pipe trench in accordance with Section 31 23 16 – Utility Trench Excavation, Backfill, and Compaction for work of this Section. Hand trim excavation for accurate placement of pipe to elevations indicated.
- B. Form and place concrete for pipe thrust restraints at any change of pipe direction. Place concrete to permit full access to pipe and pipe accessories. Provide adequate thrust restraint bearing on subsoil.
- C. Place bedding material in trench bottom, level fill materials in one continuous layer not exceeding 4 inches compacted depth; compact to 95 percent modified Proctor density.
- D. Backfill around sides and top of pipe with bedding material to a depth of 18 inches above pipe, and compact to 95 percent modified Proctor density.
- E. Maintain optimum moisture content of bedding material to attain required compaction density.

3.4 INSTALLATION - PIPE

- A. Maintain separation of water main from sewer piping in accordance with:
 - 1. State of Wisconsin Administrative Code, Department of Commerce, Plumbing Code, Chapters 82 and 84 and local code if more stringent for installation of the Work of this Section.
- B. Install pipe to indicated elevation to within tolerance of 5/8-inch.
- C. Install PVC pipe in accordance with AWWA C605.
- D. Route pipe in straight line.
- E. Install pipe to allow for expansion and contraction without stressing pipe or joints.
- F. Install access fittings to permit disinfection of water system performed under Section 33 13 00 – Water Main Disinfection.

- G. Slope water pipe and position drains at low points.
- H. Form and place concrete for thrust restraints at each elbow or change of direction of pipe main.
- I. Establish elevations of buried piping to ensure not less than six foot of cover.
- J. Install tracer wire continuous over top of pipe. Secure tracer wire to top of pipe with industrial strength tape.
- K. Backfill trench in accordance with Section 31 23 16 – Utility Trench Excavation, Backfill, and Compaction. Do not displace or damage pipe when compacting.

3.5 INSTALLATION - VALVES AND HYDRANTS

- A. Set valves on solid concrete block bearing.
- B. Center and plumb valve box over valve. Set box cover flush with finished grade.
- C. Set hydrants plumb; locate pumper nozzle perpendicular to and facing roadway.
- D. Set hydrants to grade, with nozzles a minimum of 20 inches above finished grade.
- E. Locate hydrant valve on hydrant lead a minimum of 24 inches from hydrant.
- F. Provide a drainage pit 36 inches square by 24 inches deep filled with 6 inches of Type A5 clear stone, as specified in Section 31 05 16 – Aggregates for Earthwork. Encase elbow of hydrant in clear stone to 6 inches above drain opening. Do not connect drain opening to sewer.

3.6 TRACER WIRE INSTALLATION

- A. Lateral tracer wire originates and terminates in tracer wire access box located at right-of-way line. Install conductor tracer wire in one continuous loop.
- B. Tape conductor tracer wire to top of pipe at minimum 10-foot intervals. Wrapping conductor tracer wire around pipe is prohibited.
- C. Field test each locating wire after installation is completed.

3.7 DISINFECTION OF POTABLE WATER SYSTEM PIPING

- A. Flush and disinfect system in accordance with Section 33 13 00 – Water Main Disinfection.

3.8 SERVICE CONNECTIONS

- A. Provide water service to utility company requirements and plumbing drawings and specifications.
- B. Provide sleeve in retaining wall for service main. Support with reinforced concrete bridge. Calk enlarged sleeve watertight.
- C. Provide 18 gage galvanized sheet metal sleeve surrounding service main to 6 inches above floor and 6 feet minimum below grade. Size for minimum of 2 inches of foam insulation.

3.9 FIELD QUALITY CONTROL

- A. Section 31 02 00 – General Requirements for Sitework: Field inspection and testing.
- B. Request inspection prior to and immediately after placing bedding.
- C. Perform moisture content testing and compaction testing in accordance with Section 31 23 16 – Utility Trench Excavation, Backfill, and Compaction.
- D. If tests indicate Work does not meet specified requirements, remove Work, replace and retest at no cost to Owner.
- E. Frequency of Tests: As determined by Owner’s Representative.
- F. Pressure Test: Test in accordance with Section 33 17 00 – Water Main Testing, State of Wisconsin Administrative Code, Department of Commerce, Plumbing Code, Chapters 82 and 84, and local code if more stringent for installation of the Work of this Section.
- G. Deflection Test: Test in accordance with Section 33 17 00 – Water Main Testing.

3.10 PROTECTION OF FINISHED WORK

- A. Section 31 02 00 – General Requirements for Sitework: Protecting installed work.
- B. Protect pipe and aggregate cover from damage or displacement until backfilling operation is in progress.

END OF SECTION

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SECTION 33 13 00
WATER MAIN DISINFECTION

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Disinfection of Water Mains, Fittings, and Appurtenances.
 - 2. Disinfection Materials.
 - 3. Disinfection Methods.
 - 4. Pipe Filling and Contact.
 - 5. Sampling and Testing.
 - 6. Re-disinfection.
 - 7. Disinfection Procedure for Cutting into Existing Main.
 - 8. Flushing of Main.

- B. Related Sections:
 - 1. Applicable provisions of Section 31 02 00 – General Requirements for Sitework shall govern Work under this Section.
 - 2. Section 33 11 00 – Site Water System.
 - 3. Section 33 17 00 – Water Main Testing.

1.2 REFERENCES

- A. Public Works Industry Improvement Program
 - 1. Standard Specifications for Sewer and Water Construction in Wisconsin, Sixth Edition, December 22, 2003, with Addendum No. 2, April 22, 2008.

- B. American Water Works Association (AWWA)
 - 1. AWWA B300 - Standard for Hypochlorites.
 - 2. AWWA C651 - Standard for Disinfecting Water Mains.
 - 3. Standard Methods for the Examination of Water and Wastewater.

- C. NSF International
 - 1. NSF 61 - Drinking Water System Components - Health Effects.

1.3 PERFORMANCE REQUIREMENTS

- A. Basic disinfection procedure consists of:
 - 1. Preventing contaminating materials from entering water main during storage, construction, or repair.
 - 2. Removing by flushing or other means materials that may have entered water main.
 - 3. Chlorinating any residual contamination that may remain and flushing chlorinated

water from main.

4. Determining bacteriological quality by laboratory test after disinfection.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Store calcium hypochlorite in cool, dark, dry environment prior to use to minimize its deterioration.
- B. Furnish new, unopened containers for work. Partially filled containers used on previous jobs shall not be allowed.

1.5 QUALITY ASSURANCE

- A. Disinfection of water main, sampling, and testing in accordance with local, state, and federal regulatory rules and regulations. Perform disinfection to meet most stringent regulations.
- B. Owner's Representative shall take samples of water and deliver samples to an accredited and approved testing agency.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Hypochlorite Powder: Calcium hypochlorite granular powder with 65-70 percent available chlorine in accordance with AWWA B300.

PART 3 EXECUTION

3.1 PREPARATION

- A. Take precautions to protect interiors of pipes, fittings, and valves against contamination.
- B. Pipe delivered for construction shall be laid out and soundly supported above ground surface to minimize entrance of foreign material.
- C. Complete pipe joints in trenches before work is stopped. If site water accumulates in trench, plug pipe until trench is dry.
- D. Do not use contaminated material or any material capable of supporting prolific growth of microorganisms for sealing joints.
- E. Handle sealing material or gaskets in a manner that avoids contamination.
- F. Lubricant used in installation of sealing gaskets shall be suitable for potable water usage. Deliver lubricant to job in closed containers and keep clean and free of soil and other contaminants.

- G. If soil or debris enters pipe and, in opinion of Owner's Representative, will not be removed by flushing operation, clean interior of pipe by mechanical means and then swab with one percent hypochlorite disinfecting solution.
- H. Undertake cleaning using a pig, swab, or "go-devil" only when Owner Representative determines that such operation will not force mud or debris into pipe joint spaces.
- I. If difficulties arise that prevent pipe and fittings from remaining dry during installation, make every effort to assure that any water that enters pipe joint spaces contains an available chlorine concentration of approximately 25 mg/L.
- J. If main is flooded during construction, clear main of floodwater by draining and flush with potable water until clean. Fill flooded section with chlorinated potable water which at end of 24 hour holding period will have a free chlorine residual of not less than 25 mg/L.

3.2 CHLORINATION METHODS

- A. Place calcium hypochlorite in amounts indicated in this Section. Place calcium hypochlorite at upstream end of first section of pipe, at upstream end of each branch main, in first pipe section past valve, in hydrant leads, and at a minimum 500 foot interval in main.
- B. Do not use granules in solvent welded plastic or screwed joint steel pipe due to danger of fire or explosion from reaction of joint compounds with calcium hypochlorite.

Ounces of Calcium Hypochlorite Granules to Be Placed
at Beginning of Main and at Each 500 Foot Interval

<u>Pipe Diameter (Inches)</u>	<u>Calcium Hypochlorite Granules (Ounces)</u>
4	0.5
6	1.0
8	2.0
12	4.0
16 and larger	8.0

- C. Tablets may be used if prior approval is obtained from Owner Representative. Procedure shall be as follows:
 - 1. Place 5-gram calcium hypochlorite tablets in accordance with the following table in each section of pipe.
 - 2. Place one 5-gram calcium hypochlorite tablet in each hydrant, hydrant branch, and other appurtenance.

Number of 5-gram Calcium Hypochlorite Tablets to Be Placed in Each Length of Pipe

Pipe Diameter (Inches)	Length of Pipe Section (feet)				
	<13	18	20	30	40
4	1	1	1	1	1
6	1	1	1	2	2
8	1	2	2	3	4
10	2	3	3	4	5
12	3	4	4	6	7
16	4	6	7	10	13

Based on 3.25 grams available chlorine per tablet, any portion of tablet rounded to next higher integer.

3. Attach tablets to inside and top at each end of newly installed pipe with an NSF 61 approved adhesive such as ITW Redhead A7, or an approved equal.
4. No adhesive shall be on tablet except on broad side to be attached to surface of pipe.
5. If tablets are attached before pipe section is placed in trench, their position shall be marked on section so it can be readily determined that pipe is installed with tablets at top.

3.3 PIPE FILLING AND CONTACT

- A. When installation is completed, fill main with water at a rate such that water within main will flow at a velocity no greater than one foot per second.
- B. Water for filling and initial flushing of main shall be separately metered and paid for by Contractor. Contractor shall provide labor and material necessary to transfer water from source to main to be tested. Only local Water Utility employees shall operate valves.
- C. Water shall enter main and be tested at low point in system to force entrapped air out at high end through an available hydrant.
- D. Close upper end hydrant or valve after air is expelled and chlorinated water discharge is present.
- E. Take precautions to assure that entrapped air is eliminated.
- F. Water shall remain in pipe for at least 24 hours or as defined by regulatory requirements.
- G. If water temperature is less than 40 degrees F, water shall remain in pipe for at least 48 hours.

- H. Position valves so that strong chlorine solution in main being treated will not flow into water mains in active service.

3.4 SAMPLING AND TESTING

- A. Water from new mains must successfully pass bacteriological test in accordance with requirements of State environmental regulatory agency having jurisdiction over public water supply.
- B. Provide access to main for chlorination and sampling as directed by Owner's Representative.
- C. Properly and securely brace and maintain excavation until successful testing, flushing, chlorinating, and sampling of main is completed.
- D. Contractor shall be responsible for protecting any required excavation by means of proper barricades and lanterns during sampling and testing period.
- E. Owner's Representative will take necessary samples of water and obtain laboratory tests of samples.
- F. Provide minimum of one sample from new main and one from each branch.
- G. Extremely long mains will require intermediate sampling every 1200 feet as well as a sample at its end.
- H. Collect samples for bacteriological analysis in sterile bottles treated with sodium thiosulfate as required by Standard Methods.
- I. Do not use hoses or fire hydrants in collection of samples.
- J. Provide corporation cock installed in main with copper tube gooseneck assembly. After samples have been collected, remove gooseneck assembly and retain for future use.

3.5 RE-DISINFECTION

- A. If initial disinfection fails to produce satisfactory bacteriological samples, reflush and resample main.
- B. If check samples show presence of coliform organisms, rechlorinate main by continuous feed or slug method of chlorination until satisfactory results are obtained.
- C. Contractor shall be responsible for costs of re-chlorination and testing including additional cost of water from Utility for flushing and contact.

3.6 DISINFECTION PROCEDURE FOR CUTTING INTO EXISTING MAIN

- A. Disinfect area around existing main at connection or cut-in with hypochlorite powder.
- B. Swab or spray interior of pipe and fittings used in making connection with one percent hypochlorite solution just prior to installation.
- C. Make connection to a section of existing water main by isolating with new section. Both existing and first section of new main shall be isolated, disinfected using slug method in AWWA C651, sampled, and tested immediately after connection and isolation. Connect new main to existing main with a minimum of 24 inches of pipe. Clean and disinfect 24-inch section prior to installation and after approved water testing has been performed.

3.7 FLUSHING OF MAIN

- A. After required retention period has ended, flush chlorinated water from main until chlorine measurements show no residual chlorine remains.
- B. Obtain a minimum flushing velocity of 2.5 feet per second.

Minimum Flushing Rate

<u>Pipe Diameter</u> <u>(inches)</u>	<u>Flow Rate for Flushing</u> <u>(gpm)</u>
4	100
6	220
8	390
10	600
12	870
16	1600
20	2,500
24	3,500
30	5,500
36	8,000

- C. Check with local sewer utility for requirements for disposal of heavily chlorinated water to sanitary sewer system.
- D. Neutralize chlorine residual of water being disposed by treating with one of the following chemicals:

Chemical Amount Required to Neutralize Chlorine Concentration per 100,000 Gallons

Residual Chlorine Concentration Mg / L	Sulfur Dioxide (SO ₂) lb	Sodium Bisulfite (NaHSO ₃) lb	Sodium Sulfite (Na ₂ SO ₃) lb	Sodium Thiosulfate (Na ₂ S ₂ O ₃ + 5H ₂ O) lb
1	0.8	1.2	1.4	1.2
2	1.7	2.5	2.9	2.4
10	8.3	12.5	14.6	12.0
50	41.7	62.6	73.0	60.0

END OF SECTION

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SECTION 33 17 00

WATER MAIN TESTING

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Pressure testing of completed water main.
 - 2. Leakage testing of completed water main.

- B. Related Sections:
 - 1. Applicable provisions of Section 31 02 00 – General Requirements for Sitework shall govern Work under this Section.
 - 2. Section 33 11 00 – Site Water System.
 - 3. Section 33 13 00 – Water Main Disinfection.

1.2 REFERENCES

- A. Public Works Industry Improvement Program
 - 1. Standard Specifications for Sewer and Water Construction in Wisconsin, Sixth Edition, December 22, 2003, with Addendum No. 2, April 22, 2008.

- B. American Water Works Association (AWWA)
 - 1. AWWA C600 - Installation of Ductile-Iron Water Mains and Their Appurtenances.
 - 2. AWWA C605 – Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water.

- C. ASTM International
 - 1. ASTM F2164 - Practice for Field Leak Testing of Polyethylene (PE) Pressure Piping Systems Using Hydrostatic Pressure.

1.3 SUBMITTALS

- A. Section 31 02 00 – General Requirements for Sitework: Requirements for submittals.

- B. Contractor shall submit a testing schedule and procedure to Owner’s Representative for review 10 days prior to initiating testing program.

- C. Submittal shall include type of equipment and location of its connection to new system.

1.4 QUALITY ASSURANCE

- A. Testing shall be in accordance with AWWA C600 and ASTM F2164.

- B. Testing of water main shall comply with local and state regulatory agency rules and regulations where applicable.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.1 TESTS REQUIRED

- A. Test new installations of water main for pressure and leakage.
- B. Contractor shall notify Owner's Representative and Utility Owner 48 hours prior to initiation of testing.
- C. Contractor shall not perform any testing without Owner's Representative and Utility Owner present.
- D. New water main shall not be connected to an existing main until after safe water samples have been obtained from new water main system addition.
- E. Where a new main is to connect to an existing main, provide the following connection procedure prior to performance of a pressure/leakage test of new main.
 - 1. Contractor shall install a 2-foot bolted flanged spool piece between existing water main valve and new main. Prior to testing, remove spool piece and bolt a temporary plug on end of new main for testing purposes. After specified pressure and leakage tests have been completed on new main, disinfect spool piece, remove plug, and insert spool piece between new main and existing main.
 - 2. Do not connect new main to existing water main with a valved connection.

3.2 PRESSURE TESTING

- A. After pipe has been laid, subject newly laid pipe or any valved section thereof to a hydrostatic pressure of at least 1.5 times working pressure at point of testing.
- B. Tests pressures shall:
 - 1. Not be less than 1.25 times working pressure at highest point along test section.
 - 2. Not exceed pipe or thrust restraint design pressures.
 - 3. Be of at least 2-hour duration.
 - 4. Not vary by more than plus or minus 5 psi for duration of test.
 - 5. Not exceed twice rated pressure of valves or hydrants when pressure boundary of test section includes closed gate valves or hydrants. NOTE: Do not operate valves in either direction at differential pressure exceeding rated pressure.

- 6. Not exceed rated pressure of valves when pressure boundary of test section included closed, resilient seated gate valves or butterfly valves.
- C. Slowly fill each valved section of pipe and apply specified test pressure, based on elevation of lowest point of line or section under test and corrected to elevation of test gage, by means of a pump connected to pipe acceptable to Owner's Representative.
- D. Do not operate valves in either opening or closing direction at differential pressures above rated pressure.
- E. Before applying specified test pressure, completely expel air from section of pipe under test.
- F. If permanent air vents are not located at all high points, Contractor shall install corporation cocks at such points to expel air as line is filled with water.
- G. After all air has been expelled, close corporation cocks and apply test pressure. At conclusion of pressure test, remove corporation cocks and plug or leave in place at discretion of Utility.
- H. Carefully examine exposed pipe, fittings, valves, hydrants, and joints during test.
- I. Repair or replace any damaged or defective pipe, fittings, valves, or hydrants that are discovered following pressure test with sound material, and repeat test until it is satisfactory to Utility Owner.

3.3 LEAKAGE TESTS

- A. Leakage test may be conducted concurrently with pressure test.
- B. Leakage shall be defined as quantity of water that must be supplied into newly laid pipe, or any valved section thereof, to maintain pressure within 5 psi of specified test pressure after air in pipeline has been expelled and pipe has been filled with water. Leakage shall not be measured by a drop in pressure in a test section over a period of time.
- C. No pipe installation will be accepted if leakage is greater than that determined by following formula:

$$L = SD \text{ times Square Root of } P, \text{ divided by } 133,200$$

Where L is allowable leakage in gallons per hour; S is length of pipe tested in lineal feet; D is nominal diameter of pipe in inches; and P is average test pressure during leakage test in pounds per square inch gage.

- D. When hydrants are in test section, test shall be made against main valve in hydrant.

- E. Acceptance shall be determined on basis of allowable leakage. If any test of laid pipe discloses leakage greater than that specified, Contractor shall, at its own expense, locate and make repairs or replacement.

END OF SECTION

SECTION 33 31 00

SITE SANITARY SEWER SYSTEM

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Site Piping.
 - 2. Pipe Fittings.
 - 3. Precast Concrete Manholes with internal frame and chimney seals.
 - 4. Cleanouts.

- B. Related Sections:
 - 1. Applicable provisions of Section 31 02 00 – General Requirements for Sitework shall govern Work under this Section.
 - 2. Section 31 23 16 - Utility Trench Excavation, Backfill, and Compaction: For sewerage system piping.
 - 3. Section 33 37 00 - Sanitary Sewer and Manhole Testing.
 - 4. Division 22 – Plumbing.

1.2 REFERENCES

- A. American Association of State Highway and Transportation Officials (AASHTO)
 - 1. AASHTO Standard Specifications for Highway Bridges.

- B. American Concrete Institute (ACI)
 - 1. ACI 318 - Building Code Requirements for Reinforced Concrete.

- C. ASTM International (American Society for Testing and Materials)
 - 1. ASTM A48 - Specification for Gray Iron Castings ASTM A74 – Specification for Cast Iron Soil Pipe and Fittings.
 - 2. ASTM A74 – Specification for Cast Iron Soil Pipe and Fittings.
 - 3. ASTM A240 – Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
 - 4. ASTM A536 - Specification for Ductile Iron Castings.
 - 5. ASTM A615 - Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
 - 6. ASTM A746 - Specification for Ductile Iron Gravity Sewer Pipe.
 - 7. ASTM C12 - Practice for Installing Vitrified Clay Pipe Lines.
 - 8. ASTM C14 - Specification for Concrete Sewer, Storm Drain, and Culvert Pipe.
 - 9. ASTM C33 - Specification for Concrete Aggregates.
 - 10. ASTM C76 - Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.

11. ASTM C150 - Specification for Portland Cement.
12. ASTM C425 - Specification for Compression Joints for Vitrified Clay Pipe and Fittings.
13. ASTM C443 - Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets.
14. ASTM C478 - Specification for Precast Reinforced Concrete Manhole Sections.
15. ASTM C564 - Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings.
16. ASTM C700 - Specification for Vitrified Clay Pipe, Extra Strength, Standard Strength, and Perforated.
17. ASTM C923 - Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals.
1. ASTM C990 - Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants.
2. ASTM C1479 – Practice for Installation of Precast Concrete Sewer, Storm Drain, and Culvert Pipe Using Standard Installations.
3. ASTM D2122 - Test Method for Determining Dimensions of Thermoplastic Pipe and Fittings.
4. ASTM D2321 – Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.
5. ASTM D3034 - Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
6. ASTM D3035 – Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter.
7. ASTM D3212 - Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.
8. ASTM D3261 - Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing.
9. ASTM D3350 – Specification for Polyethylene Plastics Pipe and Fittings Material.
10. ASTM D4101 - Specification for Polypropylene Injection and Extrusion Materials.
11. ASTM F477 - Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
12. ASTM F593 – Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
13. ASTM F594 – Specification for Stainless Steel Nuts.
14. ASTM F679 - Specification for Poly(VinylChloride) (PVC) Large Diameter Plastic Gravity Sewer Pipe and Fittings.
15. ASTM F714 - Specification for Polyethylene (PE) Plastic Pipe (SDR-DR) Based on Outside Diameter.
16. ASTM F1055 - Specification for Electrofusion Type Polyethylene Fittings for Outside Diameter Controlled Polyethylene Pipe and Tubing.
17. ASTM F1668 - Guide for Construction Procedures for Buried Plastic Pipe.
18. ASTM F2620 - Practice for Heat Fusion Joining of Polyethylene Pipe and Fittings

D. American Water Works Association (AWWA)

1. AWWA C111 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
2. AWWA C600 - Installation of Ductile-Iron Water Mains and Their Appurtenances.

- E. Code of Federal Regulations (CFR)
 - 1. 29 CFR 1926.1053 - Ladders.

1.3 SUBMITTALS FOR REVIEW

- A. Section 31 02 00 – General Requirements for Sitework: Requirements for submittals.
- B. Product Data: Provide data indicating pipe materials pipe fittings, and precast structures.
- C. Submit Structural Design Calculations and detailed Shop Drawings for flattop and special precast concrete manhole structures prepared and sealed by a Professional Engineer licensed in State of Wisconsin.
- D. Design of flattop and special precast structures shall be in accordance with ACI 318 and ASTM C478.
- E. Submit concrete mix data and test reports from an approved testing laboratory certifying that concrete used in precast structures conforms to specified requirements.

1.4 SUBMITTALS FOR INFORMATION

- A. Section 31 02 00 – General Requirements for Sitework: Requirements for submittals.
- B. Manufacturer's Instructions: Indicate special procedures required to install Products specified.
- C. Certificates: Certify that products meet or exceed specified requirements.

1.5 SUBMITTALS AT PROJECT CLOSEOUT

- A. Section 31 02 00 – General Requirements for Sitework: Requirements for submittals.

1.6 REGULATORY REQUIREMENTS

- A. Contractor shall comply with applicable rules and regulations of:
 - 1. State of Wisconsin Department of Natural Resources (WDNR) and local code if more stringent for materials and installation of the Work of this Section.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Section 31 02 00 – General Requirements for Sitework.
- B. Deliver and store castings and gaskets in shipping containers with labeling in place.

PART 2 PRODUCTS

2.1 GENERAL

- A. Pipes, fittings, and structures shall be manufactured in the United States of America.
- B. Materials supplied are to be in accordance with:
 - 1. State of Wisconsin Administrative Code, Department of Commerce, Plumbing Code, Wis. Admin. Code Chapters 82 and 84, and local code if more stringent for materials for the Work of this Section.

2.2 PIPE MATERIALS

- A. Polyvinyl Chloride (PVC) Pipe
 - 1. Pipe: ASTM D3034, Type PSM, polyvinyl chloride (PVC) material; SDR 26, nominal inside diameter as shown on Drawings.
 - 2. Pipe: ASTM F679, polyvinyl chloride (PVC) material, PS 46, nominal inside diameter as shown on Drawings.
 - 3. Joint Device: Bell and spigot joint with ASTM F477 gasket. Joint shall conform to ASTM D3212.

2.3 PIPE FITTINGS AND ACCESSORIES

- A. Fittings: Same material as pipe molded or formed to suit pipe size and end design, in required tees, bends, elbows, wyes, reducers, traps, and other required configurations.

2.4 TRACER WIRE MATERIALS

- A. Mark all non-conductive lateral pipes with a locating wire system.
- B. Locating wire system consists of the following:
 - 1. Tracer Wire: 45-mil solid copper, No. 12 HMW-PE yellow jacket coating. Install to enable electronic locating of underground utility.
 - 2. Tracer Wire Locating Box: 2-1/2-inch diameter, minimum, ABS pipe with 2 point terminal box and cast iron cover.
 - a. Manufacturer: Valco, Inc. Model C.P. Mini Box, or an approved equal.

2.5 PRECAST REINFORCED CONCRETE MANHOLE SECTIONS

- A. Precast Concrete Risers and Cone Sections: In accordance with ASTM C478, minimum wall thickness, one twelfth of internal diameter of riser or largest cone diameter plus 1 inch.
- B. Precast Concrete Base Section with Integral Floor: In accordance with ASTM C478, minimum floor thickness 6 inches for risers up to 48-inches in diameter, and 8-inches for larger diameters; bench minimum slope 1/2-inch per foot from channel to wall; cast in place

pipe sleeves.

- C. Concrete Flat Slab Top: In accordance with ASTM C478 and approved Shop Drawings; Minimum thickness 6-inches for 48-inch diameter, 8-inches for larger diameters; equipped with lifting hooks.
- D. Minimum access opening in cone or top section: 24-inch diameter.
- E. Minimum compressive strength of concrete: 4000 psi.
- F. Section shall support its own weight and live load equivalent to AASHTO HS-20 Highway Loading, unless otherwise indicated on Drawings.
- G. Design exterior wall for a minimum equivalent fluid pressure of 90 pounds per square foot and consider additional lateral pressure from approaching truck wheels.
- H. Form and cast openings with wall sleeves in base sections as required by Drawings.
- I. Horizontal wall joints shall not be located within 18 inches of centerline of wall penetration.
- J. Precast Section Joints: Reinforced concrete base and riser sections excepting grade rings, designed and formed with tongue and groove ends to produce a continuous, uniform manhole.
- K. Identification Markings: Clearly mark on inside of each precast section date of manufacture and name or trademark of manufacturer. Clearly mark on outside of each section structure identification number from Drawings.
- L. Precast concrete grade rings shall conform to ASTM C478.

2.6 MANHOLE STEPS

- A. Rungs and Steps: Steel reinforced copolymer polypropylene plastic ASTM D4101 PP0344B33534Z02; ASTM A615, Grade 60 steel reinforced 1/2-inch diameter; size, placement and embedment shall conform to OSHA 29CFR 1926.1053 Ladders and ASTM C478; ends of legs tapered with fins for embedment.
 - 1. Rungs and Steps in risers and conical sections: Aligned in each section to form continuous ladder with rungs equally spaced vertically in assembled manhole. Steps shall be 12 inches wide, 16 inches on center vertically, set into manhole wall as indicated on Drawings.

2.7 MANHOLE FRAME AND COVER

- A. Manufacturers:
 - 1. Neenah Foundry Company, Neenah, WI.
 - 2. East Jordan Iron Works Inc., East Jordan, MI.
 - 3. U.S. Foundry & Manufacturing Corporation, Miami, FL.

4. Substitutions: In accordance with Section 31 02 00 – General Requirements for Sitework.

B. Manhole Frame and Covers:

1. Gray iron castings; ASTM A48, Class 35B, machined horizontal bearing surface, with concealed pickhole, gasketed, solid lid. Cover molded with identifying name and logo. Neenah Numbers used for identification.
 - a. Neenah R-1772 manhole frame with Type B lid.

2.8 PIPE AND JOINT SEALANTS AND GASKETS

- A. Pipe Sleeve-Factory Cast in Place: ASTM C923, "Lock Joint Flexible Manhole Sleeve;" "KOR-N-SEAL;" or an approved equal, cast in precast base section.
- B. Pipe Sleeve - Field Installed: ASTM C923, "KOR-N-SEAL" or an approved equal.
- C. Tongue and Groove Preformed Joint Sealant: ASTM C990, preformed flexible joint sealant, Kent Seal No. 2 as manufactured by Hamilton-Kent; Ram-Nek as manufactured by K.T. Snyder Co.; or an approved equal.

2.9 INTERNAL FRAME/CHIMNEY SEAL

- A. Flexible rubber sleeve, extensions and wedge strips shall be extruded or molded from high grade rubber compound conforming to applicable requirements of ASTM C923, with a minimum 1500 psi tensile strength, maximum 18 percent compressions set and durometer hardness of 48 plus/minus 5.
- B. Sleeve shall be either double or triple pleated, with a minimum unexpanded vertical height of 8 inches and 10 inches respectively and a minimum thickness of 3/16-inch.
- C. Top and bottom section of sleeve shall contain an integrally formed expansion band recess and multiple sealing fins.
- D. Top section of extension shall have a minimum thickness of 3/32-inch and be shaped to fit into bottom band recess of sleeve under bottom chimney seal band and remainder of extension shall have a thickness of 3/16-inch.
- E. Bottom section of extension shall contain an integrally formed expansion band recess and multiple sealing fins matching that of rubber sleeve.
- F. Any splice used to fabricate sleeve and extension shall be hot vulcanized and have strength such that sleeve shall withstand 180 degree bend with no visible separation.
- G. Continuous wedge strip used to adapt rubber sleeve to sloping surfaces shall have slope differential needed to provide vertical band recess surface, be shaped to fit into band recess

and have an integral band restraint.

- H. Length of wedge strip shall be such that, when its ends are butted together, it will cover entire inside circumference of that band recess needing slope adjustment.
- I. Expansion bands used to compress sleeve against manhole shall be integrally formed from 16 gage, Type 304 stainless steel conforming to ASTM A240, with no welded attachments and shall have a minimum width of 1-3/4 inches.
- J. Bands shall have a minimum adjustment range of 2 diameter inches and mechanism used to expand band shall have capacity to develop pressures necessary to make a watertight seal.
- K. Band shall be permanently held in this expanded position with a positive locking mechanism. Any studs and nuts used for this mechanism shall be Type 304 stainless steel conforming to ASTM F593 and F594.
- L. Seals shall be similar and equal to those manufactured by Cretex Specialty Products.

2.10 CLEANOUTS

- A. Sanitary lateral shall have 6 x 4-inch wye for 4-inch ASTM D3034, SDR-35, cleanout pipe riser. Riser pipe shall end in solvent welded Genova Products 30340 adaptor and Genova Products 31839 threaded plug, or approved equal.
- B. Encase top of cleanout assembly in cast iron casting. Top of cleanout assembly shall be 2 inches below bottom of cover to prevent loads being transferred from frame and cover to piping.
- C. Casting shall be Neenah Foundry R-1913, or an approved equal, cast into 12 x 12 x 6-inch thick concrete pad set flush with adjacent grade, set on 6 inches of Type A1 aggregate.
- D. Cast-in-Place Concrete Pad: ASTM C150, Portland cement, and ASTM C33, 3/4-inch coarse aggregate and small and large grained sands, 6 per cent air-entrained concrete with minimum compressive strength of 3500 psi.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that trench cut and excavation base is ready to receive work and excavations, dimensions, and elevations are as indicated on Drawings.

3.2 PREPARATION

- A. Hand trim excavations to required elevations. Correct over excavation with Type A2 aggregate as specified in Section 31 05 16 – Aggregates for Earthwork.

- B. Remove large stones or other hard matter that could damage pipe or impede consistent backfilling or compaction.
- C. Cut pipe ends square, ream pipe and tube ends to full pipe diameter, remove burrs.
- D. Remove scale and dirt on inside and outside before assembly.
- E. Prepare pipe connections to equipment with flanges or unions.

3.3 BEDDING

- A. Excavate pipe trench in accordance with Section 31 23 16 - Utility Trench Excavation, Backfill, and Compaction for Work of this section. Hand trim excavation for accurate placement of pipe to elevations indicated.
- B. Place bedding material at trench bottom in accordance with Section 31 23 16 - Utility Trench Excavation, Backfill, and Compaction. Place and shape bedding material to pipe, to a minimum depth of three inches under bell and four inches under spigot and compact to 95 percent modified Proctor density.
- C. Backfill around sides and top of pipe with bedding material to a loose lift depth of 15 inches above pipe and compact to 95 percent modified Proctor density.
- D. Maintain optimum moisture content of bedding material to attain required compaction density.

3.4 INSTALLATION - PIPE

- A. Install PVC pipe in accordance with ASTM D2321 and ASTM F1668.
- B. Install pipe, fittings, and accessories in accordance with manufacturer's instructions.
- C. Lay pipe to slope gradients noted on Drawings; with maximum variation from true slope of 1:1000.
- D. Backfill trench in accordance with Section 31 23 16 - Utility Trench Excavation, Backfill, and Compaction. Do not displace or damage pipe when compacting.
- E. Connect to building sanitary sewer outlet and municipal sewer system, through installed sleeves.
- F. Coordinate the Work with termination of sanitary sewer connection outside building, connection to municipal sewer utility service, and trenching.
- G. Install colored marker tape continuous over top of pipe, buried 18 inches below finish grade, above pipe line; coordinate with Section 31 23 16 - Utility Trench Excavation, Backfill, and Compaction.

3.5 WATER AND SEWER SEPARATION

- A. Sanitary sewer shall be installed at minimum required distances away from adjacent water mains and services as stipulated by:
 - 1. State of Wisconsin Department of Natural Resources (WDNR) and local code if more stringent for materials for the Work of this Section.

3.6 TRACER WIRE INSTALLATION

- A. Lateral tracer wire originates and terminates in tracer wire access box located at right-of-way line. Install conductor tracer wire in one continuous loop.
- B. Tape conductor tracer wire to top of pipe at minimum 10-foot intervals. Wrapping conductor tracer wire around pipe is prohibited.
- C. Field test each locating wire after installation is completed.

3.7 PREPARATION FOR STRUCTURES

- A. Coordinate placement of inlet and outlet pipe or duct sleeves required by other sections.
- B. Do not install structures where site conditions induce loads exceeding structural capacity of structures.
- C. Inspect precast concrete structures immediately prior to placement in excavation to verify structures are internally clean and free from damage. Remove and replace damaged units.

3.8 INSTALLATION - MANHOLES

- A. Excavation and Backfill:
 - 1. Excavate for manholes and drainage structures in accordance with Section 31 23 16 - Utility Trench Excavation, Backfill, and Compaction in location and to depth shown. Provide clearance around sidewalls of structure for construction operations.
 - 2. When groundwater is encountered, prevent accumulation of water in excavations. Place manholes in dry trench.
 - 3. Where possibility exists of watertight structure becoming buoyant in flooded excavation, anchor structure to avoid flotation.
 - 4. Backfill excavations for manholes and drainage structures in accordance with Section 31 23 16 - Utility Trench Excavation, Backfill, and Compaction.
- B. Install manholes and drainage structures supported at proper grade and alignment on Type A2, A5, A6, or A7 aggregate, as specified in Section 31 05 16 – Aggregates for Earthwork, bedding to a minimum compacted thickness of as shown on Drawings.

- C. Set base section, align pipe sleeve openings to provide straight alignment of pipe through manhole base, level and plumb sections.
- D. Set manhole at a grade to assure that no more than 8 inches of precast concrete rings would be required to bring manhole frame and cover to final grade.
- E. Lift precast structures at lifting points designated by manufacturer.
- F. When lowering manholes and drainage structures into excavations and joining pipe to units, take precautions to ensure interior of structure remains clean.
- G. Place preformed flexible joint sealant on either side of tongue portion of joint in base section to assure filling of entire joint when assembled.
- H. Set riser section on base, aligning joint prior to setting, lower riser section level and uniformly on to base to squeeze joint compound throughout tongue and groove joint, visible for inspection both interior and exterior for water tight fit.
- I. Trowel excess joint compound material flush at interior and exterior surface after placement.
- J. Repeat process for remaining riser sections and top, exercising care to align ladder rungs to form uniform vertical ladder.
- K. Section shall be vertical and in true alignment with a maximum 1/4-inch tolerance per section allowed.
- L. Allow joints to set for a minimum 24-hour period before backfilling.
- M. Plug holes in section required for handling or other purposes with non-shrink grout, finished flush on inside.
- N. Remove knockouts or cut structure to receive piping without creating openings larger than required to receive pipe. Fill annular space with mortar.
- O. Cut pipe to finish flush with interior of structure.
- P. Provide concrete flowline at bottom of lowest structure section to achieve sloped drainage from entering pipe to exiting pipe. Trowel smooth. Perform backfilling carefully, bringing fill up evenly on all sides.
- Q. Compact fill around vault with a mechanical hand operated wacker.

3.9 INSTALLATION - PIPE SLEEVES

- A. If an additional pipe sleeve is required in base section due to changed conditions, provide hole in section prior to it being set.

- B. Core hole in base section of sufficient diameter to accommodate pipe and pipe sleeve, using care not to crack or splay concrete.
- C. Install "KOR-N-SEAL" pipe sleeve in accordance with manufacturer's instructions.
- D. Extend sanitary sewer pipe through pipe sleeves.
- E. Extend minimum of two full lengths of pipe out from centerline of manhole in either direction.
- F. Bring bedding material for pipe up to manhole face.
- G. Provide a poured concrete bench sloped at 2 inches per foot to flow channel utilizing pipe for form.

3.10 INSTALLATION - MANHOLE FRAME AND COVER

- A. Set frames using mortar and precast concrete adjustment rings as required.
- B. Place precast concrete rings in full bed of mortar with completely fill joints. Verify maximum height of adjustment rings allowed by code prior to installing.
- C. Plaster adjustment rings on both inside and outside of ring cylinder with mortar.
- D. Place flexible joint sealant on centerline circumference of slab top or concrete ring with mortar bed placed on interior and exterior of sealant to full width of frame or ring area.
- E. Where a bolted down frame is required, set bolts and tighten down nuts, leveling frame to finished grade.

3.11 FRAME/CHIMNEY SEAL INSTALLATION

- A. Measure manhole to determine information necessary to order proper size sleeve and extensions.
- B. Sealing surfaces shall be reasonably smooth, clean, and free of any form offsets or excessive honeycomb. Top internal portion of cone section shall have a minimum 3-inch high vertical surface.
- C. Installation:
 1. Install rubber sleeve with printing at top and top edge lined up with alignment marks.
 2. Wipe off outside of stainless steel band and apply moderate coating of band lubricant to slot area and a light to moderate coating to remainder of bands outside surface.
 3. Install band in appropriate band recess with slotted end against rubber surface. Position expansion tool and expand band until locking tabs pop into tightest slots possible. Loosen tool slowly until tabs are fully engaged in slots, then continue to

loosen and remove tool. When installing large diameter band, use auxiliary tool slots to start expansion process. Move one tool leg to primary tool slot if necessary to complete expansion.

4. Lubricate second band and install in other band recess. Attach tool and expand as before, keeping bands parallel. Bands can be put closer together if only limited height is available or if excessive sleeve expansion is desired.
5. If extension is being used, position it such that top portion of extension fits snugly into lower band recess of chimney seal sleeve, prior to installing band. Lubricate and install band inside recess formed by top portion of extension and expand as before, thereby compressing both extension and sleeve against manhole surface.
6. If multiple extensions are required, repeat step 5 above.
7. Position extension's bottom sealing surface on vertical surface of cone. Lubricate and install third band in lower band recess of extension and expand as before.
8. Check top and bottom edges of installed sleeve to insure they have been properly compressed against surfaces.

3.12 INSTALLATION OF CLEANOUTS

- A. Install cleanouts in accordance with:
 1. State of Wisconsin Department of Natural Resources (WDNR) and local code if more stringent for installation of the Work of this Section.
- B. Form and place cast-in-place concrete pad with provision for frame and cover.
- C. Establish elevations and inverts for cleanouts as indicated on Drawings.
- D. Mount cleanout surface hub level in grout, to elevation indicated.

3.13 FIELD QUALITY CONTROL

- A. Section 31 02 00 – General Requirements for Sitework: Field inspection and testing.
- B. Request inspection prior to and immediately after placing bedding.
- C. Perform compaction and moisture testing in accordance with Section 31 23 16 - Utility Trench Excavation, Backfill, and Compaction.
- D. Sewer System Testing:
 1. Pressure Test: Test in accordance with Section 33 37 00 – Sanitary Sewer and Manhole Testing and
 - a. Wisconsin Administrative Code, Department of Commerce, Plumbing Code, Wis. Admin. Code Chapters 82 and 84.
 2. Infiltration Test: Test in accordance with Section 33 37 00 – Sanitary Sewer and Manhole Testing and

- a. Wisconsin Administrative Code, Department of Commerce, Plumbing Code, Wis. Admin. Code Chapters 82 and 84.
- 3. Deflection Test: Test in accordance with Section 33 37 00 – Sanitary Sewer and Manhole Testing and ASTM D2122.

3.14 PROTECTION OF FINISHED WORK

- A. Section 31 02 00 – General Requirements for Sitework: Protecting installed work.
- B. Protect pipe and aggregate cover from damage or displacement until backfilling operation is completed.

END OF SECTION

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SECTION 33 37 00

SANITARY SEWER AND MANHOLE TESTING

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Water Leakage Test (Exfiltration/Infiltration).
 - 2. Low Pressure Air Testing.
 - 3. Deflection Testing Polyvinyl Chloride (PVC) Pipe.
 - 4. Vacuum Testing of Manholes.

- B. Related Sections:
 - 1. Applicable provisions of Section 31 02 00 - General Requirements for Sitework shall govern Work under this Section.
 - 2. Section 33 31 00 - Site Sanitary Sewer System.

1.2 REFERENCES

- A. ASTM International (American Society for Testing and Materials)
 - 1. ASTM C828 – Test Method for Low-Pressure Air Test of Vitrified Clay Pipe Lines.
 - 2. ASTM C924 – Practice for Testing Concrete Pipe Sewer Lines by Low-Pressure Air Test Method.
 - 3. ASTM C969 - Practice for Infiltration and Exfiltration Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines.
 - 4. ASTM C1091 - Test Method for Hydrostatic Infiltration Testing of Vitrified Clay Pipe Lines.
 - 5. ASTM C1103 - Practice for Joint Acceptance Testing of Installed Precast Concrete Sewer Lines.
 - 6. ASTM C1244 - Test Method for Concrete Sewer Manholes by Negative Air Pressure (Vacuum) Test Prior to Backfill.
 - 7. ASTM D2122 - Test Method for Determining Dimensions of Thermoplastic Pipe and Fittings.
 - 8. ASTM F1417 - Test Method for Installation Acceptance of Plastic Gravity Sewer Lines Using Low-Pressure Air.

1.3 REGULATORY REQUIREMENTS

- A. Wisconsin Administrative Code, Department of Natural Resources (WDNR), Wis. Admin. Code Chapter NR110, Sewerage Systems and other federal, state, and local requirements if more stringent for the Work of this Section.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.1 GENERAL

- A. Sanitary Sewers shall meet requirements of:
 - 1. Wisconsin Administrative Code, Department of Natural Resources (WDNR), Wis. Admin. Code Chapter NR110, Sewerage Systems and other federal, state, and local requirements if more stringent for the Work of this Section.
- B. Conduct quality testing under observation of Owner's Representative.
- C. Furnish and pay for costs of tests.
- D. Selection of Infiltration/Exfiltration test or Low Pressure Air test by Owner's Representative will be based upon invert elevation differential between adjacent manholes and range of groundwater elevations projected and groundwater elevations encountered prior to testing.
 - 1. Gravity Sanitary Sewer 24-inches or less in diameter where invert elevation is 10-feet or less: Water exfiltration test or water infiltration test as directed.
 - 2. Gravity Sanitary Sewer 24-inches or less in diameter where invert elevation is greater than 10-feet: Air Pressure test or water infiltration test as directed.
 - 3. Gravity Sanitary Sewer Greater than 24-inches in diameter: Air Pressure test or water infiltration test as directed.
- E. Include equipment, materials, and labor necessary to perform testing in unit price for sanitary sewer.
- F. Determine groundwater elevation above installed pipe by attaching a transparent plastic tube to a provided opening in manhole and using plastic tube as a manometer.
- G. Plug branches, laterals, tees, wyes, and stubs to be included in reach of sewer to be tested to prevent leakage.
- H. Repair visible defective joints or leaks in pipes, even though leakage test requirements are met.

3.2 WATER LEAKAGE TEST (EXFILTRATION/INFILTRATION)

- A. Leakage into sewer system (Infiltration) or out of sewer system (Exfiltration) shall not exceed 200 gallons per inch of pipe diameter per mile per day for any section of sewer system.

- B. Infiltration test shall only be allowed if groundwater elevation is a minimum of two feet above of pipe reach being measured at time test is performed as follows:
1. Discontinue groundwater pumping (if in process) for at least three days prior to testing section for infiltration.
 2. Install a watertight plug in downstream end of pipe reach to be tested.
 3. After 24-hour period measure amount of water that has infiltrated into pipe reach. Allowable leakage due to infiltration will be computed as follows:

$E = 0.0001 \text{ LD times square root of H for mortared joints.}$

$E = 0.00002 \text{ LD time square root of H for all other joints.}$

Where:

E = allowable leakage in gallons per minute of sewer tested.

L = length of sanitary sewer main and house connections tested in feet.

D = internal diameter of pipe in inches.

H = difference in elevation between water surface in upper manhole and groundwater elevation at lower manhole.

- C. Perform exfiltration test as follows:
1. Install a watertight plug in downstream end of pipe reach to be tested and inlet pipe(s) of upstream manhole.
 2. Fill pipe and manhole with water to a point 4-foot above invert of sewer at upper manhole; or if groundwater is present, 4-foot above average adjacent ground water present.
 3. After 24-hour period measure amount of water which has exfiltrated from pipe reach being tested. Allowable leakage due to exfiltration will be computed as follows:

$E = 0.0001 \text{ LD times square root of H for mortared joints.}$

$E = 0.00002 \text{ LD time square root of H for all other joints.}$

Where:

E = allowable leakage in gallons per minute of sewer tested.

L = length of sanitary sewer main and house connections tested in feet.

D = internal diameter of pipe in inches.

H = difference in elevation between water surface in upper manhole and invert of pipe at lower manhole.

3.3 LOW PRESSURE AIR TEST (PIPE)

- A. Conduct Low Pressure Air Test in accordance with ASTM C828.

- B. Low Pressure Air test shall not be used on sections of line which have a groundwater elevation two foot or more above pipe.
- C. Perform test on lines after connection laterals, if any, have been plugged and braced adequately to withstand test pressure and after trenches have been backfilled for a sufficient time to generate a significant portion of ultimate trench load on pipe line.
- D. Owner's Representative shall determine time between completion of backfill operation and low pressure air testing.
- E. For diameters of sewer pipe, between three (3) inches and forty-two (42) inches, test pipe between adjacent manholes in accordance with Table below:

MINIMUM TEST TIME BY PIPE SIZE

Diameter (inches)	Minimum Time (min:sec)	Length for Minimum Time (feet)	Time for Longer Length (seconds)
4	3:46	595	0.380L
6	5:40	402	0.845L
8	7:34	298	1.520L
10	9:26	239	2.374L
12	11:20	199	3.418L
15	14:10	159	5.342L
18	17:00	133	7.694L
21	19:50	114	10.470L
24	22:40	99	13.674L

3.4 LOW PRESSURE AIR TEST PROCEDURES

- A. Flush section of sewer line to be tested to wet interior surface and clean to eliminate debris prior to conducting low-pressure air test.
- B. Isolate section of sewer line to be tested by means of inflatable stoppers or other suitable test plugs.
- C. If test section is less than two foot below ground water level, determine height of ground water above spring line of pipe at each end of test section and compute average height. For every foot of groundwater above pipe spring line, increase gage test pressures by 0.43 pounds per square inch.
- D. Air testing equipment shall consist of necessary valves and pressure gages to control rate at which air flows into test section and to enable monitoring of air pressure within test section.

- E. Add air slowly to test section until pressure inside pipe is raised to 4.0 psig plus allowance in Paragraph C if groundwater condition exists.
- F. Observe the following safety precautions while conducting test:
 - 1. An internal pressure of 5 psi exerts a force of 250 lbf on an 8-inch pipe plug.
 - 2. Allow no one in manholes during test.
 - 3. Install plugs securely, block and brace as necessary as an added safety factor.
 - 4. Do not over pressurize lines.
- G. After pressure of 4.0 psig is reached allow pressure to stabilize, typically 2 to 5 minutes.
- H. Reduce pressure to 3.5 psi before starting test.
- I. Determine time required for test pressure to drop from 3.5 psig to 2.5 psig by means of a stopwatch. Compare this time interval to specification time as calculated from Table above to determine if rate of air loss is within allowable time limit.
- J. If section of line to be tested includes more than one pipe size, calculate test time for each size and add test times together to arrive at total test time for section.
- K. If a 1.0 psi drop does not occur within test time, line has passed.
- L. If pressure drop is more than 1.0 psi during test time, line is presumed to have failed test.
- M. If line fails test, segmental testing may be used solely to determine location of leaks, if any, but not for acceptance test as required by this Section.

3.5 DEFLECTION TEST POLYVINYL CHLORIDE (PVC) PIPE

- A. Perform deflection tests for polyvinyl chloride (PVC) pipe installations in accordance with ASTM D2122.
- B. Perform deflection test using a rigid ball or mandrel without a mechanical pulling device.
- C. If deflection testing occurs within 30 days of placement of final backfill, deflection shall not exceed 5 percent.
- D. When deflection testing occurs more than 30 days after placement of final backfill, maximum deflection shall not exceed 7.5 percent.

3.6 VACUUM TESTING OF MANHOLES

- A. Test sanitary sewer manholes leakage immediately after installation and prior to backfilling.
- B. Plug lift holes with non-shrink grout.

- C. Plug inlet and outlet pipes at manhole, taking care to securely brace plug to avoid its being drawn into manhole.
- D. Place vacuum test equipment inside top of cone section and inflate to 40 psi to affect a seal between vacuum base and structure.
- E. Draw a vacuum of 10 inches of mercury and shut-off vacuum pump.
- F. With valves closed, measure time for vacuum to drop to 9 inches.
- G. Manhole integrity is acceptable if time exceeds:
 - 1. 60 seconds for 48-inch diameter manhole.
 - 2. 75 seconds for 60-inch diameter manhole.
 - 3. 90 seconds for 72-inch manhole.
- H. If manhole fails initial test, make necessary repairs with non-shrink grout or other acceptable and approved materials.
- I. Continue retesting until a satisfactory test is obtained.
- J. Repair visible defective joints or leaks in manhole even though vacuum test requirements are met.
- K. Cost of equipment purchase or lease, materials, and labor necessary to conduct vacuum testing of manholes is incidental; include in cost bid for sanitary manhole construction.

3.7 EXFILTRATION/INFILTRATION MANHOLE TEST

- A. Owner's Representative will visually inspect structure(s) for possible leaks prior to backfilling of structure.
- B. Reseal joints found to be unacceptable by Owner's Representative.
- C. Owner's Representative may require an exfiltration test for those structures for which a test is deemed necessary.
- D. Prior to and during exfiltration test groundwater level will be reduced to below manhole base.
- E. Suitably plug open pipes and other openings into manhole and brace to prevent blowout.
- F. Fill manhole with water to top of cone section or underside of flat top.
- G. If manhole has not been backfilled and visual inspection of exterior by Owner's Representative reveals no leaks, vault may be considered to be satisfactorily watertight.

- H. If manhole has been backfilled or visual inspection is satisfactory, allow water to remain in manhole for a period of 4 hours to provide for absorption.
- I. Bring water in manhole top again and allowed to remain for a period of 8 or 16 hours.
- J. At end of time period, add water to vault to return level to top and measure and record quantity added.
- K. Extrapolate amount of water to a 24 hour time period and determine rate of exfiltration on basis of vertical foot.
- L. Leakage for each structure shall not exceed 1 gallon per vertical foot per day.
- M. If manhole does not meet this requirement but does not exceed 3 gallons per vertical foot per day, Owner's Representative may permit repairs to structure to reduce leakage to required test level.
- N. Leakage due to defective section or in excess of 3 feet per vertical foot per day shall be cause for rejection.
- O. Uncover, disassemble, reconstruct or replace manhole structure as directed by Owner's Representative and bear costs of correction.
- P. Upon reconstruction, retest manhole for compliance.
- Q. During testing, demonstrate to Owner's Representative that water table is below bottom of manhole.

END OF SECTION

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SECTION 33 41 00

SITE STORM SEWER SYSTEM

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Sewer Pipe Materials.
 - 2. Pipe Fittings and Accessories.
 - 3. Storm Sewer Manholes, including Frames and Covers.
 - 4. Catch Basins and Plant Area Drains, including Frames and Grates.
 - 5. Inlets, including Frames and Grates.

- B. Related Sections:
 - 1. Applicable provisions of Section 31 02 00 – General Requirements for Sitework shall govern Work under this Section.
 - 2. Section 31 23 16 - Utility Trench Excavation, Backfill, and Compaction: Excavating for storm sewer system piping.
 - 3. Division 22 - Plumbing.

1.2 REFERENCES

- A. American Association of State Highway and Transportation Officials (AASHTO)
 - 1. AASHTO M36 - Corrugated Steel Pipe, Metallic-Coated, for Sewers and Drains.
 - 2. AASHTO M294 – Corrugated Polyethylene Pipe, 300- to 1200-mm Diameter.
 - 3. AASHTO Standard Specifications for Highway Bridges.

- B. American Concrete Institute (ACI)
 - 1. ACI 318 - Building Code Requirements for Structural Concrete and Commentary.

- C. ASTM International (American Society for Testing and Materials)
 - 1. ASTM A48 – Specification for Gray Iron Castings.
 - 2. ASTM A536 - Specification for Ductile Iron Castings.
 - 3. ASTM A615 - Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
 - 4. ASTM C12 - Practice for Installing Vitrified Clay Pipe Lines.
 - 5. ASTM C14 - Specification for Concrete Sewer, Storm Drain, and Culvert Pipe.
 - 6. ASTM C76 - Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.
 - 7. ASTM C270 - Specification for Mortar for Unit Masonry.
 - 8. ASTM C443 - Specification for Joints for Circular Pipe and Manholes, Using Rubber Gaskets.
 - 9. ASTM C478 – Specification for Precast Reinforced Concrete Manhole Sections.

10. ASTM C700 - Specification for Vitrified Clay Pipe, Extra Strength, Standard Strength and Perforated.
11. ASTM C1479 – Practice for Installation of Precast Concrete Sewer, Storm Drain, and Culvert Pipe Using Standard Installations.
12. ASTM D2235 – Specification for Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings.
13. ASTM D2321 – Practice for Underground Installation of Flexible Thermoplastic Sewer Pipe.
14. ASTM D2564 - Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems.
15. ASTM D2661 - Specification for Acrylonitrile-Butadiene-Styrene (ABS) Schedule 40 Plastic Drain, Waste, and Vent Pipe and Fittings.
16. ASTM D2665 - Specification for Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste and Vent and Vent Pipe and Fittings.
17. ASTM D3034 - Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
18. ASTM D3212 - Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.
19. ASTM D3350 – Specification for Polyethylene Plastics Pipe and Fitting Materials.
20. ASTM D3965 - Specification for Rigid Acrylonitrile-Butadiene-Styrene (ABS) Materials for Pipe and Fittings.
21. ASTM D4101 - Specifications for Propylene Plastic Injection and Extrusion Materials.
22. ASTM F477 – Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
23. ASTM F628 - Specification for Acrylonitrile-Butadiene-Styrene (ABS) Schedule 40 Plastic Drain, Waste, and Vent Pipe With a Cellular Core.
24. ASTM F679 - Specification for Poly(VinylChloride) (PVC) Large Diameter Plastic Gravity Sewer Pipe and Fittings.
25. ASTM F1668 - Guide for Construction Procedures for Buried Plastic Pipe.
26. ASTM F2306 - Specification for 12 to 60 in. (300 to 1500 mm) Annular Corrugated Profile-Wall Polyethylene (PE) Pipe and Fittings for Gravity-Flow Storm Sewer and Subsurface Drainage Applications.
27. ASTM F2648 - Specification for 2 to 60 inch (50 to 1500 mm) Annular Corrugated Profile Wall Polyethylene (PE) Pipe and Fittings for Land Drainage Applications.

D. Code of Federal Regulation (CFR)

1. Title 29, Part 1926 Safety and Health Regulations for Construction, Occupational Safety and Health Administration (OSHA), U.S. Department of Labor.

1.3 SUBMITTALS FOR REVIEW

- A. Section 31 02 00 – General Requirements for Sitework: Requirements for submittals.
- B. Product Data: Provide data indicating pipe materials pipe fittings, and precast structures.

- C. Submit Structural Design Calculations and detailed Shop Drawings for flattop and special precast concrete manhole structures prepared and sealed by a Professional Engineer licensed in the State of Wisconsin.
- D. Design of flattop and special precast structures shall be in accordance with ACI 318 and ASTM C478.
- E. Submit concrete mix data and test reports from an approved testing laboratory certifying that concrete used in precast structures conforms to specified requirements.

1.4 SUBMITTALS FOR INFORMATION

- A. Section 31 02 00 – General Requirements for Sitework: Requirements for submittals.
- B. Manufacturer's Instructions: Indicate special procedures required to install Products specified.
- C. Certificate: Certify that Products meet or exceed specified requirements.

1.5 SUBMITTALS AT PROJECT CLOSEOUT

- A. Section 31 02 00 – General Requirements for Sitework: Requirements for submittals.

1.6 REGULATORY REQUIREMENTS

- A. Contractor shall comply with applicable rules and regulations of
 - 1. State of Wisconsin Department of Natural Resources (WDNR) and local code if more stringent for materials and installation of the Work of this Section.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect and handle products to site under provisions of Section 31 02 00 – General Requirements for Sitework.
- B. Deliver and store castings and gaskets in shipping containers with labeling in place.

PART 2 PRODUCTS

2.1 GENERAL

- A. Pipes, fittings, and structures shall be manufactured in the United States of America.
- B. Materials supplied are to be in accordance with:
 - 1. State of Wisconsin Administrative Code, Department of Commerce, Plumbing Code, Wis. Admin. Code Chapters 82 and 84, and local code if more stringent for materials for the Work of this Section.

2.2 PIPE MATERIALS

- A. Reinforced Concrete Pipe
 - 1. Pipe: ASTM C76, Class as shown on Drawings with Wall Type B; bar reinforcement; inside nominal diameter as shown on Drawings.

2.3 PIPE FITTINGS AND ACCESSORIES

- A. Fittings and fitting joints shall be in accordance with:
 - 1. State of Wisconsin Administrative Code, Department of Commerce, Plumbing Code, Chapters 82 and 84, and local code if more stringent for materials for the Work of this Section.
- B. Fittings: Same material as pipe, molded or formed to suit pipe size and end design, in required tee, bends, elbows, cleanouts, reducers, traps and other configurations required.
- C. Mortar: ASTM C270, Type S.
- D. Filter Fabric: Non-biodegradable, nonwoven:
 - 1. Carthage Mills, HS series
 - 2. TenCate North American Mirafi N series.
 - 3. Propex, Geotex Nonwoven series
 - 4. US Fabrics, Medium Weight NW series.

2.4 PIPE LOCATION MATERIALS

- A. Identification Warning Tape: Heavy plastic underground warning tape, 2-inch width. Color-Bright Green, warning message "Caution Buried STORM SEWER Below" to repeat every 30 inches.

2.5 TRACER WIRE MATERIALS

- A. Mark all non-conductive lateral pipes with a locating wire system.
- B. Locating wire system consists of the following:
 - 1. Tracer Wire: 45-mil solid copper, No. 12 HMW-PE yellow jacket coating. Install to enable electronic locating of underground utility.
 - 2. Tracer Wire Locating Box: 2-1/2-inch diameter, minimum, ABS pipe with 2 point terminal box and cast iron cover.
 - a. Manufacturer: Valco, Inc. Model C.P. Mini Box, or an approved equal.

2.6 PRECAST CONCRETE STRUCTURES INCLUDING FRAMES AND COVERS

- A. Precast Concrete Risers and Cone Sections for Manholes, Catch Basins, and Inlets: In accordance with ASTM C478, minimum wall thickness, one twelfth of internal diameter of

riser or largest cone diameter plus 1 inch.

- B. Precast Concrete Base Section with Integral Floor: In accordance with ASTM C478, minimum floor thickness 6 inches for risers up to 48-inches in diameter, and 8 inches for larger diameters; bench minimum slope 1/2-inch per foot from channel to wall; cast in place pipe sleeves.
- C. Concrete Flat Slab Top: In accordance with ASTM C478 and approved Shop Drawings; Minimum thickness 6 inches for 48-inch diameter, 8 inches for larger diameters; equipped with lifting hooks.
- D. Minimum access opening in cone or top section: 24-inch diameter.
- E. Minimum compressive strength of concrete: 4000 psi.
- F. Section shall support own weight and live load equivalent to AASHTO HS-20 Highway Loading unless otherwise indicated on Drawings.
- G. Design exterior wall for a minimum equivalent fluid pressure of 90 pounds per square foot and consider additional lateral pressure from approaching truck wheels.
- H. Form and cast openings with wall sleeves in base sections as required by Drawings.
- I. Section joints: Reinforced concrete base and riser sections excepting grade rings, designed and formed with tongue and groove ends to produce a continuous, uniform manhole.
- J. Identification Markings: Clearly mark on inside of each precast section indicating date of manufacture, name or trademark of manufacturer. Clearly mark on outside of each section vault identification number from Drawings.
- K. Precast concrete grade rings shall conform to ASTM C478.
- L. Mortar: ASTM C270, Type S.
- M. Reinforcement: Formed steel wire, galvanized finish.
- N. Manhole Steps
 1. Steel reinforced copolymer polypropylene plastic ASTM D4101 PP0344B33534Z02; ASTM A615, Grade 60 steel reinforced 1/2 inch diameter formed; size, placement and embedment shall conform to OSHA 29 CFR 1926.1053 Ladders and ASTM C478; ends of legs tapered with fins for embedment.
 2. Rungs and Steps in Risers and Conical Sections: Aligned in each section to form continuous ladder with rungs equally spaced vertically in assembled manhole. Steps shall be as indicated on Drawings.

2.7 STRUCTURE FRAMES, COVERS, AND GRATES

- A. Manufacturers:
 - 1. Neenah Foundry Company, Neenah, WI.
 - 2. East Jordan Iron Works Inc., East Jordan, MI.
 - 3. U.S. Foundry & Manufacturing Corporation, Miami, FL.
 - 4. Substitutions: In accordance with Section 31 02 00 – General Requirements for Sitework.

- B. Manhole Frame and Covers:
 - 1. Gray iron castings; ASTM A48, Class 35B, machined horizontal bearing surface, with concealed pickhole, gasketed, solid lid. Neenah Numbers used for identification.
 - a. Neenah R-2502 Manhole Frame with Type A lid.

- C. Catch Basin and Inlet Frame and Grate:
 - 1. Gray iron castings; ASTM A48, Class 35B, machined horizontal bearing surface, with concealed pickhole, gasketed, solid lid. Neenah Numbers used for identification.
 - a. Pavement: Neenah R-3210-L or equal, with Type L vane grate.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that trench cut and excavation base are ready to receive work and excavations, dimensions, and elevations are as indicated on Drawings.

3.2 PREPARATION

- A. Hand trim excavations to required elevations. Correct over excavation with Type A2 aggregate as specified in Section 31 05 16 – Aggregates for Earthwork.
- B. Remove large stones or other hard matter that could damage pipe or impede consistent backfilling or compaction.
- C. Cut pipe ends square, ream pipe and tube ends to full pipe diameter, remove burrs.
- D. Remove scale and dirt on inside and outside before assembly.
- E. Prepare pipe connections to equipment with flanges or unions.

3.3 BEDDING

- A. Excavate pipe trench in accordance with Section 31 23 16 – Utility Trench Excavation, Backfill, and Compaction for Work of this section. Hand trim excavation for accurate

placement of pipe to elevations indicated.

- B. Place and shape bedding material to pipe, to a minimum depth of three inches under bell and four inches under spigot and compact to 95 percent modified Proctor density.
- C. Backfill around sides and top of pipe with bedding material to a loose lift depth of 15 inches above pipe and compact to 95 percent modified Proctor density.
- D. Maintain optimum moisture content of bedding material to attain required compaction density.

3.4 INSTALLATION - PIPE

- A. Install pipe, fittings, and accessories in accordance with manufacturer's instructions and
 1. State of Wisconsin Administrative Code; Department of Commerce, Plumbing Code, Wis. Admin. Code Chapters 82 and 84 and local code if more stringent for installation of the Work of this Section.
- B. Install concrete pipe and fittings in accordance with ASTM C1479.
- C. Install pipe, fittings, and accessories in accordance with manufacturer's instructions.
- D. Lay pipe to slope gradients noted on Drawings; with maximum variation from true slope of 1:1000.
- E. Backfill trench in accordance with Section 31 23 16 – Utility Trench Excavation, Backfill, and Compaction. Do not displace or damage pipe when compacting.
- F. Connect to building storm sewer outlet and municipal sewer system, through installed sleeves.
- G. Coordinate the Work with termination of storm sewer connection outside building, connection to municipal sewer utility service, and trenching.
- H. Install colored marker tape continuous over top of pipe, buried 18 inches below finish grade, above pipe line; coordinate with Section 31 23 16 - Utility Trench Excavation, Backfill, and Compaction.

3.5 PREPARATION FOR STRUCTURES

- A. Coordinate placement of inlet and outlet pipe sleeves required by other sections.
- B. Do not install structures where site conditions induce loads exceeding structural capacity of structures.

- C. Inspect precast concrete structures immediately prior to placement in excavation to verify structures are internally clean and free from damage. Remove and replace damaged units.

3.6 INSTALLATION - STRUCTURES

- A. Excavation and Backfill:
 - 1. Excavate for manholes and drainage structures in accordance with Section 31 23 16 – Utility Trench Excavation, Backfill, and Compaction in locations and to depth shown. Provide clearance around sidewalls of structure for construction operations.
 - 2. When groundwater is encountered, prevent accumulation of water in excavations. Place manholes or drainage structures in dry trench.
 - 3. Where possibility exists of watertight structure becoming buoyant in flooded excavation, anchor structure to avoid flotation.
 - 4. Backfill excavations for manholes and drainage structures in accordance with Section 31 23 16 – Utility Trench Excavation, Backfill, and Compaction.
- B. Install manholes and drainage structures supported at proper grade and alignment on Type A2 aggregate bedding, as specified in Section 31 05 16 – Aggregates for Earthwork, to a minimum compacted thickness as shown on Drawings.
- C. Set base section, align pipe sleeve openings to provide straight alignment of pipe through manhole base, level and plumb sections.
- D. Set manhole at a grade to assure that no more than 8 inches of precast concrete rings would be required to bring manhole frame and cover to final grade.
- E. Lift precast structures at lifting points designated by manufacturer.
- F. When lowering manholes and drainage structures into excavations and joining pipe to units, take precautions to ensure interior of structure remains clean.
- G. Place preformed flexible joint sealant on either side of tongue portion of joint in base section to assure filling of entire joint when assembled.
- H. Set riser section on base, aligning joint prior to setting, lower riser section level and uniformly on to base to squeeze joint compound throughout tongue and groove joint, visible for inspection both interior and exterior for water tight fit.
- I. Trowel excess joint compound material flush at interior and exterior surface after placement.
- J. Repeat process for remaining riser sections and top, exercising care to align manhole ladder rungs to form uniform vertical ladder.
- K. Section shall be vertical and in true alignment with a maximum 1/4-inch tolerance per section allowed.

- L. Allow joints to set for a minimum 24-hour period before backfilling.
- M. Plug holes in section required for handling or other purposes with non-shrink grout, finished flush on inside.
- N. Remove knockouts or cut structure to receive piping without creating openings larger than required to receive pipe. Fill annular space with mortar.
- O. Cut pipe to finish flush with interior of structure.
- P. Provide concrete flowline at bottom of lowest structure section to achieve sloped drainage from entering pipe to exiting pipe. Trowel smooth. Perform backfilling carefully, bringing fill up evenly on all sides.
- Q. Compact fill around vault with a mechanical hand operated wacker.

3.7 INSTALLATION - FRAME AND COVER

- A. Set frames using mortar and precast concrete adjustment rings as required.
- B. Place precast concrete rings in full bed of mortar with completely fill joints. Verify maximum height of adjustment rings allowed by code prior to installing.
- C. Plaster adjustment rings on both inside and outside of ring cylinder with mortar.
- D. Place flexible joint sealant on centerline circumference of slab top or concrete ring with mortar bed placed on interior and exterior of sealant to full width of frame or ring area.
- E. In non-pavement areas set frame and cover two inches above finished grade for manholes and other structures with covers to allow area to be graded away from cover beginning 1-inch below top surface of frame.

3.8 TRACER WIRE INSTALLATION

- A. Originate and terminate lateral tracer wire in wire access box located at right-of-way line. Install conductor tracer wire in one continuous loop.
- B. Tape conductor tracer wire to top of pipe at minimum 10-foot intervals. Wrapping conductor tracer wire around pipe is prohibited.
- C. Field test each locating wire after completing installation.

3.9 FIELD QUALITY CONTROL

- A. Section 31 02 00 – General Requirements for Sitework: Field inspection and testing.

- B. Perform compaction and moisture content testing in accordance with Section 31 23 16 – Utility Trench Excavation, Backfill, and Compaction.
- C. If tests indicate Work does not meet specified requirements, remove Work, replace and retest.
- D. Frequency of Tests: As determined by Owner’s Representative.

3.10 PROTECTION OF FINISHED WORK

- A. Section 31 02 00 – General Requirements for Sitework: Protecting installed work.
- B. Protect pipe and aggregate cover from damage or displacement until backfilling operation is completed.

END OF SECTION

SECTION 33 42 23

CONCRETE BOX CULVERTS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes
 - 1. Reinforced precast concrete box culverts.
- B. Related Sections
 - 1. Applicable provisions of Section 31 02 00 – General Requirements for Sitework shall govern Work under this Section.
 - 2. Section 31 05 16 – Aggregates for Earthwork.
 - 3. Section 31 23 16 - Utility Trench Excavation, Backfill, and Compaction.

1.2 REFERENCES

- A. Wisconsin Department of Transportation, Transportation
 - 1. Standard Specifications for Highway and Structure Construction, Current Edition. (WISDOT)
- B. Public Works Industry Improvement Program
 - 1. Standard Specifications for Sewer and Water Construction in Wisconsin, Sixth Edition, December 22, 2003, with Addendum No. 2, April 22, 2008.
- C. American Association of State Highway and Transportation Officials
 - 1. AASHTO Standard Specifications for Highway Bridges, Current Edition.
- D. ASTM International (American Society for Testing and Materials)
 - 1. ASTM A185 – Specification for Steel Welded Wire Reinforcement, Plain, for Concrete.
 - 2. ASTM A497 – Specification for Steel Welded Wire Reinforcement, Deformed, for Concrete.
 - 3. ASTM A615 – Specification for Steel Welded Wire Reinforcement, Deformed, for Concrete.
 - 4. ASTM C33 – Specification for Portland Cement.
 - 5. ASTM C150 - Specification for Concrete Aggregates.
 - 6. ASTM C990 - Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants.
 - 7. ASTM C1433 - Specification for Precast Reinforced Concrete Box Sections for Culverts, Storm Drains, and Sewers.
 - 8. ASTM C1479 - Practice for Installation of Precast Concrete Sewer, Storm Drain, and

Culvert Pipe Using Standard Installations.

9. ASTM C1577 - Specification for Precast Reinforced Concrete Box Sections for Culverts, Storm Drains, and Sewers Designed According to AASHTO LRFD
10. ASTM D698 – Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft.-lbf/ft³ (600 kN-m/m³)).
11. ASTM D1557 – Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft.-lbf/ft³ (2,700 kN-m/m³)).
12. ASTM D6938 - Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).

1.3 SUBMITTALS

- A. Section 31 02 00 – General Requirements for Sitework: Requirements for submittals.
- B. Shop Drawings and product data shall show details of construction, reinforcing and joints.
- C. Submit Structural Design Calculations and detailed Shop Drawings for precast concrete structure prepared and sealed by a Professional Structural Engineer licensed in State of Wisconsin.
- D. Submit concrete mix data and test reports from an approved testing laboratory certifying that concrete used in precast structures conforms to requirements specified.
- E. Submit reinforcement types including grades, bending limitations and structural capacities.
- F. Manufacturer's Installation Instructions: Indicate special procedures required to install Products specified.
- G. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

1.4 QUALITY ASSURANCE

- A. Box culvert shall meet requirements of listed ASTM Standards.
- B. Manufacturer shall mark and affirm that product was manufactured, inspected, sampled, and tested in accordance with ASTM Standards and has been found to meet requirements of specification.
- C. Materials shall be subject to rejection for failure to meet requirements of this Section or may be rejected due to any of following:
 1. Fractures or cracks passing through wall, except for a single end crack that does not exceed depth of joint.
 2. Defects indicating that mixing and molding not in compliance with ASTM C1433; surface defects indicating honey-combed or open texture.

3. Plane of ends of culvert sections are not perpendicular to longitudinal axis within tolerances.
 4. Damaged or cracked ends that prevent making a satisfactory joint.
 5. Any continuous crack having a surface width of 0.01-inch or more and extending for a length of 12 inches or more regardless of position in section wall.
- D. Repairs to imperfections may be made only after manufacturer has made a written request and received approval from Owner's Representative of materials and methods proposed to effect repair.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Load and unload box culvert sections by lifting with hoists to avoid shock or damage.
- B. Under no circumstances shall material be dropped.
- C. Pad hooks or pipe tongs and use to prevent damage to exterior surface of culvert sections.
- D. Keep stored culvert sections free of damage.
- E. Keep interiors of culvert sections free from dirt or foreign matter.
- F. Store gaskets for joints in cool location out of direct sunlight and contact with petroleum products.
- G. Clearly mark each culvert section with the following information.
 1. Date of manufacture.
 2. Name or trademark of manufacturer and identification of plant where made.
 3. Box section span, rise, table number, maximum and minimum design earth cover, and specification designation.
- H. Indent markings on culvert section or paint with waterproof paint.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. American Concrete Pipe Company; Wauwatosa, WI.
- B. Crest Precast Concrete, Inc., Barneveld, WI.
- C. Madison Concrete Pipe, Inc., Madison, WI.
- D. American Concrete Pipe Company, Green Bay, WI.

- E. County Concrete Corp., Roberts, WI.
- F. Holmen Concrete Products, Holmen, WI.
- G. Wausau Concrete Company, Inc., Marathon, WI.
- H. Wieser Concrete Products, Inc., Maiden Rock, WI.
- I. Wisconsin Concrete Products, Inc., Kiel, WI.
- J. Substitutions: In accordance with Section 31 02 00 – General Requirements for Sitework.

2.2 PRECAST CONCRETE BOX CULVERT

- A. Precast concrete box culvert shall conform to requirements of ASTM C1433, Type 1. Culvert size shall be as indicated on Drawings. Box culvert shall have round corners.
- B. Supplier shall design box culverts, including concrete mix. In addition to dead load, design culverts for AASHTO HS20 live load.
- C. Culvert joints shall be tongue and groove type with preformed plastic joint sealant conforming to ASTM C990, Kent Seal No. 2 as manufactured by Hamilton-Kent; Ram-Nek as manufactured by K.T. Snyder Co.; or an approved equal.
- D. Culverts shall conform to requirements of WISDOT Section 504.

2.3 CONCRETE

- A. Cement: Portland cement conforming to ASTM C150.
- B. Aggregate: Conforming to ASTM C33 with a maximum size of 3/4-inch.
- C. Reinforcing Bars: Conforming to ASTM A615, Grade 60.
- D. Welded Wire Fabric: Conforming to ASTM A185 or ASTM A497.

PART 3 EXECUTION

3.1 PREPARATION

- A. Perform excavation, bedding, cover placement, backfill and compaction required for installation of box culvert section and appurtenances in accordance with Section 31 23 16 – Utility Trench Excavation, Backfill, and Compaction.

- B. Bedding for culvert shall be a minimum of 6 inches of Type A7 aggregate as specified in Section 31 05 16 – Aggregates for Earthwork, compacted to 95 percent modified Proctor density.

3.2 CULVERT LAYING

- A. Commence pipe laying from lowest point in proposed sewer line.
- B. Lay box culvert sections with receiving groove end of tongue and groove section pointing upgrade.
- C. Lay box culvert sections uniformly to line and grade so that finished culvert will present a uniform bore.
- D. Noticeable variations from true alignment and grade will be considered sufficient cause for rejection of work.
- E. If excavation of bottom of trench has been carried to a depth greater than 6 inches below culvert outer wall, fill excess depth with backfill concrete or Type A2 fill as specified in Section 31 05 16 – Aggregates for Earthwork.
- F. Bring bedding material up to level with top of pipe and compact to a minimum 95 percent modified Proctor density to provide lateral support of culvert.
- G. Bring cover material to a minimum compacted depth of 12 inches above top of culvert.
- H. Take care insure that voids around pipe are filled.

3.3 MULTI-CELL REQUIREMENTS

- A. Where two or more culvert cells are to be placed in parallel, leave a 1-1/2-inch separation space between adjacent cells. When culverts are in place, bring backfill up to culvert springline and backfill remainder of separation space with concrete with a 28-day compressive strength of 3500 psi.

3.4 CLEANING

- A. Clean new sewer lines and any existing lines affected by this work.
- B. Furnish water and jetting equipment for cleaning operation.
- C. Repair visible leaks and defects, whether or not lines have been subjected to required tests.
- D. Remove any stuck cleaning, inspection, or testing equipment and materials from sewer lines.

3.5 TOLERANCES

- A. Section 31 02 00 – General Requirements for Sitework: Tolerances.
- B. Lay box culvert to alignment and slope gradients noted on Drawings; with maximum variation from indicated slope of 1/8-inch in 10 feet.
- C. Maximum Variation from Intended Elevation of Culvert Invert: 1/2-inch.
- D. Maximum Offset of Box Culvert from Indicated Alignment: 1-inch.
- E. Maximum Variation in Profile of Structure from Intended Position: 1 percent.

3.6 FIELD QUALITY CONTROL

- A. Section 31 02 00 – General Requirements for Sitework: Testing and inspection services.
- B. Request inspection prior to and immediately after placing aggregate cover over culvert.
- C. Compaction Testing: In accordance with ASTM D1557 and ASTM D6938.
- D. When tests indicate Work does not meet specified requirements, remove Work, replace, and retest.
- E. Frequency of Tests: As determined by Owner's Representative.

3.7 PROTECTION OF INSTALLED CONSTRUCTION

- A. Section 31 02 00 – General Requirements for Sitework: Protecting installed construction.
- B. Protect pipe and bedding from damage or displacement until backfilling operation is completed.

END OF SECTION

SECTION 33 46 00

SUBDRAINAGE

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Pipe Materials.
 - 2. Aggregate and Bedding.
 - 3. Accessories.
 - 4. Subdrainage Installation.

- B. Related Sections:
 - 1. Applicable provisions of Section 31 02 00 – General Requirements for Sitework shall govern Work under this Section.
 - 2. Section 31 05 13 – Soils for Earthwork.
 - 3. Section 31 05 16 - Aggregates for Earthwork.
 - 4. Section 31 23 16 - Utility Trench Excavation, Backfill, and Compaction: Excavating and backfilling for drainage system piping and surrounding filter aggregate.
 - 5. Section 32 11 23 - Aggregate Base Course.
 - 6. Section 33 41 00 – Site Storm Sewer System.

1.2 REFERENCES

- A. American Association of State Highway and Transportation Officials (AASHTO)
 - 1. AASHTO M 178 - Concrete Drain Tile.
 - 2. AASHTO M 252 - Corrugated Polyethylene Drainage Pipe.
 - 3. AASHTO M 294 -Corrugated Polyethylene Pipe, 300- to 1500-mm Diameter.

- B. ASTM International (American Society for Testing and Materials)
 - 1. ASTM C4 - Specification for Clay Drain Tile and Perforated Clay Drain Tile.
 - 2. ASTM C412 - Specification for Concrete Drain Tile.
 - 3. ASTM C444 - Specification for Perforated Concrete Pipe.
 - 4. ASTM C700 - Specification for Vitrified Clay Pipe, Extra Strength, Standard Strength, and Perforated.
 - 5. ASTM C923 - Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals.
 - 6. ASTM D1248 – Specification for Polyethylene Plastics Extrusion Materials For Wire and Cable
 - 7. ASTM D2321 – Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
 - 8. ASTM D2729 - Specification for Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.

9. ASTM D3350 - Specification for Polyethylene Plastics Pipe and Fittings Materials.
 10. ASTM D3887 – Specification for Tolerances for Knitted Fabrics.
 11. ASTM D5034 - Test Method for Breaking Strength and Elongation of Textile Fabrics (Grab Test).
 12. ASTM F405 - Specification for Corrugated Polyethylene (PE) Pipe and Fittings.
 13. ASTM F667 - Specification for Large Diameter Corrugated Polyethylene Pipe and Fittings.
- C. United States Department of the Army, Corps of Engineers, Office of the Chief of Engineers.
1. CW-02215 - Civil Works Construction Guide Specification for Plastic Filter Fabric.
- D. Wisconsin Department of Transportation
1. Standard Specifications for Highway and Structure Construction, Current Edition. (WISDOT)

1.3 SUBMITTALS

- A. Section 31 02 00 – General Requirements for Sitework: Requirements for submittals.
- B. Shop Drawings: Indicate dimensions, layout of piping, high and low points of pipe inverts, and gradient of slope between corners and intersections.
- C. Product Data: Submit data on pipe drainage products and pipe accessories.
- D. Manufacturer’s Certificate: Certify Products meet or exceed specified requirements.

1.4 CLOSEOUT SUBMITTALS

- A. Section 31 02 00 – General Requirements for Sitework: Requirements for submittals.
- B. Section 31 02 00 – General Requirements for Sitework: Submit Record Drawings showing location of pipe runs, connections, cleanouts, and principal invert elevations.

PART 2 PRODUCTS

2.1 PIPE MATERIALS

- A. Polyvinyl Chloride Pipe with Fabric Sock Covering: ASTM D2729; plain end, 4-inch inside diameter; with required fittings.
- B. Use perforated pipe for subdrainage system; unperforated through sleeved walls.

2.2 AGGREGATE AND BEDDING

- A. Filter Aggregate and Bedding Materials: Fill Type A6 as specified in Section 31 05 16 - Aggregates for Earthwork.

2.3 ACCESSORIES

- A. Joints: Gasketed, Water-tight.
- B. Geotextile Fabric:
 - 1. Non-biodegradable, nonwoven fabric made from 100 percent polypropylene staple filaments.
 - 2. Manufacturers: Carthage Mills FX-30HS, TenCate Geosynthetics North America Mirafi 140NL, Propex Inc. Geotex 311, or US Fabrics, Inc. 80NW.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 31 02 00 – General Requirements for Sitework: Coordination and project conditions.
- B. Verify trench cut and excavated base is ready to receive work and excavations, dimensions, and elevations are as indicated on Drawings.

3.2 PREPARATION

- A. Hand trim excavations to required elevations. Correct over excavation with Type A1 aggregate as specified in Section 31 05 16 – Aggregates for Earthwork.
- B. Remove large stones or other hard matter that could damage drainage piping or impede consistent backfilling or compaction.

3.3 SUBDRAINAGE INSTALLATION

- A. Place drainage pipe on compacted impervious fill.
- B. Lay pipe to slope gradients as noted on Drawings; with maximum variation from indicated slope of 1/8-inch in 10 feet.
- C. Loosely butt pipe ends. Place joint cover strip 12 inches wide, around pipe diameter centered over joint.
- D. Place pipe with perforations facing down. Mechanically join pipe ends.
- E. Install pipe couplings.
- F. Install Type A5 aggregate, as specified in Section 31 05 16 – Aggregate for Earthwork, at sides, over joints and top of pipe. Install top cover to compacted thickness of 12 inches.
- G. Place filter fabric over leveled top surface of aggregate cover prior to subsequent backfilling operations.

H. Refer to Section 31 23 16 – Utility Trench Excavation, Backfill, and Compaction for compaction requirements. Do not displace or damage pipe when compacting.

I. Place impervious fill over drainage pipe aggregate cover and compact.

J. Connect to storm sewer system with unperforated pipe, through installed sleeves.

3.4 FIELD QUALITY CONTROL

A. Section 31 02 00 – General Requirements for Sitework: Testing and inspection services.

B. Request inspection prior to and immediately after placing aggregate cover over pipe.

3.5 PROTECTION OF INSTALLED CONSTRUCTION

A. Section 31 02 00 – General Requirements for Sitework: Protecting installed construction.

B. Protect pipe and aggregate cover from damage or displacement until backfilling operation is completed.

END OF SECTION