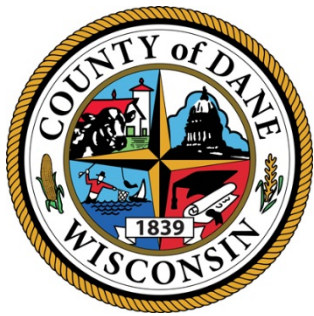


RFB NO. 315011



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. 315011 CONSTRUCT C&D MATERIALS RECOVERY FACILITY DANE COUNTY LANDFILL SITE #2 7102 U.S. HIGHWAY 12 & 18 MADISON, WISCONSIN

PREPARED BY:
SCS ENGINEERS
2830 DAIRY DRIVE
MADISON, WISCONSIN 53718

Due Date / Time: **THURSDAY, MAY 21, 2015 / 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:

MIKE RUIPER, SPECIAL PROJECTS MANAGER
TELEPHONE NO.: 608/266-4990
FAX NO.: 608/267-1533
E-MAIL: RUPIPER.MICHAEL@COUNTYOFDANE.COM

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DRAWINGS

Drawings for RFB 315011 are a separate document entitled “Construction & Demolition Waste Recycling Facility Bid Documents”, dated April 2015, prepared by SCS Engineers (53 pages).

Plot drawings on 30” x 42” (ARCH E1) paper for correct scale.

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, MAY 21, 2015

REQUEST FOR BIDS NO. 315011

CONSTRUCT C&D MATERIALS RECOVERY FACILITY

DANE COUNTY LANDFILL SITE #2

7102 U.S. HIGHWAY 12 & 18

MADISON, WISCONSIN 53718

Dane County is inviting Bids for the construction of a Material Recovery (Recycling) Facility for construction and demolition waste. Construction includes a pre-engineered metal building addition of approximately 7,800 square feet, renovation of existing building to accommodate processing equipment and proposed site operations, restrooms, and site improvements. Work also includes upgrading electric service and HVAC systems.

Request for Bids document may be obtained after **2:00 p.m. on Thursday, April 30, 2015** by downloading it from countyofdane.com/pwbids. Please call Mike Rupiper, Special Projects Manager, at 608/266-4990 for any questions or additional information.

All Bidders must be a registered vendor with Dane County & pay an annual registration fee & must be pre-qualified as a Best Value Contractor before award of Contract. Complete Vendor Registration Form at danepurchasing.com/registration or obtain one by calling 608/266-4131. Complete Pre-qualification Application for Contractors at countyofdane.com/pwht/BVC_Application.aspx or obtain one by calling 608/266-4029.

A pre-bid site tour will be held Friday, May 8, 2015 at 10:00 a.m. at the Dane County Waste Transfer Station, 7102 U.S. Highway 12 & 18, Madison, WI starting at the scale building. Bidders are strongly encouraged to attend this optional tour.

PUBLISH: APRIL 30 & MAY 7, 2015 - WISCONSIN STATE JOURNAL

APRIL 30 & MAY 7, 2015 - THE DAILY REPORTER



DANE COUNTY DEPARTMENT of PUBLIC WORKS, HIGHWAY and TRANSPORTATION

County Executive
Joseph T. Parisi

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 pre-qualification 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 fifteen (15) days of any changes to its business or operations that are relevant to the pre-qualification application. Failure to do so could result in suspension, revocation of the contractor's pre-qualification, debarment from County contracts for up to three (3) 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 who employ less than five (5) apprenticeable trade workers are not required to pre-qualify.
- 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, pre-qualified 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?	Yes: <input type="checkbox"/> No: <input type="checkbox"/>
16	Is your firm exempt from being pre-qualified 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 pre-qualified with the County or become so ten days prior to commencing work?	Yes: <input type="checkbox"/> No: <input type="checkbox"/>
18	Contractor has been in business less than one year?	Yes: <input type="checkbox"/> No: <input type="checkbox"/>
19	Is your firm a first time Contractor requesting a one time exemption, but, intend to comply on all future contracts and are taking steps typical of a "good faith" effort?	Yes: <input type="checkbox"/> No: <input type="checkbox"/>
20	Not applicable. My firm does not intend to work on Best Value Contracts. Note: Best Value Contracting is required to bid on most Public Works Contracts (if unclear, please call Jan Neitzel Knox 608-266-4029).	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:

JAN NEITZEL KNOX
EMAIL: NEITZEL-KNOX@COUNTYOFDANE.COM
OFFICE: (608)266-4029, 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

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 May 8, 2015 at 10:00 AM at the Dane County Waste Transfer Station, 7102 U.S. Highway 12 & 18, Madison, WI starting at the scale building. Attendance by all bidders is optional, however bidders and subcontractors are strongly encouraged to attend.
- D. 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.

3. INTERPRETATION

- A. No verbal explanation or instructions will be given in regard to meaning of Drawings or Specifications before Bid Due Date. Bidders shall bring inadequacies, omissions or conflicts to Owner or Architect / Engineer's attention at least ten (10) days before Bid Due Date. 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. 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 Due Date.
- 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 (3) lowest qualified, responsible bidders, will be returned to their makers within three (3) days after Bid Due Date. 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 Due Date, 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 Due 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 Due Date.

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 \$15,000.00 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 twenty-five (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 Due Date 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 Due Date. Bidder who fails to submit Emerging Small Business Report shall be deemed not responsive.
- D. **ESB Goal.** Goal of this project is ten percent (10%) ESB participation. 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. An ESB listing is available on the Dane County Targeted Business Directory at [http://pdf.countyofdane.com/commissions/2013-2015 Targeted Business Directory.pdf](http://pdf.countyofdane.com/commissions/2013-2015_Targeted_Business_Directory.pdf) An additional listing of potential ESBs can be found on the Wisconsin Department of Transportation web site at <http://www.dot.wisconsin.gov/business/engrserv/dbe-firms.htm>

- 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 Due 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 Due Date.
- 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 may 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 due time to place designated in Invitation to Bid, and identified with project name, bid number, location, category of work being bid upon, Bid Due Date, name and address of bidder.
- G. Bidder shall be responsible for sealed Bid being delivered to place designated for Bid Due Date 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, 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 no later than date by which successful Bidder is required to submit his or her signed Contract, as established in Construction Documents.

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. Provide unit prices requested on Bid Form. Unit prices will include all costs for materials, labor, insurance, taxes, overhead and profit necessary to perform specified work. Estimated quantities are approximate only. Payment will be based upon actual quantities placed, provided or installed. Failure to provide requested unit prices may result in rejection of entire Bid.
- B. Owner reserves right to accept or reject any unit prices as given in Bid.
- C. Bidder shall refer to Bid Form and applicable specification section to determine basis of unit measure and detailed information related to each unit price item requested.

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 purchase the following equipment for the C&D waste processing and sorting system under separate contract(s). Drawing Equipment No. is noted in parentheses:
 - Primary Finger Screen (vibratory) (1)
 - Slider Bed Conveyor (Primary Finger Screen Overs) (2)
 - Apron Conveyor (Picking A-Line) (3)
 - Ferrous Magnet (4)
 - Slider Bed Conveyor (Secondary Finger Screen Infeed) (5)
 - Secondary Finger Screen (vibratory) (6)
 - De-stoner / Air Knife (7)
 - Slider Bed Conveyor (De-stone/Air Knife Outfeed) (8)
 - Apron Conveyor (Picking B-Line) (9)
 - Troughing Idler Conveyor (Small Residuals Bunker) (10)
 - Troughing Idler Conveyor (Primary Finger Screen Unders) (11)
 - Slider Bed Conveyor (Fines Bunker Infeed) (12)
 - Dust Collector / Filter System for De-stoner / Air Knife (13)
 - Aggregate Conveyor (14)

- Slider Bed Conveyor (Aggregate on Platform) (15)
 - Stationary Electric Wood Grinder (17)
 - Wood Conveyor (18)
 - Cardboard Baler (19)
 - Equipment Control Panel and Safety / Shut-down System
 - Elevated Picking Line Platform and Drop Chutes
 - Access Ladders to various pieces of equipment at common material jam points, Conveyor Transition, Chutes/Guards, as needed
2. Owner will also arrange mechanical installation of the equipment with the supplier(s). Contractor to provide electrical conduit to equipment. Contractor to coordinate equipment installation with all other Work.
 3. Testing and Balancing of HVAC System.
 4. Concrete Strength Testing.
 5. Soil Testing.
 6. Pavement marking and wheel stops/ parking blocks for parking area.

20. SPECIAL HAZARDS COVERAGE

- A. Not Applicable.

21. COUNTY DIRECT PURCHASE MATERIALS & EQUIPMENT

- A. The County will use its tax-exempt status to purchase materials that will become part of this construction project. In preparing your bid, include all labor, materials and tax in your Bid totals. If the County elects to exercise its tax exempt status to purchase materials and equipment, the contract (when issued) will deduct the cost of materials selected for direct purchase and the related sales tax from your bid total.
- B. Products excluded from purchase by County include products manufactured or fabricated by Contractor, products which Contractor would be the vendor, products which would be furnished and installed by the same entity.
- C. Do not include miscellaneous material such as, but not limited to: mortar, sealants, anchors, connectors, glue, accessories, etc. Items such as these are to be furnished and purchased by the installing contractors as required for their respective work.
- D. For materials where the quantities are not easily identifiable from the Construction Documents, such as, but not limited to, concrete and piping, the Contractor will be responsible for quantities and costs exceeding the quantity and cost stated on the purchase order.
- E. The Contractor shall provide all services necessary to facilitate the purchase of these materials and equipment including, but not limited to, preparation of proposed purchase orders, recommendations of suppliers and vendors, receipt, unloading, storage, and protection of materials and equipment. All purchases by the County shall be used for the sole benefit of the County.
- F. The County shall cause all materials and equipment purchased directly to be delivered to the Contractor who shall accept delivery as the County's agent and promptly notify the Architect

/ Engineer thereof. When the materials and/or equipment are delivered to the jobsite, the Contractor shall promptly inspect them and bring to the attention of the County and Architect / Engineer any defects therein. The Contractor shall assist in contacting the Supplier in an effort to correct and adjust any defect.

- G. The Contractor shall have the same responsibilities for installation of materials and equipment provided by the County as he would have if purchased by the Contractor. The Contractor shall be responsible for any damage to such materials and equipment after delivery and installation and prior to turning the project over to the County. The Contractor is responsible for obtaining product warranties with regard to those materials and equipment purchased by the County.

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 Due Date.

PROJECT NAME: _____

BID NO.: _____ BID DUE 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 and
that information contained in this Emerging Small Business Report is true and correct.

Bidder's Signature

Date



Construction • Geotechnical
Consulting Engineering/Testing

March 30, 2015
C15064

Mr. Mike Rupiper, P.E.
Dane County Public Works, Highway & Transportation
1919 Alliant Energy Center Way
Madison, WI 53713

Re: Geotechnical Exploration Report
Proposed Construction and Demolition Waste Recycling Addition
Dane County Waste Transfer Station
7102 USH 12/18
Madison, Wisconsin

Dear Mr. Rupiper:

Construction • Geotechnical Consultants, Inc. (CGC) has completed the subsurface exploration program for the above-referenced project. The purpose of this program was to evaluate the subsurface conditions within the proposed building and ramp addition areas and to provide geotechnical recommendations regarding site preparation, foundation, floor slab, retaining wall and pavement design/construction. A determination of the site class for seismic design is also included. We are sending you an electronic copy of this report, and we can send a paper copy upon request. We are also sending an electronic copy to the project civil engineer, Ms. Betsy Powers at SCS Engineers and to the project structural engineer, Mr. Kurt Frey at Pierce Engineers.

PROJECT DESCRIPTION

We understand that an approximately 6,500-sq ft (53 ft by 122 ft), one-story, slab-on-grade building addition is proposed east of the existing Waste Transfer Station building. The floor slab of most of the addition will be located at EL 880.0 ft, except for a lower-level addition in the southwest portion of the addition where the slab will be established at EL 872.0 ft. (As reference, the finish floor elevation of the existing transfer station building is at EL 885.0 ft, except for the lower level at EL 872.0 ft.) A concrete slab-on-grade ramp will be located east of the building that slopes down to the east to a paved drive. A retaining wall will be constructed north of the north building wall line.

The building will be a pre-engineered steel building. Column loads will range from 150 to 200 kips, and wall loads will range from 1.5 to 2.5 kips/ft. Floor slab loads will be up to 300 psf.

Based on existing and proposed grades, the portion of the addition closest to the existing building will require cutting about 5 ft to grade, while new fill on the order of 6 ft to 8.5 ft will be required around the perimeter of the existing concrete ramp, especially in eastern portions of the addition.

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Dane County Public Works, Highway & Transportation
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SITE CONDITIONS

The area of proposed addition is primarily a concrete slab-on-grade ramp east of the existing Waste Transfer Station building. The concrete ramp slopes down to the east to match the asphalt pavement drive. A cold storage building exists east of the paved drive. From the north side of the ramp, a vegetated slope exists behind a retaining wall, which abuts a concrete driveway. A retaining wall is also located along the south end of the ramp, which also abuts a concrete drive, with a vegetated slope off the southeast side of the ramp.

During construction of the existing Waste Transfer Station and concrete ramp east of the building (largely in the footprint of the proposed addition), the existing non-engineered fill and buried topsoil were mass undercut, and grade was restored with well-compacted granular fill. According to photographs taken by Dane County and discussions with Dane County personnel, the non-engineered fill and buried topsoil were also undercut within the existing ramp area, too. It does appear, however, that the non-engineered fill (and buried topsoil in some areas) remains around the existing ramp.

SUBSURFACE CONDITIONS

Subsurface conditions on site were explored by drilling a total of four Standard Penetration Test (SPT) borings to planned depths of 20 to 60 ft below existing site grades. The borings are labeled B-1(15) through B-4(15) in order to differentiate from 12 previous borings drilled in 2009 for the existing Waste Transfer Station; of the 12 previous borings, five (B-1, 4, 8, 10 and 12) were along or near the east end of the Waste Transfer Station (west end of proposed addition). The locations of B-1(15) through B-3(15) were selected and located in the field by others, while B-4(15) was added to the drilling program later and was located in the field by CGC and Dane County.

The borings were performed on March 16, 2015 by Badger State Drilling (under subcontract to CGC) using a truck-mounted rotary CME-55 drill rig equipped with hollow-stem augers, mud rotary tooling and an automatic SPT hammer. The soil boring locations are shown in plan on the Soil Boring Location Map attached in Appendix B. Ground surface elevations at Borings 1(15) through 3(15) were surveyed by others, while the elevation of Boring 4(15) was estimated using a provided topographic map.

The subsurface profiles at the recent boring locations were fairly similar, and a generalized profile includes the following strata (in descending order):

- **Surficial layers:** 4 in. to 12 in. of *topsoil fill* in Borings 1(15) and 3(15), 10.5 in. *concrete pavement*/12 in. *base course* in Boring 2(15) and 5 in. *asphalt*/8 in. *base course* in Boring 4(15).

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- **Fill:** 5 ft to 9.5 ft of loose to dense silty sand with scattered silt and clay pockets. The lower part of fill in Boring 1(15) was intermixed with *concrete* and *cinders*. The lower part of fill in Boring 4(15) contained apparent *cinders* and had an *petroleum odor*.
- **Buried Topsoil:** 1.5 ft of loose to medium dense silt to clayey silt with trace organics in Boring 1(15).
- **Cohesive Soil:** 2.5 ft to 3 ft of stiff to very stiff to stiff lean clay with trace organics in Borings 1(15) and 4(15) and 3 ft of loose clayey sand to sandy lean clay in Boring 3(15).
- **Sand:** Loose to very dense sand with variable silt and gravel content, as well as scattered cobbles/boulders, which extended to the maximum depths explored.

The profiles in the five previous borings near the west end of the addition were fairly similar to the generalized profile in the recent borings, although the natural silty sand layer was slightly looser in the previous borings. The 2009 soil boring logs are included in Appendix B.

Groundwater was encountered in the recent borings at 11 ft to 14.5 ft below existing site grades (approximately EL 857.7 ft to 869.2 ft) during or shortly after the completion of drilling. Note that the water level in B-2(15) was near EL 869.2 ft, which is 6 ft higher than then next highest water level (EL 863 ft in B-4(15)) in the recent borings. Therefore, the water in B-2(15) may be “perched” water. Note that longer-term water level readings in two monitoring wells in the 2009 borings indicated groundwater was near EL 860 to 860.5 ft. Groundwater levels should be expected to fluctuate with seasonal variations in precipitation, infiltration, evapotranspiration and other factors. A more detailed description of the site soil and groundwater conditions is presented on the Soil Boring Logs attached in Appendix B.

DISCUSSION AND RECOMMENDATIONS

Subject to the limitations discussed below and based on the subsurface exploration, it is our opinion that the area is generally suitable for the proposed building addition, and the structure can be supported by conventional spread footing foundations. *However, undercutting/ replacement will be required below the building and ramp additions, similar to the existing building, where non-engineered fill, buried topsoil and softer clayey soils exist around the perimeter of the existing concrete ramp.* Our recommendations for site preparation, foundation, floor slab, retaining wall and pavement design/construction are presented in the following subsections. Additional information regarding the conclusions and recommendations presented in this report is discussed in Appendix C.



Mr. Mike Rupiper, P.E.
 Dane County Public Works, Highway & Transportation
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1. Site Preparation

We recommend that the topsoil/vegetation and concrete and asphalt pavement be stripped/removed at least 10 ft beyond the proposed construction areas, including areas required for cuts and fills beyond the proposed building and ramp footprints or pavement limits. The topsoil can be stockpiled on-site and re-used as fill in landscaped areas or hauled off site.

As mentioned above, it appears that the non-engineered fill and buried topsoil layers were removed within the existing concrete ramp, which is consistent with the findings of Boring 2(15). However, non-engineered fill, buried topsoil and/or a moderately compressible clayey sand/sandy clay layer were present in the borings drilled around the perimeter of the existing ramp. Due to the building loads in addition to the weight of the new fill to establish building and ramp grades, these layers are considered unacceptable for building support and will require undercutting/removal beneath the addition footprint and ramp. The undercutting/replacement should extend below proposed retaining walls outside the proposed building footprint. The undercut excavation should extend laterally beyond the outside footing edge a minimum of 0.5 ft for each foot of undercut depth for stress distribution purposes. To further delineate the extent and depth of the unsuitable soils, we recommend that test pits be excavated at the time of construction. Note that apparent *cinders* were noted in the fill in Borings 1 and 4, and an apparent *petroleum odor* was noted in the fill in Boring 4. Therefore, these soils may require special handling procedures and landfill disposal. The approximate undercut depths anticipated at the recent boring locations are summarized in Table 1.

**Table 1 - Estimated Undercut Depths
 Dane County Waste Transfer Station - C & D Addition**

Boring	Ground Surface Elevation (ft)	Approximate Bottom of Unsuitable Soil	
		Depth below existing grade (ft)	Elevation (ft)
1(15)	876.2	10	866.2
2(15)	883.7	Not Encountered	-
3(15)	871.6	8.5	863.1
4(15)	874	8	866

The soils below the fill, soft clay and buried topsoil are expected to consist of native stiff to very stiff lean clay or sand with variable silt and gravel content. The native clays should be statically recompacted with a smooth drum roller (without vibration), and granular soils should be recompacted with vibration. After recompaction, we recommend that the soils be checked for soft/unstable areas by

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proof-rolling with a loaded tri-axle dump truck. If soft/loose areas are detected, these areas should be undercut and replaced with granular backfill compacted to a minimum of 95% compaction based on modified Proctor methods (ASTM D 1557) or compacted 3-in. dense graded base.

After undercutting, recompaction and proof-rolling are completed to create a stable surface, fill placement to establish site grades can occur. We recommend using granular soils as fill within and at least 10 ft beyond the addition and ramp areas, as well as in the upper 3 ft in pavement areas, as sand/gravel are generally easier to place and compact in a wider range of weather and soil moisture conditions. Silt/clay soils generally require moisture conditioning to achieve adequate compaction levels, which could delay the construction schedule. Therefore, silt/clay soils are best used as fill in landscaped areas or in lower portions in pavement areas provided the cohesive soils can be adequately dried to achieve the required compaction. Similar to construction of the existing building, the shallow silty sand soils will likely be acceptable for use as undercut backfill provided these soils are selectively stockpiled during undercutting (i.e., not mixed with significant silt and clay soils) and the moisture content is near the optimum moisture content (the optimum moisture content will likely be around 7% to 8%). Where the fill will tie into the existing fill on and around the ramp, we recommend that the fill be "knit" into the existing soils by benching into existing soils about 2 ft laterally for each foot of vertical fill. Periodic field density tests should be taken by CGC staff within the fill/backfill to document the adequacy of compactive effort.

The west portion of the addition will be cut to grade about 5 ft, while new fill will be required to establish building grade in the eastern portion of the building. Based on existing and proposed grades, up to 6 to 8.5 ft of new fill will be required in eastern portions of the building addition. We estimate that the weight of the fill could result in the underlying loose to medium dense silty sand soils settling about 1 to 1.5 in. Since the western portion of the addition is being cut to grade, no settlement would be expected there. Therefore, the weight of the new fill would result in *differential settlement* of 1 to 1.5 in. across the addition footprint. To minimize the chance of differential settlement across the addition footprint, we recommend that the fill be placed to the floor slab subgrade elevation (i.e., EL 879 ft) prior to excavating for the building footings. Where grades are being raised, we recommend that the new fill to the slab subgrade elevation extend at least 5 ft beyond the building footprint. After fill placement to the floor slab subgrade elevation has been accomplished, excavation for footings may begin. The settlement of the granular soils is expected to occur fairly rapidly, such that with early fill placement to the floor slab subgrade elevation, post-construction foundation settlement should be within typically tolerable levels.

2. Foundation Design

In our opinion, the proposed building can be supported on reinforced concrete spread footing foundations bearing on existing native sands and cohesive soils, as well as on newly-placed compacted granular fill. *As discussed previously and completed during construction of the existing building, the existing non-engineered fill, buried topsoil and softer clay layers will require undercutting/replacement within the building and ramp addition areas and grade should be restored*

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with well-compacted granular backfill. The allowable soil bearing pressure is limited by the native stiff clays and loose to medium granular soils encountered in the borings. The following parameters should be used for foundation design:

- Maximum net allowable bearing pressure: 3,000 psf

- Minimum foundation widths:
 - Continuous wall footings: 18 in.
 - Column pad footings: 30 in.

- Minimum footing depths:
 - Exterior/perimeter footings: 4 ft
 - Interior footings: no minimum requirement

Undercutting below footings will be required where loose sands or silts or native cohesive soils with pocket penetrometer readings (an estimate of the unconfined compressive strength of cohesive soils) of less than 1.5 tsf are encountered at or slightly below footing grade. Where undercutting is required, the base of the undercut excavation should be widened beyond the footing edges at least 0.5 ft in each direction for each foot of undercut depth for stress distribution purposes. Where undercut grade will be above the water table, granular backfill compacted to at least 95% compaction (modified Proctor - ASTM D1557) or well-compacted 3-in. dense graded base can be used to re-establish footing grade. If the undercut excavation will extend near or slightly below the water table, a thin (6 in. to 12 in. thick) layer of clear stone may be required to stabilize the wet soils prior to subsequent fill placement. If the clear stone layer exceeds 12 in., the stone should be enveloped with non-woven geotextile fabric (e.g., Mirafi 160N or equivalent). Based on apparent perched groundwater in Boring 2(15) near footing grade of the lower level, some dewatering with pumps in shallow sump pits may be required in addition to the stone stabilization layer.

CGC should be present during footing excavations to check whether subgrades are satisfactory for the design bearing pressure and to advise on corrective measures, where necessary. We recommend using a smooth-edged backhoe bucket for footing excavations. Additionally, granular soils exposed at footing grade should be thoroughly recompacted with a large vibratory plate compactor prior to formwork/concrete placement to densify soils loosened during the excavation process. Soils potentially susceptible to disturbance from compaction (e.g., silty or clayey soils) should be hand trimmed. Provided the foundation design/construction recommendations discussed above are followed, including early fill placement to the floor slab subgrade elevation, we estimate that total settlement should be on the order of 1.0 in., with differential settlement about half of the total settlement (i.e., about 0.5 in.).

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3. Seismic Site Class

In our opinion, the average soil properties in the upper 100 ft of the site (based on SPT blow counts (N-values) of less than 15 blows/ft on average) can be characterized as a soft soil profile. This characterization would place the site in Class E for seismic design according to International Building Code (see Table 1613.5.2).

4. Floor Slabs

Building Floor Slab

We anticipate that the floor slabs within the proposed building addition will be supported on several feet of new or previously-placed engineered granular soils. Removal of existing non-engineered fill, buried topsoil and marginal clayey sand layers should be completed below slab areas, as discussed previously. Based on the moderately heavy (up to 300 psf) floor slab loads, we recommend that the floor slab be underlain by a minimum of 8 in. of dense graded base. With the inclusion of the dense graded base layer, it is our opinion that a subgrade modulus of 150 pci may be used for floor slab design. Prior to slab construction, the subgrades should be thoroughly proof-rolled/recompacted to densify soils that may become disturbed or loosened during construction activities. Areas that remain loose after recompaction should be undercut and replaced with compacted 3-in. dense graded base or granular fill. The design subgrade modulus is based on a recompacted subgrade such that non-yielding conditions are developed. To further minimize the potential for moisture migration, a plastic vapor barrier can also be utilized below the slabs. The slabs should be structurally separate from the foundations and have construction joints and reinforcement for crack control.

Exterior Ramp Slab

For the exterior ramp, we recommend that the concrete slab-on-grade be underlain by 6 in. of dense graded base over 6 in. of open-grade stone to drain water. A woven geotextile fabric (e.g., Mirafi 600X or equivalent) should be placed between the dense graded and open graded stone layers to prevent migration into the open-graded stone layer. In our opinion, a subgrade modulus of 150 pci can be used for design of the ramp slab-on-grade. Fill and base layer material below the ramp slab should be placed as described in the Site Preparation section of this report. A drain tile should be included at the toe of the ramp to drain water that may accumulate below the slab-on-grade and drains downhill.

5. Retaining Walls

In our opinion, retaining walls that will be not be laterally restrained from rotating at the top should be designed for *active earth pressures* behind the walls and *passive pressures* in front of the walls. Lateral pressures behind the retaining walls can be minimized by backfilling with a high quality backfill within 3 to 5 ft of the walls. For exterior retaining walls that may be subject to occasional moisture infiltration, the wall backfill should consist of imported, free-draining, well-graded sand or gravel having no more than 12 percent passing the No. 200 U.S. Standard Sieve. Interior wall backfill that will not be subject to moisture can be backfilled with sands with higher silt content (<30% P200).



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Since the backfill will be below or adjacent to the interior or ramp slab-on-grade with moderately heavy loads, the backfill should be compacted to a minimum of 95% compaction (ASTM D1557) following Appendix D guidelines. Recommended retaining wall design parameters are included in Table 2 for imported free-draining backfill or on-site silty sand backfill. Where pavement will not extend to the back of the retaining walls, we recommend including 2 ft compacted clay cap at the ground surface behind the retaining walls to minimize infiltrating water.

To prevent the development of hydrostatic pressures behind exterior retaining walls, we recommend including a drainage system behind the walls. A drain tile should be included at the base of the wall that is hydraulically connected to the free-draining backfill to remove infiltrating water. The drain tile should "daylight" at the ends of the walls. Weepholes should be placed near the base of exterior walls on 10-ft centers to provide intermediate drainage points of the wall backfill. The weepholes should be hydraulically connected with the backfill and should be protected with a non-woven geotextile fabric to minimize soil loss through the weepholes.

Undercutting below retaining wall footings will be required where non-engineered fill, buried topsoil or softer cohesive soils exist, as discussed in the Foundation Design section of the report.

The retaining wall design should also take into account surcharge effects that could be applied during or after construction.

Table 2 - Recommended Retaining Wall Parameters

Parameter	Design Value	
	< 12 (SP/SP-SM)	SM ($\leq 30\%$)
P200 Content (%)		
Minimum Compaction (% - modified Proctor)	95	95
Unit Weight (pcf)	125	143 ⁽²⁾
Friction Angle (degrees)	34 ⁽¹⁾	37 ⁽²⁾
Active Earth Pressure Coefficient (K_a)	0.28	0.25
Passive Earth Pressure Coefficient (K_p)	3.5 ⁽³⁾	4.0 ⁽³⁾
At-Rest Earth Pressure Coefficient (K_o)	0.44	0.40
Friction Factor (mass concrete on stiff to hard clay or silty sand)	0.4	
Allowable Bearing Pressure (psf) - on native stiff clays or medium dense sand or engineered granular backfill	3,000	

- Notes:**
1. Friction angle was estimated based on typical published values for compacted clean sand.
 2. Unit weight and friction angle based on Proctor and direct shear tests completed on sample of on-site silty sand borrow material collected in 2012 during construction of existing Waste Transfer Station.
 3. The passive earth pressure coefficient should be reduced by a factor of 2.0 to reduce the chance of excessive wall deflections.

6. Pavement Design

We anticipate that the relocated drive lane east of the addition will experience heavy traffic loads (e.g., approximately 50 daily 18-kip equivalent single axle load (ESAL)). The pavement design is controlled by the variable sand and clay fill soils exposed in the borings. Based on the presence of some marginal shallow soils, as was encountered in much of the current pavement area, we anticipate that undercutting/stabilization will be required below the typical base course section in order to develop a firm subgrade for moderately heavy traffic support. Therefore, *we recommend including a*

Mr. Mike Rupiper, P.E.
 Dane County Public Works, Highway & Transportation
 March 30, 2015
 Page 10

contingency in the budget for about 12 in. of additional coarse aggregate (3-in. dense graded base, select crushed material, breaker run stone) below about 50% of the pavement area. The pavement section tabulated below in Table 3 was selected assuming a CBR of approximately 3 for a firm or stabilized sand or clay subgrade and a design life of 20 years.

**TABLE 3
 RECOMMENDED PAVEMENT SECTION
 MODERATE TO HEAVY TRAFFIC LOADS**

Material	Thickness (in.)	WDOT Specification ¹
Bituminous upper layer	2.0	Section 460, Table 460-1, 12.5 mm
Bituminous lower layer	3.0	Section 460, Table 460-1, 19 mm
Dense graded base	12.0	Sections 301 and 305, 31.5mm and 75mm
TOTAL THICKNESS	17.0	

Notes:

1. Wisconsin DOT *Standard Specifications for Highway and Structure Construction*, latest edition, including supplemental specifications but excluding limits on layer thickness recoated to aggregate size (Section 460.3.2).
2. Compaction requirements:
 - Bituminous concrete: Refer to Section 460.3
 - Base course: Refer to Section 301.3.4.2, Standard Compaction
3. Mixture Type E-1 is recommended; refer to Section 460, Table 460-2 of the *Standard Specifications*.

The pavement design assumes a stable/non-yielding subgrade and a regular program of preventative maintenance. Alternative pavement designs may prove acceptable and should be reviewed by CGC. Performance of the existing pavement should also be reviewed to determine if the existing pavement section is performing adequately or not. If there is a delay between subgrade preparation and placing the base course, the subgrade should be recompacted.

Pavement areas subjected to concentrated wheel loads (i.e., loading dock aprons, dumpster pads, etc.) should be constructed of Portland cement concrete. The slab should be a *minimum* of 6-in. thick, be



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underlain by a minimum of 6 in. of dense graded base and should contain reinforcement for crack control. *Note that concrete pavement in truck traffic areas may need to be thicker than 6 in., which should be evaluated by a structural engineer.* A subgrade modulus of 150 pci should be used for concrete pavement resting on a minimum of 8 in. of well-compacted dense graded base or firm or stabilized fill or native soils.

CONSTRUCTION CONSIDERATIONS

Due to variations in weather, construction methods and other factors, specific construction problems are difficult to predict. Soil related difficulties which could be encountered on the site are discussed below:

- Due to the potentially sensitive nature of the on-site soils, we recommend that final site grading activities be completed during dry weather, if possible. Construction traffic should be avoided on prepared subgrades to minimize potential disturbance.
- Contingencies in the project budget for subgrade stabilization with coarse aggregate should be increased if the project schedule requires that work proceed during adverse weather conditions.
- Earthwork construction during the early spring or late fall could be complicated as a result of wet weather and freezing temperatures. During cold weather, exposed subgrades should be protected from freezing before and after footing construction. Fill should never be placed while frozen or on frozen ground.
- Excavations extending greater than 4 ft in depth below the existing ground surface should be sloped or braced in accordance with current OSHA standards.
- Based on observations made during the field exploration, groundwater infiltration into footing excavations is generally not expected to be a problem, except potentially for the lower level footings. Water accumulating at the base of excavations as a result of precipitation or seepage should be controlled and quickly removed using pumps operating from filtered sump pits.

RECOMMENDED CONSTRUCTION MONITORING

The quality of the foundation, floor slab and pavement subgrades will be largely determined by the level of care exercised during site development. To check that earthwork and foundation construction proceeds in accordance with our recommendations, the following operations should be monitored by CGC:



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Dane County Public Works, Highway & Transportation
March 30, 2015
Page 12

- Topsoil stripping/pavement removal/subgrade proof-rolling within the construction areas;
- Fill/backfill placement and compaction;
- Foundation excavation/subgrade preparation; and
- Concrete placement.

* * * * *

It has been a pleasure to serve you on this project. If you have any questions or need additional consultation, please contact us.

Sincerely,

CGC, Inc.

David A. Staab, P.E., LEED AP
Consulting Professional

Michael N. Schultz, P.E.
Principal/Consulting Professional

- Encl: Appendix A - Field Exploration
Appendix B - Soil Boring Location Map
Logs of Recent Test Borings (4)
Logs of Previous (2009) Test Borings (5)
Log of Test Boring-General Notes
Unified Soil Classification System
Appendix C - Document Qualifications
Appendix D - Recommended Compacted Fill Specifications

cc: Ms. Betsy Powers, SCS Engineers (email)
Mr. Kurt Frey, Pierce Engineers (email)

APPENDIX A

FIELD EXPLORATION

APPENDIX A

FIELD EXPLORATION

A total of four Standard Penetration Test (SPT) borings were drilled to planned depths of 20 to 60 ft below existing site grades. The borings are labeled B-1(15) through B-4(15) in order to differentiate from 12 previous borings drilled in 2009 for the existing Waste Transfer Station; of the 12 previous borings, five (B-1, 4, 8, 10 and 12) were along or near the east end of the Waste Transfer Station (west end of proposed addition). The locations of B-1(15) through B-3(15) were selected and located in the field by others, while B-4(15) was added to the drilling program later and was located in the field by CGC and Dane County.

The borings were performed on March 16, 2015 by Badger State Drilling (under subcontract to CGC) using a truck-mounted rotary CME-55 drill rig equipped with hollow-stem augers, mud rotary tooling and an automatic SPT hammer. The soil boring locations are shown in plan on the Soil Boring Location Map attached in Appendix B. Ground surface elevations at Borings 1(15) through 3(15) were surveyed by others, while the elevation of Boring 4(15) was estimated using a provided topographic map.

In each boring, soil samples were obtained at 2.5 foot intervals to a depth of 10 ft and at 5 ft intervals thereafter. The soil samples were obtained in general accordance with specifications for standard penetration testing, ASTM D 1586. The specific procedures used for drilling and sampling are described below.

1. Boring Procedures between Samples

The boring is extended downward, between samples, by a hollow-stem auger.

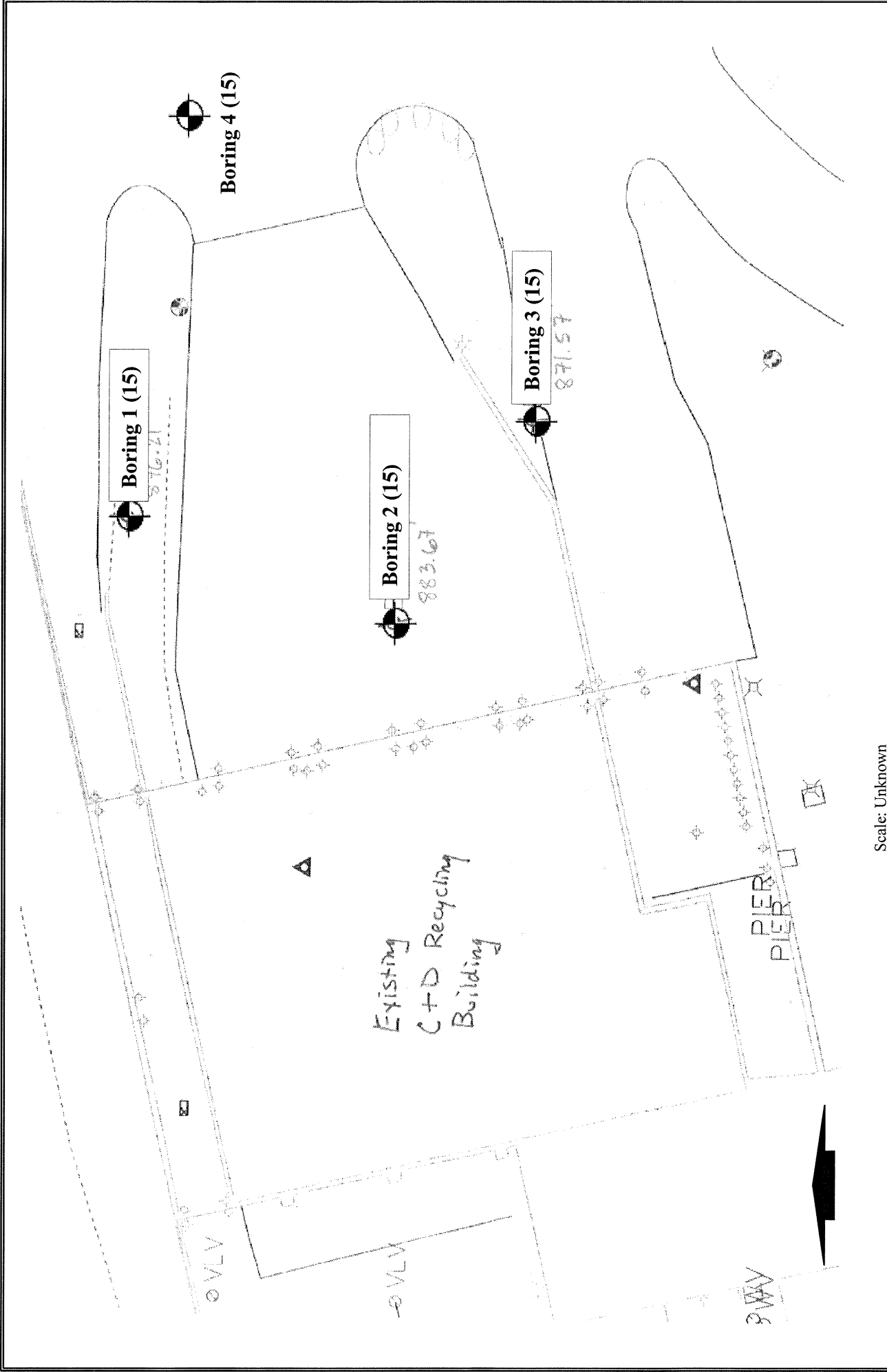
2. Standard Penetration Test and Split-Barrel Sampling of Soils
(ASTM Designation: D 1586)

This method consists of driving a 2-inch outside diameter split-barrel sampler using a 140-pound weight falling freely through a distance of 30 inches. The sampler is first seated 6 inches into the material to be sampled and then driven 12 inches. The number of blows required to drive the sampler the final 12 inches is recorded on the log of borings and is known as the Standard Penetration Resistance.

During the field exploration, the driller visually classified the soil and prepared a field log. *Field screening of the soil samples for possible environmental contaminants was not conducted by the drillers as these services were not part of CGC's work scope.* Water level observations were made in each boring during and after drilling and are shown at the bottom of each boring log. Upon completion of drilling, the borings were backfilled with bentonite to satisfy WDNR regulations and the soil samples were delivered to our laboratory for visual classification and laboratory testing. The soils were visually classified by a geotechnical engineer using the Unified Soil Classification System. The final logs prepared by the engineer and a description of the Unified Soil Classification System are presented in Appendix B.

APPENDIX B

**SOIL BORING LOCATION MAP
LOGS OF RECENT TEST BORINGS (4)
LOGS OF PREVIOUS (2009) TEST BORING (5)
LOG OF TEST BORING – GENERAL NOTES
UNIFIELD SOIL CLASSIFICATION SYSTEM**



Legend
 Denotes Boring Location and Number

Notes
 1. Borings drilled by Badger State Drilling on March 16, 2015.
 2. Base map provided by Dane County.
 3. Boring locations are approximate.

Scale: Unknown

Job No. C15064	
Date: 03/2015	

SOIL BORING LOCATION MAP
 Proposed Construction & Demolition
 Recycling Building Addition
 7102 USH 12/18
 Madison, WI



LOG OF TEST BORING

Project Dane County Waste Transfer Station
C & D Building Addition
 Location Madison, Wisconsin

Boring No. 1 (15)
 Surface Elevation (ft) 876.2
 Job No. C15064
 Sheet 1 of 2

2921 Perry Street, Madison, WI 53713 (608) 288-4100, FAX (608) 288-7887

SAMPLE					VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES				
No.	TYPE	Rec (in.)	Moist	N		Depth (ft)	qu (qa) (tsf)	W	LL	PL
					12 in. ± TOPSOIL Fill (OL)					
1		12	M	13	FILL: Medium Dense, Red Brown Silty Fine to Medium Sand, Some Gravel, Scattered Silt/Clay Pockets					
2		12	M	11			8.6			
3		14	M	20						
4		12	M	10	FILL: Medium Dense, Dark Gray Silty Fine to Medium Sand, Some Gravel, Trace Organics, Scattered Concrete, Cinders, etc.					
5		10	M	11	Loose to Medium Dense, Gray/Dark Gray SILT to Clayey SILT, Trace to Little Organics, Trace Sand and Gravel (ML-Possible Topsoil)	(2.25)	23.9			3.2
6		12	M	16	Very Stiff, Greenish Gray/Brown (Mottled) Lean CLAY, Trace Sand and Organics (CL)					
					Medium Dense, Reddish Brown Silty Fine to Medium SAND, Little to Some Gravel, Scattered Silt Pockets and Cobble/Boulders (SM)					
7		12	M/W	15						
8		6	W	18						
9		10	W	12						
							11.2			

WATER LEVEL OBSERVATIONS				
While Drilling	▽	18.5'	Upon Completion of Drilling	_____
Time After Drilling	_____	_____	_____	_____
Depth to Water	_____	_____	_____	▽
Depth to Cave in	_____	_____	_____	_____

GENERAL NOTES				
Start	3/16/15	End	3/16/15	
Driller	BSD	Chief	JF	Rig CME-55
Logger	DB	Editor	DAS	
Drill Method	2.25 in. HSA 0'-20'; 3-7/8" RB/DM 20'-60'; Autohammer			

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.



LOG OF TEST BORING

Project Dane County Waste Transfer Station
C & D Building Addition
 Location Madison, Wisconsin

Boring No. 1 (15)
 Surface Elevation 876.2
 Job No. C15064
 Sheet 2 of 2

2921 PERRY STREET, MADISON, WIS. 53713 (608) 288-4100, FAX (608) 288-7887

SAMPLE					VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES					
No.	TYPE	Rec (in.)	Moist	N		Depth (ft)	q _u (qa) (tsf)	W	LL	PL	LI
10		0	W	13	Trace Clay Near 30 ft Medium Dense, Reddish Brown Silty Fine to Medium SAND, Little to Some Gravel, Scattered Silt Pockets and Cobble/Boulders (SM)						
11		6	W	50/3"	Very Dense Sandy Gravel Layer Near 40 ft						
12		10	W	37	Dense, Reddish Brown Silty Fine SAND, Little to Some Gravel, Scattered Cobbles/Boulders (SM)						
13		12	W	31							
14		4	W	45							
15		12	W	37							
					End Boring at 60 ft Backfilled with Bentonite Slurry and Chips						



LOG OF TEST BORING

Project Dane County Waste Transfer Station
C & D Building Addition
 Location Madison, Wisconsin

Boring No. 2 (15)
 Surface Elevation (ft) 883.7
 Job No. C15064
 Sheet 1 of 2

2921 Perry Street, Madison, WI 53713 (608) 288-4100, FAX (608) 288-7887

SAMPLE					VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES				
No.	TYPE	Rec (in.)	Moist	N		Depth (ft)	qu (qa) (tsf)	W	LL	PL
					0	10.5 in. Concrete/12 in. Base Coarse				
1		10	M	40	0	FILL: Medium Dense to Dense, Reddish Brown Silty Fine to Medium Sand, Some Gravel, Scattered Silt/Clay Pockets				
2		14	M	20	5					
3		12	M	40	10					
4		12	M	24	15					
5		18	M/W	43	20					
					20	Medium Dense to Dense, Reddish Brown/Brown Silty Fine to Medium SAND, Little to Some Gravel and Cobbles/Boulders (SM)				
6		4	W	35	25	Layer of Gravel Near 20 ft				
7		3	W	30	30					
8		3	W	36	35					
					35	Layers of Fine to Medium SAND, Trace to Little Silt (SP/SP-SM) Near 25 ft				
9		15	W	28	40	Loose to Medium Dense, Reddish Brown Silty Fine to Medium SAND, Little to Some Gravel, Trace to Little Clay, Scattered Cobbles/Boulders (SM)				
10		12	W	4	45					
					50	12.8				

WATER LEVEL OBSERVATIONS	GENERAL NOTES
While Drilling ∇ <u>14.5'</u> Upon Completion of Drilling _____ Time After Drilling _____ Depth to Water _____ Depth to Cave in _____	Start <u>3/16/15</u> End <u>3/16/15</u> Driller <u>BSD</u> Chief <u>JF</u> Rig <u>CME-55</u> Logger <u>DB</u> Editor <u>DAS</u> Drill Method <u>2.25 in. HSA 0'-10'; 3-7/8" RB/DM 10'-40'; Autohammer</u>
The stratification lines represent the approximate boundary between soil types and the transition may be gradual.	



LOG OF TEST BORING

Project Dane County Waste Transfer Station
C & D Building Addition
 Location Madison, Wisconsin

Boring No. 2 (15)
 Surface Elevation 883.7
 Job No. C15064
 Sheet 2 of 2

2921 PERRY STREET, MADISON, WIS. 53713 (608) 288-4100, FAX (608) 288-7887

SAMPLE					VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES					
No.	TYPE	Rec (in.)	Moist	N		Depth (ft)	qu (qa) (tsf)	W	LL	PL	LI
11		12	W	10	35	Loose to Medium Dense, Reddish Brown Silty Fine to Medium SAND, Little to Some Gravel, Trace to Little Clay, Scattered Cobbles/Boulders (SM)					
12		6	W	13	40		End Boring at 40 ft				
					45	Backfilled with Bentonite Slurry, Chips and Concrete Patch					
					50						
					55						
					60						



LOG OF TEST BORING

Project Dane County Waste Transfer Station
C & D Building Addition
 Location Madison, Wisconsin

Boring No. **3 (15)**
 Surface Elevation (ft) 871.6
 Job No. C15064
 Sheet 1 of 2

2921 Perry Street, Madison, WI 53713 (608) 288-4100, FAX (608) 288-7887

SAMPLE					VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES				
No.	Rec (in.)	Moist	N	Depth (ft)		qu (qa) (tsf)	W	LL	PL	LI
					4 in. ± TOPSOIL FILL (OL)					
1	12	M	8		FILL: Loose, Reddish Brown Silty Fine to Medium Sand, Some Gravel, Trace Clay, Scattered Silt/Clay Pockets		10.2			
2	10	M	6				9.2			
3	12	M	5		Loose, Brown Clayey Fine to Medium SAND, to Sandy Lean CLAY, Trace Gravel (SC/CL)	(0.75-1.0)	18.4			
4	12	M	14		Medium Dense, Light Brown Fine to Medium SAND, Some Silt (SM) Scattered Sand Seams with Trace to Little Silt (SP/SP-SM)					
5	6	W	13		Loose to Medium Dense Reddish Brown/Brown Silty Fine to Medium SAND, Little to Some Gravel, Trace Clay, Scattered Cobbles/Boulders (SM)		10.9			
6	6	W	12							
7	8	W	9				11.3			
8	4	W	4				12.5			
9	12	W	37		Dense, Reddish Brown Silty Fine SAND, Little to Some Gravel, Scattered Cobbles/Boulders (SM)					

WATER LEVEL OBSERVATIONS					GENERAL NOTES				
While Drilling	<input checked="" type="checkbox"/>	11.0'	Upon Completion of Drilling	_____	Start	3/16/15	End	3/16/15	
Time After Drilling	_____	_____	_____	_____	Driller	BSD	Chief	JF	Rig CME-55
Depth to Water	_____	_____	_____	_____	Logger	DB	Editor	DAS	
Depth to Cave in	_____	_____	_____	_____	Drill Method	2.25 in. HSA 0'-10'; 3-7/8"			
<small>The stratification lines represent the approximate boundary between soil types and the transition may be gradual.</small>					RB/DM 10'-60'; Autohammer				



LOG OF TEST BORING

Project Dane County Waste Transfer Station
C & D Building Addition
 Location Madison, Wisconsin

Boring No. 3 (15)
 Surface Elevation 871.6
 Job No. C15064
 Sheet 2 of 2

2921 PERRY STREET, MADISON, WIS. 53713 (608) 288-4100, FAX (608) 288-7887

SAMPLE					VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES					
No.	TYPE	Rec (in.)	Moist	N		Depth (ft)	qu (qa) (tsf)	W	LL	PL	LI
10		10	W	26	Dense, Reddish Brown Silty Fine SAND, Little to Some Gravel, Scattered Cobbles/Boulders (SM)						
					Medium Dense, Light Brown Fine to Coarse SAND, Trace to Little Silt and Gravel, Scattered Silty Sand Seams (SP/SP-SM)						
11		4	W	35	Dense to Very Dense, Reddish Brown Silty Fine SAND, Little to Some Gravel, Scattered Cobbles/Boulders (SM)						
12		14	W	66							
13		10	W	62							
14		14	W	60							
15		14	W	73							
					End Boring at 60 ft						
					Backfilled with Bentonite Slurry and Chips						



LOG OF TEST BORING

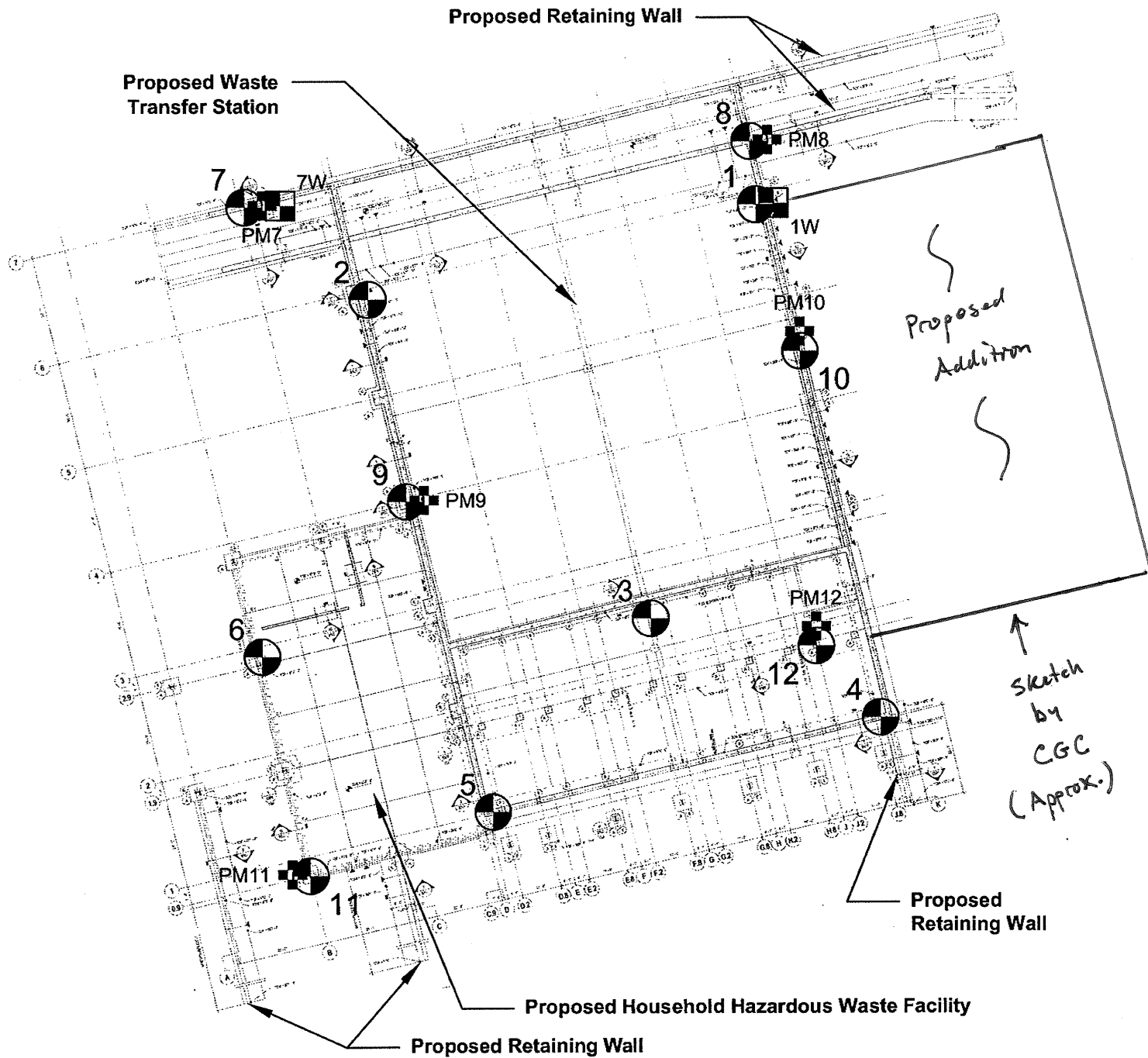
Project Dane County Waste Transfer Station
C & D Building Addition
 Location Madison, Wisconsin

Boring No. 4 (15)
 Surface Elevation (ft) 874±
 Job No. C15064
 Sheet 1 of 1

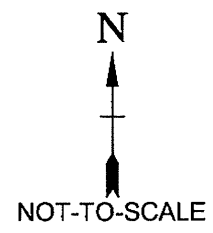
2921 Perry Street, Madison, WI 53713 (608) 288-4100, FAX (608) 288-7887

SAMPLE					VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES				
No.	TYPE	Rec (in.)	Moist	N		Depth (ft)	qu (qa) (tsf)	W	LL	PL
					0	5 in. Asphalt Pavement/ 8 in. Base Coarse				
1		10	M	20	0	FILL: Medium Dense, Red Brown Silty Fine to Medium Sand, Some Gravel, Scattered Silt/Clay Pockets				
2		4	M	69/9"	5	FILL: Loose to Very Dense, Dark Gray Silty Fine Sand, Some Gravel, Scattered Cinders, Possible Petroleum Odor				
3		0	M	5	6	Drove Stone (No Recovery) From 6 to 7.5 ft				
4		18	M	9	10	Stiff, Greenish Gray/Brown (Mottled) Lean CLAY, Trace Sand and Organics (CL)				
5		18	M/W	11	11	Medium Dense, Reddish Brown Silty Fine to Medium SAND, Little to Some Gravel and Cobbles/Boulders (SM)				
6		8	M/W	22	15	Cobbles/Boulders Near 15 ft				
7		18	M/W	12	20	End Boring at 20 ft				
					20	Backfilled with Bentonite Chips and Asphalt Patch				
					25					
					30					

WATER LEVEL OBSERVATIONS					GENERAL NOTES				
While Drilling	∇	11.0'	Upon Completion of Drilling	_____	Start	3/16/15	End	3/16/15	
Time After Drilling	_____	_____	_____	_____	Driller	BSD	Chief	JF	Rig CME-55
Depth to Water	_____	_____	_____	∇	Logger	DB	Editor	DAS	
Depth to Cave in	_____	_____	_____	_____	Drill Method	2.25 in. HSA; Autohammer			
The stratification lines represent the approximate boundary between soil types and the transition may be gradual.									



Sketch by CGC (Approx.)




PM7
 = Auger Boring PM7 (typical)

1W
 = Auger Boring 1W (typical)

2
 = Boring 2 (typical)

Soils & Engineering Services, Inc.
 1102 STEWART STREET • MADISON, WISCONSIN 53713-4648
 Phone: 608-274-7600 • 888-866-SOIL (7645)
 Fax: 608-274-7511 • Email: soils@soils.ws
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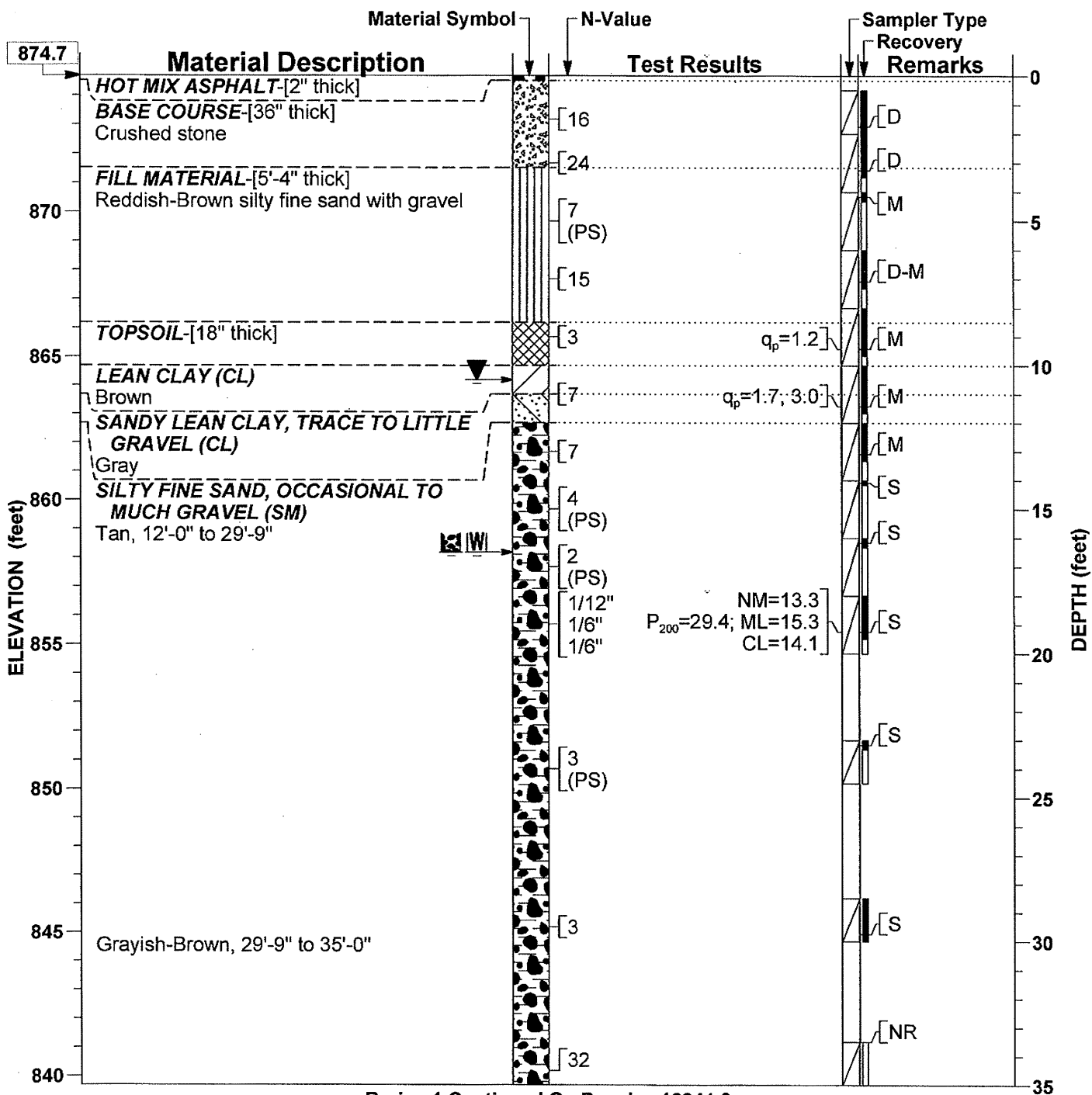
LOCATION SKETCH
 New Waste Transfer Station
 Rodefeld Landfill
 7102 US Highway 12
 Dane County, Wisconsin



DRAWING
 12844-0.5

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
- Wet 16'-6" at completion

OTHER LEVEL LEGEND

- (caved) 16'-6" at completion

For Notes and Legend, see Drawing 12844-1.

Soils & Engineering Services, Inc.

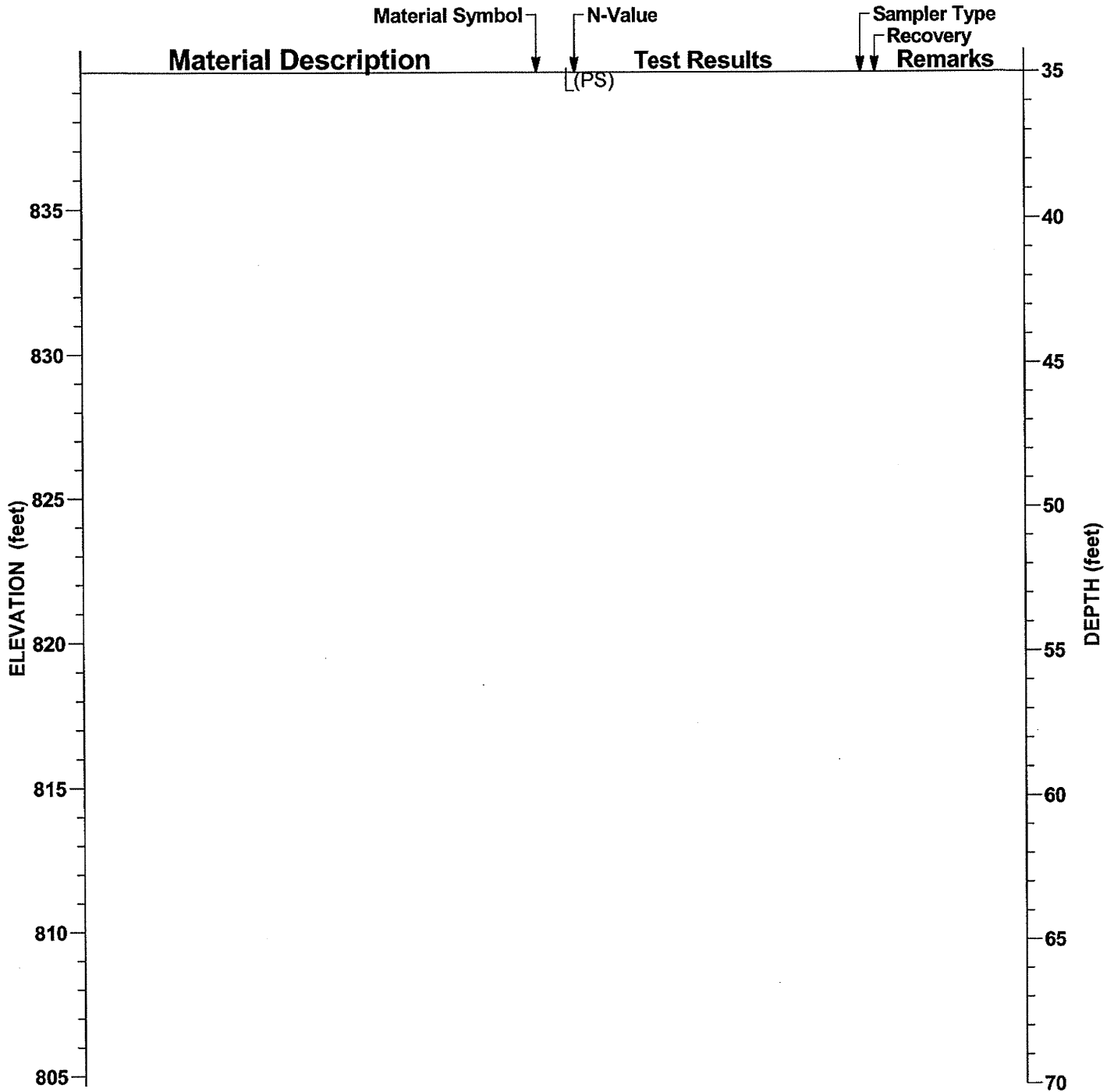
1102 STEWART STREET • MADISON, WISCONSIN 53713
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CONSULTING CIVIL ENGINEERS SINCE 1966


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



DRAWING
 12844-2

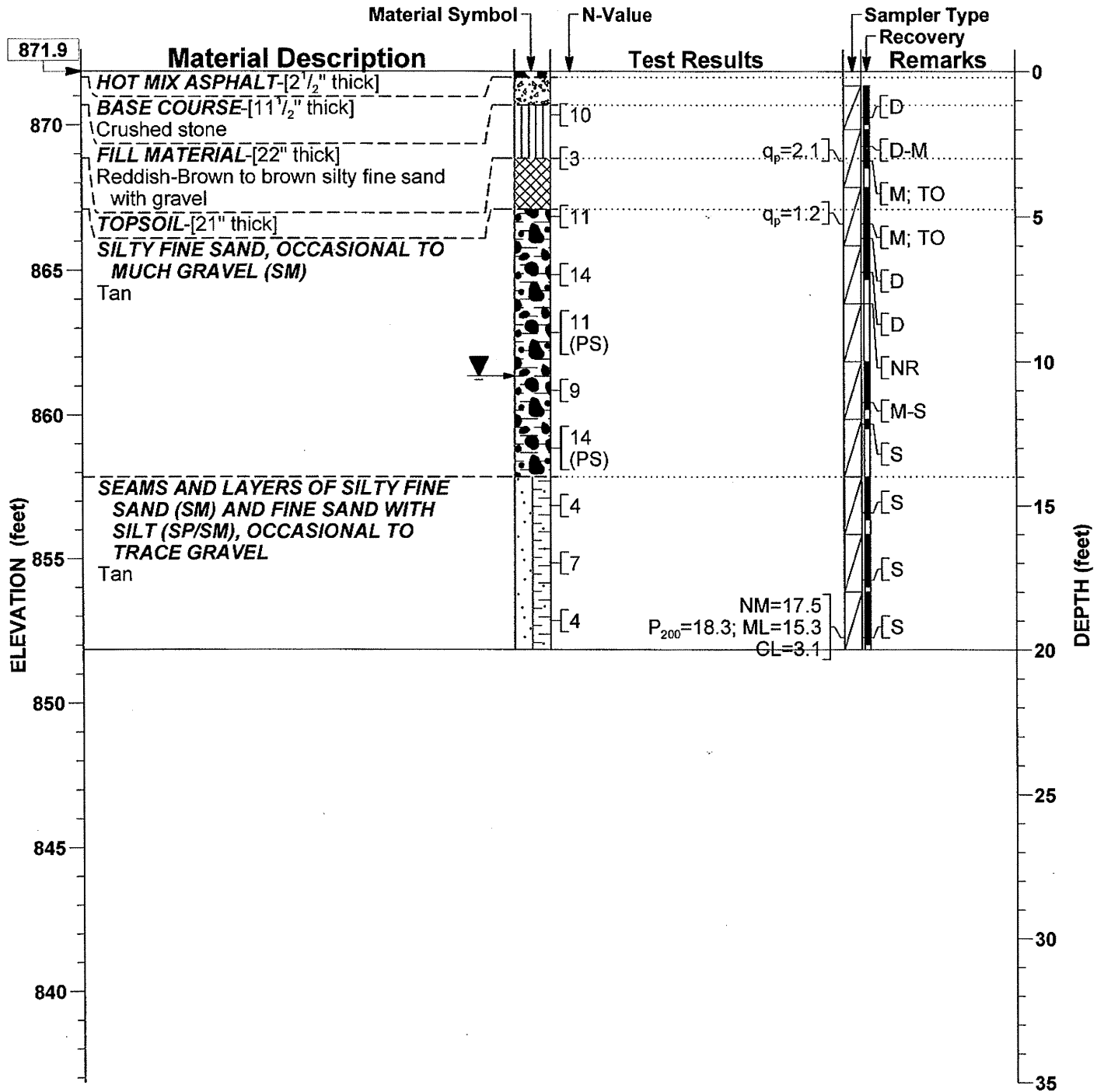


For Notes and Legend, see Drawing 12844-1.

<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 12844-3
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Location: (N472616, E853435)

Boring 4
 Completed October 7, 2009
 Total Depth = 20'-0" (Page 1/1)



WATER LEVEL LEGEND

▼ 10'-6" at completion & 7 hours

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
 Rodefild Landfill
 7102 US Highway 12
 Dane County, Wisconsin



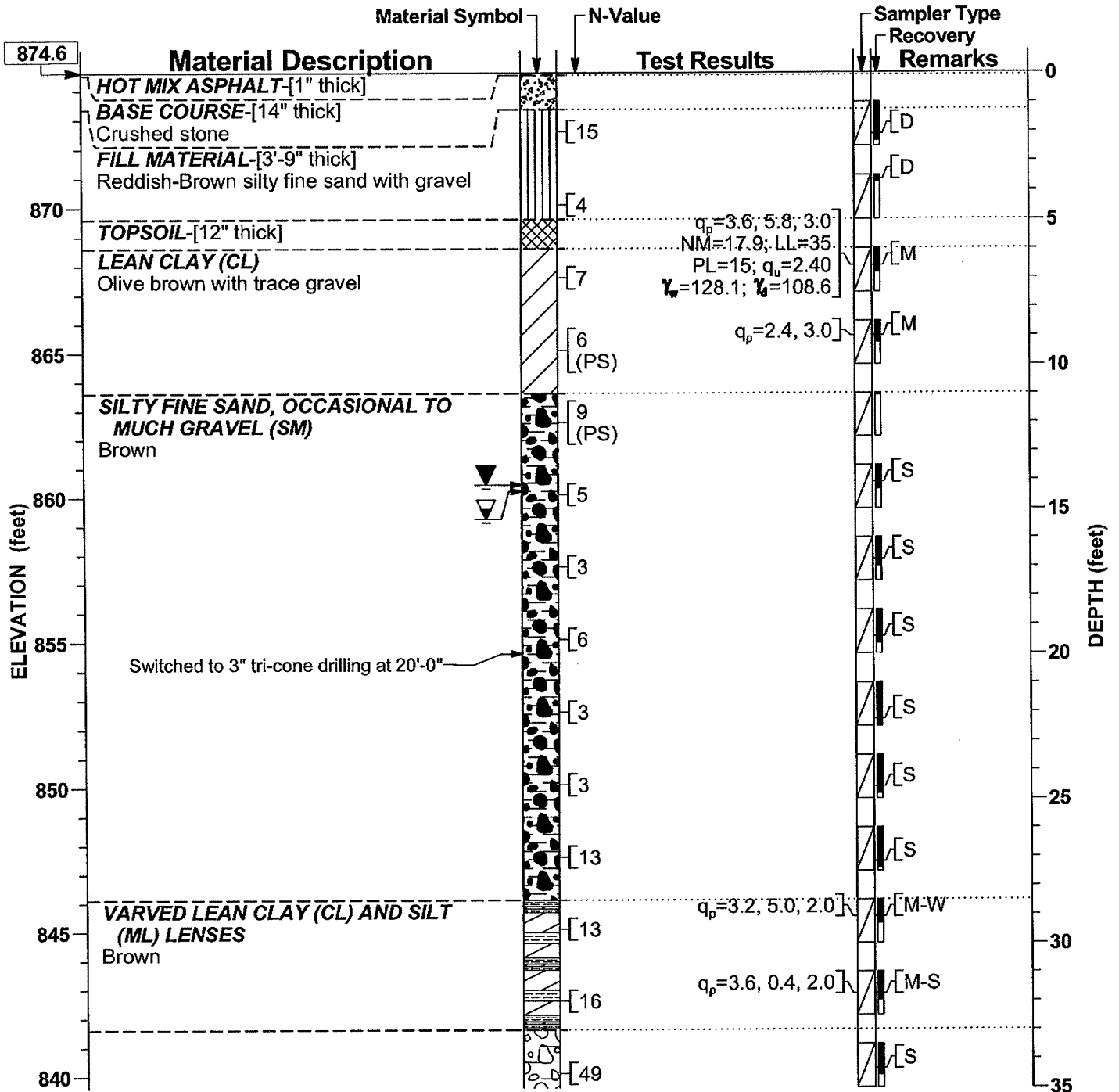
DRAWING
 12844-7

Boring 8

Completed December 3, 2009

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

Location: (N472777, E853399)



Boring 8 Continued On Drawing 12844-13

WATER LEVEL LEGEND

- ▼ 14'-2" at completion
- ▼ 14'-4³/₄" (estimated)

For Notes and Legend, see Drawing 12844-1.

Soils & Engineering Services, Inc.

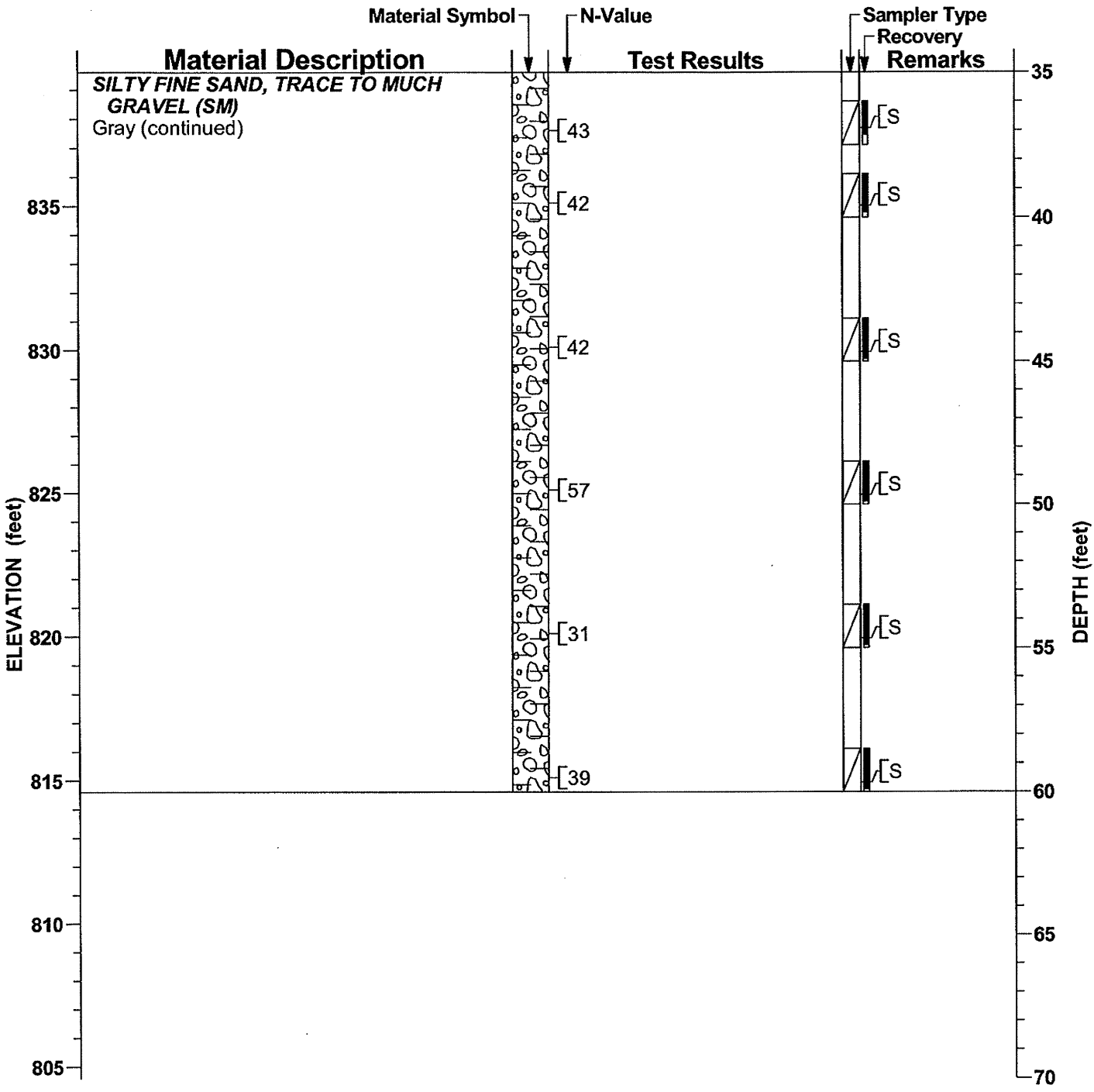
1102 STEWART STREET • MADISON, WISCONSIN 53713
 Phone: 608-274-7600 • 888-866-SOIL (7645)
 Fax: 608-274-7511 • Email: soils@soils.ws

CONSULTING CIVIL ENGINEERS SINCE 1966

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



DRAWING
 12844-12



For Notes and Legend, see Drawing 12844-1.

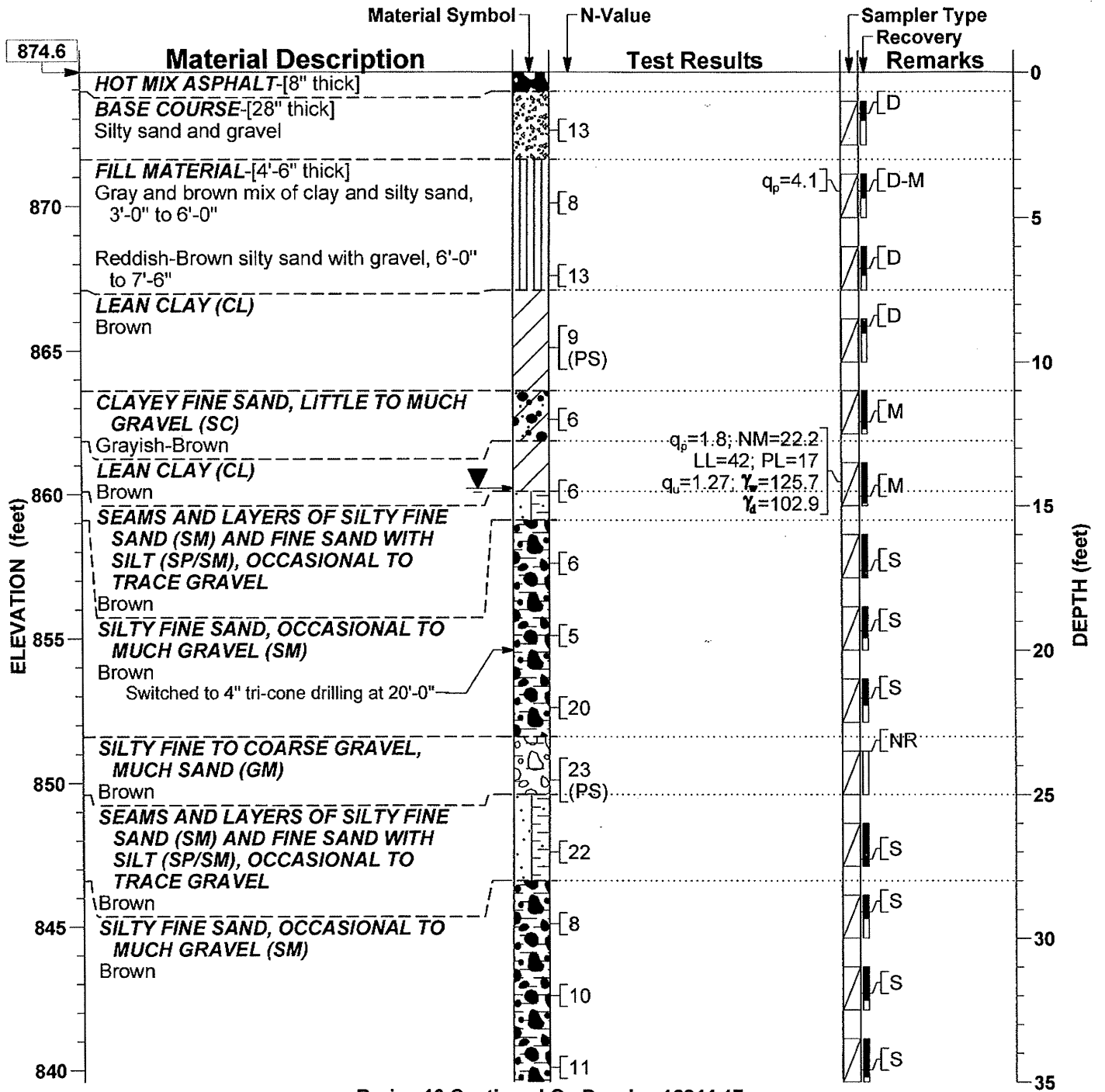
<p>Soils & Engineering Services, Inc. 1102 STEWART STREET • MADISON, WISCONSIN 53713 Phone: 608-274-7600 • 888-866-SOIL (7645) Fax: 608-274-7511 • Email: soils@soils.ws CONSULTING CIVIL ENGINEERS SINCE 1966</p>	<p>SOIL BORING RECORD New Waste Transfer Station Rodefild Landfill 7102 US Highway 12 Dane County, Wisconsin</p>	 DRAWING 12844-13
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Revised on 1/8/2010

Boring 10

Location: (N472719, E853413)

Completed December 11, 2009
Total Depth = 60'-0" (Page 1/2)



Boring 10 Continued On Drawing 12844-17

WATER LEVEL LEGEND

▼ 14'-4³/₄" (estimated)

For Notes and Legend, see Drawing 12844-1.

Soils & Engineering Services, Inc.

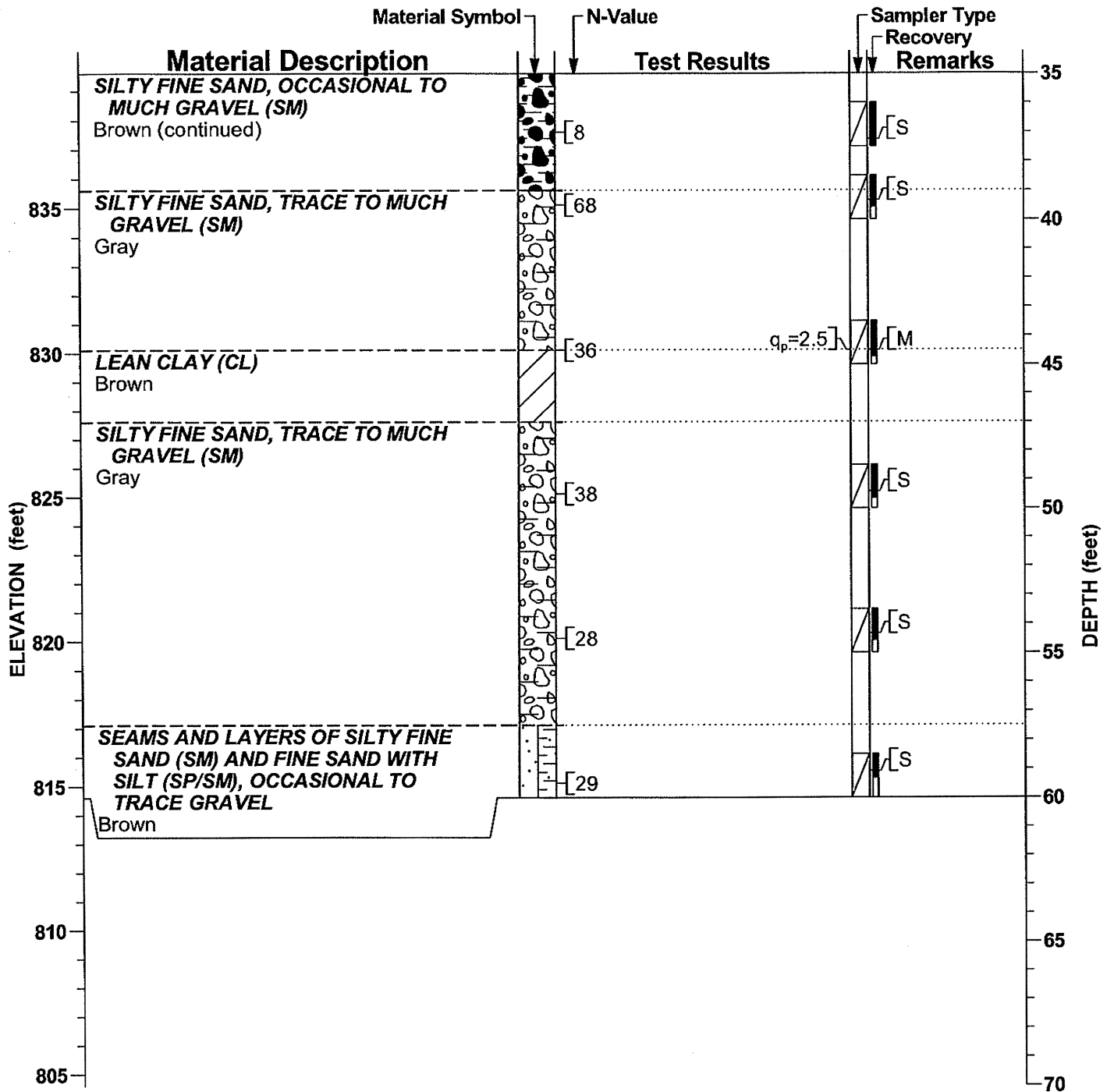
1102 STEWART STREET • MADISON, WISCONSIN 53713
Phone: 608-274-7600 • 888-866-SOIL (7645)
Fax: 608-274-7511 • Email: soils@soils.ws

CONSULTING CIVIL ENGINEERS SINCE 1966


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



DRAWING
12844-16

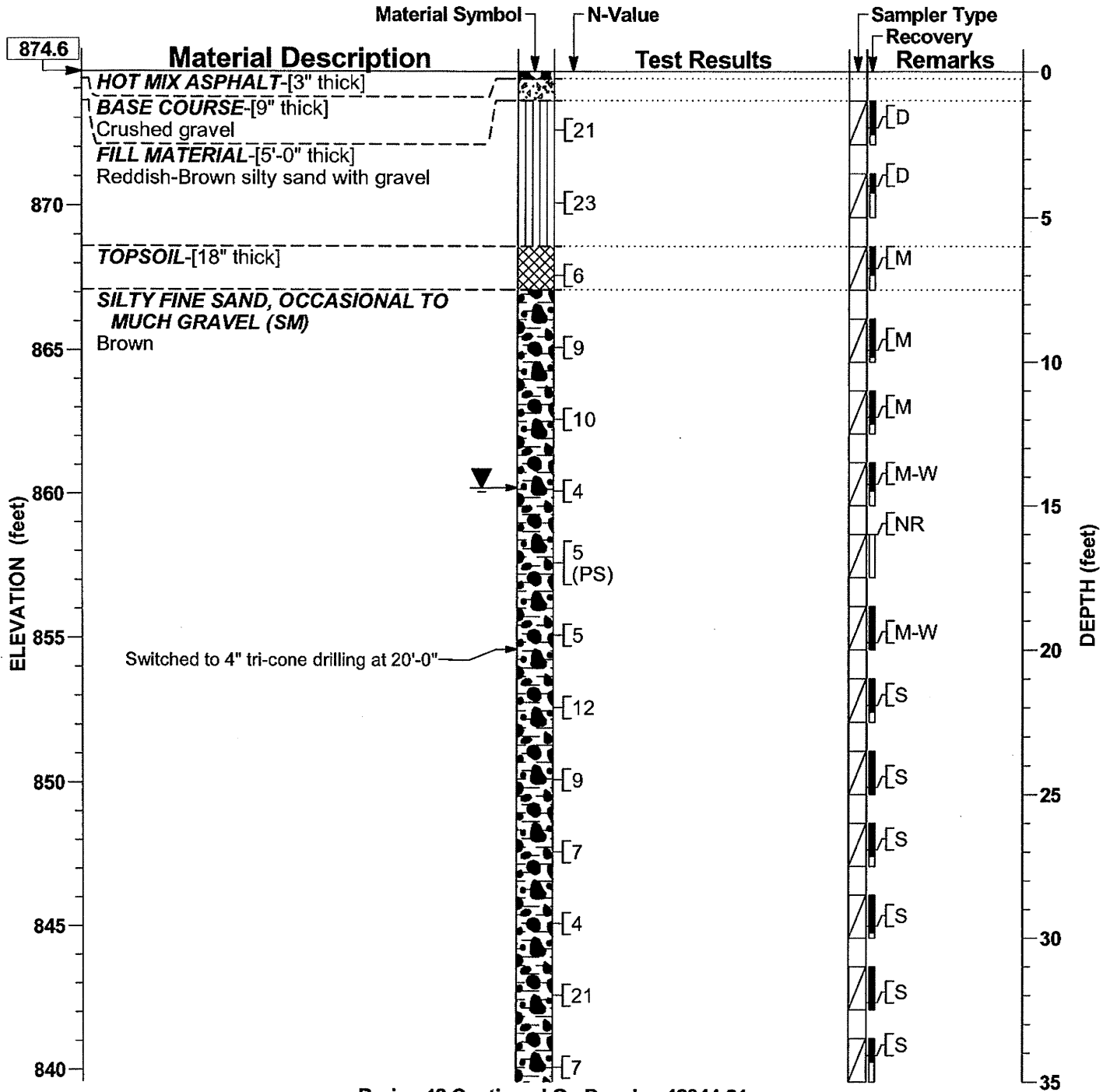


For Notes and Legend, see Drawing 12844-1.

<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: (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.

Soils & Engineering Services, Inc.

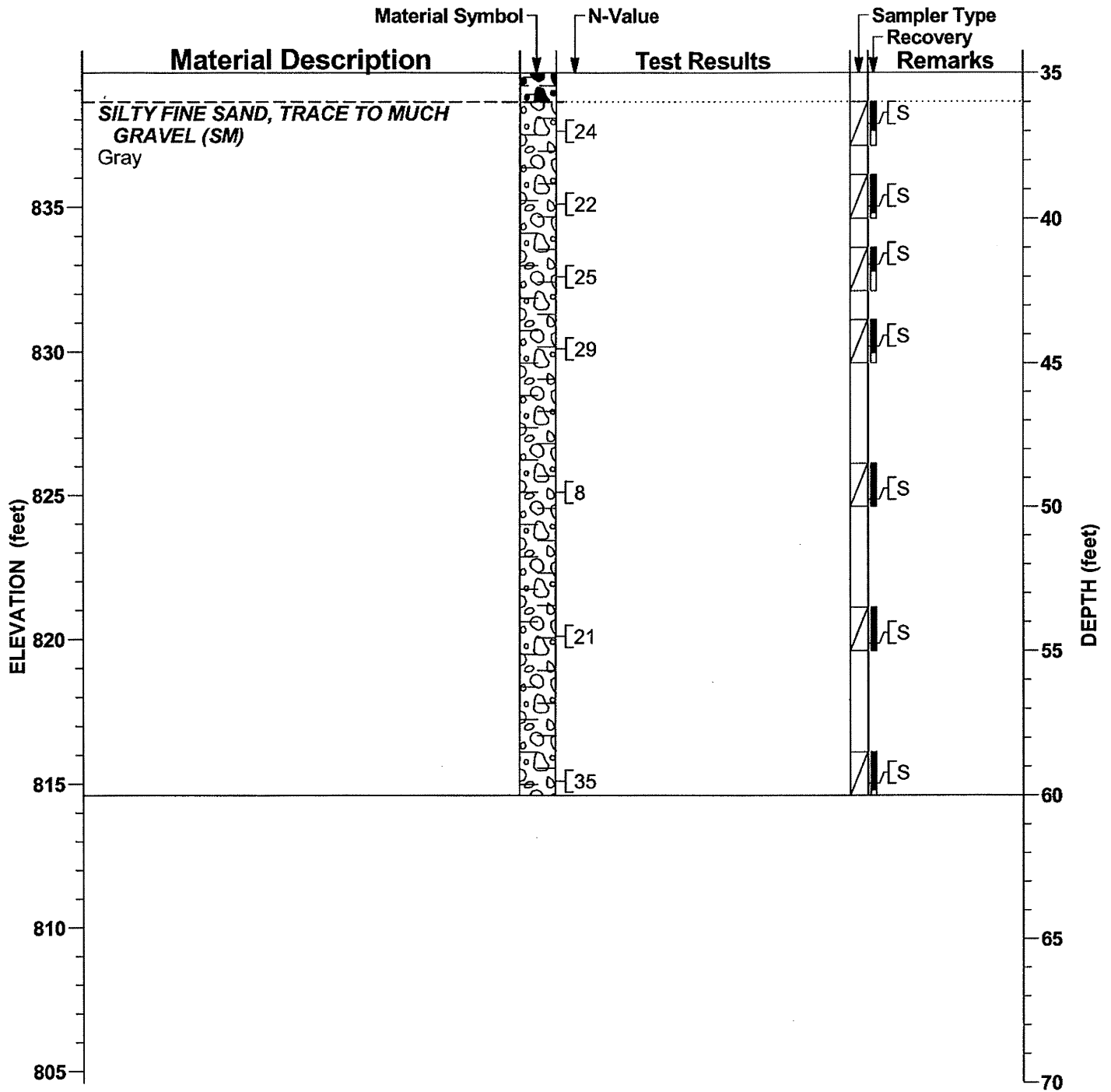
1102 STEWART STREET • MADISON, WISCONSIN 53713
 Phone: 608-274-7600 • 888-866-SOIL (7645)
 Fax: 608-274-7511 • Email: soils@soils.ws

CONSULTING CIVIL ENGINEERS SINCE 1966


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



DRAWING
 12844-20



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 12844-21
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APPENDIX C

DOCUMENT QUALIFICATIONS

APPENDIX C DOCUMENT QUALIFICATIONS

I. GENERAL RECOMMENDATIONS/LIMITATIONS

CGC, Inc. should be provided the opportunity for a general review of the final design and specifications to confirm that earthwork and foundation requirements have been properly interpreted in the design and specifications. CGC should be retained to provide soil engineering services during excavation and subgrade preparation. This will allow us to observe that construction proceeds in compliance with the design concepts, specifications and recommendations, and also will allow design changes to be made in the event that subsurface conditions differ from those anticipated prior to the start of construction. CGC does not assume responsibility for compliance with the recommendations in this report unless we are retained to provide construction testing and observation services.

This report has been prepared in accordance with generally accepted soil and foundation engineering practices and no other warranties are expressed or implied. The opinions and recommendations submitted in this report are based on interpretation of the subsurface information revealed by the test borings indicated on the location plan. The report does not reflect potential variations in subsurface conditions between or beyond these borings. Therefore, variations in soil conditions can be expected between the boring locations and fluctuations of groundwater levels may occur with time. The nature and extent of the variations may not become evident until construction.

II. IMPORTANT INFORMATION ABOUT YOUR GEOTECHNICAL ENGINEERING REPORT

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical engineering study conducted for a civil engineer may not fulfill the needs of a construction contractor or even another civil engineer. Because each geotechnical engineering study is unique, each geotechnical engineering report is unique, prepared *solely* for the client. *No one except you* should rely on your geotechnical engineering report without first conferring with the geotechnical engineer who prepared it. *And no one - not even you* - should apply the report for any purpose or project except the one originally contemplated.

Serious problems have occurred because those relying on a geotechnical engineering report did not read it all. Do not rely on an executive summary. Do not read selected elements only.

A GEOTECHNICAL ENGINEERING REPORT IS BASED ON A UNIQUE SET OF PROJECT-SPECIFIC FACTORS

Geotechnical engineers consider a number of unique, project-specific factors when establishing the scope of a study. Typical factors include: the client's goals, objectives, and risk management preferences; the general nature of the structure involved, its size, and configuration; the location of the structure on the site; and other planned or existing site improvements, such as access roads, parking lots, and underground utilities. Unless the geotechnical engineer who conducted the study specifically indicates otherwise, *do not rely on a geotechnical engineering report* that was:

- not prepared for you,
- not prepared for your project,
- not prepared for the specific site explored, or
- completed before important project changes were made.

Typical changes that can erode the reliability of an existing geotechnical report include those that affect:

- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light industrial plant to a refrigerated warehouse,
- elevation, configuration, location, orientation, or weight of the proposed structure,
- composition of the design team, or project ownership.

As a general rule, , *always* inform your geotechnical engineer of project changes - even minor ones - and request an assessment of their impact. *CGC cannot accept responsibility or liability for problems that occur because our reports do not consider developments of which we were not Informed.*

SUBSURFACE CONDITIONS CAN CHANGE

A geotechnical engineering report is based on conditions that existed at the time the study was performed. *Do not rely on a geotechnical engineering report* whose adequacy may have been affected by: the passage of time; by man-made events, such as construction on or adjacent to the site; or by natural events, such as floods, earthquakes, or groundwater fluctuations. *Always* contact the geotechnical engineer before applying the report to determine if it is still reliable. A minor amount of additional testing or analysis could prevent major problems.

MOST GEOTECHNICAL FINDINGS ARE PROFESSIONAL OPINION

Site exploration identifies subsurface conditions only at those points where surface tests are conducted or samples are taken. Geotechnical engineers review field and laboratory data and then apply their professional judgement to render an opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ - sometimes significantly - from those indicated in your report. Retaining the geotechnical engineer who developed your report to provide construction observation is the most effective method of managing the risks associated with unanticipated conditions.

A REPORT'S RECOMMENDATIONS ARE NOT FINAL

Do not over-rely on the construction recommendations included in your report. *Those recommendations are not final*, because geotechnical engineers develop them principally from judgement and opinion, geotechnical engineers can finalize their recommendations only by observing actual subsurface conditions revealed during construction. *CGC cannot assume responsibility or liability for the report's recommendations if we do not perform construction observation.*

A GEOTECHNICAL ENGINEERING REPORT IS SUBJECT TO MISINTERPRETATION

Other design team members' misinterpretation of geotechnical engineering reports has resulted in costly problems. Lower that risk by having your geotechnical engineer confer with appropriate members of the design team after submitting the report. Also retain your geotechnical engineer to review pertinent elements of the design team's plans and specifications. Contractors can also misinterpret a geotechnical engineering report. Reduce that risk by having CGC participate in prebid and preconstruction conferences, and by providing construction observation.

DO NOT REDRAW THE ENGINEER'S LOGS

Geotechnical engineers prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in a geotechnical engineering report should *never* be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable, *but recognize that separating logs from the report can elevate risk.*

GIVE CONTRACTORS A COMPLETE REPORT AND GUIDANCE

Some owners and design professionals mistakenly believe they can make contractors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give contractors the complete geotechnical engineering report, *but* preface it with a clearly written letter of transmittal. In that letter, advise contractors that the report was not prepared for purposes of bid development and that the report's accuracy is limited; encourage them to confer with the geotechnical engineer who prepared the report (a modest fee may be required) and/or to conduct additional study to obtain the specific types of information they need or prefer. A prebid conference can also be valuable. *Be sure contractors have sufficient time* to perform additional study. Only then might you be in a position to give contractors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

READ RESPONSIBILITY PROVISIONS CLOSELY

Some clients, design professionals, and contractors do not recognize that geotechnical engineering is far less exact than other engineering disciplines. This lack of understanding has created unrealistic expectations that have led to disappointments, claims, and disputes. To help reduce such risks, geotechnical engineers commonly include a variety of explanatory provisions in their reports. Sometimes

labeled "limitations," many of these provisions indicate where geotechnical engineer's responsibilities begin and end, to help others recognize their own responsibilities and risks. Read these provisions closely. Ask questions. Your geotechnical engineer should respond fully and frankly.

GEOENVIRONMENTAL CONCERNS ARE NOT COVERED

The equipment, techniques, and personnel used to perform a *geoenvironmental* study differ significantly from those used to perform a *geotechnical* study. For that reason, a geotechnical engineering report does not usually relate any geoenvironmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated environmental problems have led to numerous project failures.* If you have not yet obtained your own geoenvironmental information, ask your geotechnical consultant for risk management guidance. *Do not rely on an environmental report prepared for someone else.*

OBTAIN PROFESSIONAL ASSISTANCE TO DEAL WITH MOLD

Diverse strategies can be applied during building design, construction, operation, and maintenance to prevent significant amounts of mold from growing on indoor surfaces. To be effective, all such strategies should be devised for the *express purpose* of mold prevention, integrated into a comprehensive plan, and executed with diligent oversight by a professional mold prevention consultant. Because just a small amount of water or moisture can lead to the development of severe mold infestations, a number of mold prevention strategies focus on keeping building surfaces dry. While groundwater, water infiltration, and similar issues may have been addressed as part of the geotechnical engineering study whose findings are conveyed in this report, the geotechnical engineer in charge of this project is not a mold prevention consultant; *none of the services performed in connection with the geotechnical engineer's study were designed or conducted for the purpose of mold prevention. Proper implementation of the recommendations conveyed in this report will not of itself be sufficient to prevent mold from growing in or on the structure involved.*

RELY ON YOUR GEOTECHNICAL ENGINEER FOR ADDITIONAL ASSISTANCE

Membership in ASFE exposes geotechnical engineers to a wide array of risk management techniques that can be of genuine benefit for everyone involved with a construction project. Confer with CGC, a member of ASFE, for more information.

Modified and reprinted with permission from:

ASFE/The Best People on Earth
881 Colesville Road, Suite G 106
Silver Spring, MD 20910

APPENDIX D

RECOMMENDED COMPACTED FILL SPECIFICATIONS

APPENDIX D

CGC, INC.

RECOMMENDED COMPACTED FILL SPECIFICATIONS

General Fill Materials

Proposed fill shall contain no vegetation, roots, topsoil, peat, ash, wood or any other non-soil material which by decomposition might cause settlement. Also, fill shall never be placed while frozen or on frozen surfaces. Rock, stone or broken concrete greater than 6 in. in the largest dimension shall not be placed within 10 ft of the building area. Fill used greater than 10 ft beyond the building limits shall not contain rock, boulders or concrete pieces greater than a 2 sq ft area and shall not be placed within the final 2 ft of finish subgrade or in designated utility construction areas. Fill containing rock, boulders or concrete pieces should include sufficient finer material to fill voids among the larger fragments.

Special Fill Materials

In certain cases, special fill materials may be required for specific purposes, such as stabilizing subgrades, backfilling undercut excavations or filling behind retaining walls. For reference, WisDOT gradation specifications for various types of granular fill are attached in Table 1.

Placement Method

The approved fill shall be placed, spread and leveled in layers generally not exceeding 10 in. in thickness before compaction. The fill shall be placed at moisture content capable of achieving the desired compaction level. For clay soils or granular soils containing an appreciable amount of cohesive fines, moisture conditioning will likely be required.

It is the Contractor's responsibility to provide all necessary compaction equipment and other grading equipment that may be required to attain the specified compaction. Hand-guided vibratory or tamping compactors will be required whenever fill is placed adjacent to walls, footings, columns or in confined areas.

Compaction Specifications

Maximum dry density and optimum moisture content of the fill soil shall be determined in accordance with modified Proctor methods (ASTM D1557). The recommended field compaction as a percentage of the maximum dry density is shown in Table 2. Note that these compaction guidelines would generally not apply to coarse gravel/stone fill. Instead, a method specification would apply (e.g., compact in thin lifts with a vibratory compactor until no further consolidation is evident).

Testing Procedures

Representative samples of proposed fill shall be submitted to CGC, Inc. for optimum moisture-maximum density determination (ASTM D1557) prior to the start of fill placement. The sample size should be approximately 50 lb.

CGC, Inc. shall be retained to perform field density tests to determine the level of compaction being achieved in the fill. The tests shall generally be conducted on each lift at the beginning of fill placement and at a frequency mutually agreed upon by the project team for the remainder of the project.

**Table 1
Gradation of Special Fill Materials**

Material	WisDOT Section 311	WisDOT Section 312	WisDOT Section 305			WisDOT Section 209		WisDOT Section 210
	Breaker Run	Select Crushed Material	3-in. Dense Graded Base	1 1/4-in. Dense Graded Base	3/4-in. Dense Graded Base	Grade 1 Granular Backfill	Grade 2 Granular Backfill	Structure Backfill
Sieve Size	Percent Passing by Weight							
6 in.	100							
5 in.		90-100						
3 in.			90-100					100
1 1/2 in.		20-50	60-85					
1 1/4 in.				95-100				
1 in.					100			
3/4 in.			40-65	70-93	95-100			
3/8 in.				42-80	50-90			
No. 4			15-40	25-63	35-70	100 (2)	100 (2)	25-100
No. 10		0-10	10-30	16-48	15-55	75 (2)		
No. 40			5-20	8-28	10-35	15 (2)	30 (2)	
No. 200			2-12	2-12	5-15	8 (2)	15 (2)	15 (2)

Notes:

1. Reference: Wisconsin Department of Transportation *Standard Specifications for Highway and Structure Construction*.
2. Percentage applies to the material passing the No. 4 sieve, not the entire sample.
3. Per WisDOT specifications, both breaker run and select crushed material can include concrete that is 'substantially free of steel, building materials and other deleterious material'.

**Table 2
Compaction Guidelines**

Area	Percent Compaction (1)	
	Clay/Silt	Sand/Gravel
<u>Within 10 ft of building lines</u>		
Footing bearing soils	93 - 95	95
Under floors, steps and walks		
- Lightly loaded floor slab	90	90
- Heavily loaded floor slab and thicker fill zones	92	95
<u>Beyond 10 ft of building lines</u>		
Under walks and pavements		
- Less than 3 ft below subgrade	92	95
- Greater than 3 ft below subgrade	90	90
Landscaping	85	90

Notes:

1. Based on Modified Proctor Dry Density (ASTM D 1557)

Name of Bidding Firm: _____

BID FORM

BID NO. 315011

**PROJECT: CONSTRUCT C&D MATERIALS RECOVERY FACILITY
DANE COUNTY LANDFILL SITE #2**

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

BASE BID - LUMP SUM:

Construction of a Material Recovery (Recycling) Facility for construction and demolition waste. The project includes a pre-engineered metal building addition of approximately 7,500 square feet, renovation of existing building to add sorting bunkers, restrooms, concrete work, and associated civil/site, HVAC, electrical, plumbing/fire protection, hydronic heat, and utility work. 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

BASE BID LUMP SUM BREAKDOWN

ITEM	DESCRIPTION	UNITS	SCHEDULE OF VALUE PRICE
1	Mobilization	LS	\$
2	Selective Demolition	LS	\$
3	Erosion Control	LS	\$
4	Earthwork and Utilities	LS	\$
5	Concrete	LS	\$
6	Asphalt	LS	\$
7	Metals	LS	\$
8	Wood, Plastic, and Composites	LS	\$
9	Thermal and Moisture Protection	LS	\$
10	Doors and Windows	LS	\$
11	Finishes	LS	\$
12	Specialties	LS	\$
13	Pre-engineered Metal Building	LS	\$
13	Fire Protection	LS	\$
14	Plumbing	LS	\$
15	HVAC	LS	\$
16	Electrical	LS	\$

17	Restoration	LS	\$
	TOTAL BASE BID	LS	\$

The undersigned 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, as stipulated below.

ALTERNATE BID ITEMS - LUMP SUM:

ALTERNATE BID ITEM 1: HANGAR DOOR AND LOUVERS - LUMP SUM:

Add price for providing horizontal sliding hangar door and providing four louvers in the building addition as described in the plans and specifications.

_____ and _____ /100 Dollars
 Written Price

\$ _____
 Numeric Price (Add)

ALTERNATE BID ITEM 2: LED LIGHTING - LUMP SUM:

Add price for substituting LED lighting fixtures in place of metal halide fixtures in the high bay area as described in the plans and specifications.

_____ and _____ /100 Dollars
 Written Price

\$ _____
 Numeric Price (Add)

ALTERNATE BID ITEM 3: OVERHEAD CRANE SYSTEM - LUMP SUM:

Add price for providing a 3 ton overhead crane system (including crane, mono-rail, and guard railing) as described in the plans and specifications.

_____ and _____ /100 Dollars
 Written Price

\$ _____
 Numeric Price (Add)

ALTERNATE BID ITEM 4A: INCREASE WOOD GRINDER FEEDER - LUMP SUM:

Add price for increasing the 350 HP wood grinder and motor feeder to a 500 HP grinder and motor feeder as described in the plans and specifications.

_____ and _____ /100 Dollars
 Written Price

\$ _____
 Numeric Price (Add)

ALTERNATE BID ITEM 4B: INCREASE WOOD GRINDER FEEDER - LUMP SUM:

Add price for increasing the 350 HP wood grinder and motor feeder to a 700 HP grinder and motor feeder as described in the plans and specifications.

_____ and _____ /100 Dollars
Written Price

\$ _____
Numeric Price (Add)

ALTERNATE BID ITEM 5: BUNKER WALLS WITHOUT STEEL LINER - LUMP SUM:

Deduct price for eliminating steel liners on bunker walls under the sorting platform as described in the plans and specifications.

_____ and _____ /100 Dollars
Written Price

\$ _____
Numeric Price (Deduct)

ALTERNATE BID ITEM 6: ELECTRICAL SERVICE SIZE REDUCTION - LUMP SUM:

Deduct price for reducing the new electrical service size from 2,500 amp, 480 volt, 3 phase to 2,000 amp, 480 volt, 3 phase as described in the plans and specifications.

_____ and _____ /100 Dollars
Written Price

\$ _____
Numeric Price (Deduct)

DIRECT PURCHASE OF MATERIALS & EQUIPMENT BY COUNTY:

The amount of materials and equipment that individually exceeds Five Thousand Dollars (\$5,000), to be purchased by the County that is included in the above base price (including tax).

Direct Owner Purchase Value:

_____ and _____ /100 Dollars
Written Price

\$ _____
Numeric Price

UNIT PRICES:

Should more or less work of the following categories be required, adjustment will be made to the contract sum at the following unit prices, which shall include all expenses, transportation, trucking, restocking charges and overhead profit.

UNIT PRICE 1: REMOVAL OF UNSUITABLE SOIL:

Provide price per cubic yard for the removal of unsuitable soil where soil testing agency has determined existing conditions are insufficient for the purposes of the project. Price per cubic yard shall include cutting, loading, and hauling to adjacent landfill. Volume will be measured jointly in the field by Engineer or Owner and Contractor. Refer to section 31 20 00 Excavating, Backfilling and Compaction.

- 700 cubic yards or less: @ \$ _____/cu.yd.
- 700 cubic yards or greater: @ \$ _____/cu.yd.

UNIT PRICE 2: PROVIDE 3” DENSE GRADED BASE MATERIAL:

Provide price per cubic yard for providing, placing and compacting 3” dense graded base coarse material to stabilize a soft subgrade in accordance with the project specifications. Furnish and Install Coarse Aggregate Material will be measured based on weight determined by quarry scale or site scale. Refer to section 31 20 00 Excavating, Backfilling and Compaction..

- 270 cubic yards or less: @ \$ _____/cu.yd.
- 270 cubic yards or greater: @ \$ _____/cu.yd.

ADDENDA:

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

Addendum No(s). _____ through _____

Dated _____

COMPLETION:

Dane County Department of Public Works, Highways, & Transportation / Solid Waste Division must have this project completed no later than December 31, 2015. Assuming this Work can be started by June 30, 2015, 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 Bids Due Date to another bidder or competitor; that the above statement is accurate under penalty of perjury.

The undersigned further agrees to honor the Base Bid and the Alternate Bid(s) for ninety (90) days from date of Award of Contract.

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 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.countyofdane.com/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. Equal Benefits Compliance Payment Certification shall be submitted with final pay request. For more information:

www.danepurchasing.com/partner_benefit.aspx

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 a submitted a bid, application or proposal for a contract or agreement 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.nlrb.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.

Include this completed Certification with your bid, application or proposal.

COUNTY OF DANE

PUBLIC WORKS CONSTRUCTION CONTRACT

Contract No. _____ Bid No. 315011

Authority: 2015 RES - _____

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 Assistant Public Works Director, 1919 Alliant Energy Center Way, Madison, WI 53713, desires to have CONTRACTOR provide Construction of C&D Material Recovery Facility at Dane County Landfill Site #2, 7102 U.S. Highway 12 & 18, Madison, WI, including Alternate Bid(s) #1-3 (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 SCS Engineers, Inc. (hereinafter referred to as "the Architect / Engineer"), and as enumerated in the Project Manual Table of Contents, 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 H, 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 Assistant Public Works Director.

FOR COUNTY:

Joseph T. Parisi, County Executive Date

Scott McDonell, County Clerk Date

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)
(Witness)
ATTORNEY-IN-FACT

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:

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:

EQUAL BENEFITS COMPLIANCE PAYMENT CERTIFICATION

PURPOSE

25.016(8) of the Dane County Ordinance requires that each contractor receiving payment for contracted services must certify that he or she has complied fully with the requirements of Chapter 25.016 “Equal Benefits Requirement” of the Dane County Ordinances. Such certification must be submitted prior to the final payment on the contract.

This form should be included with a copy of the final contract invoice forwarded to your contract representative at Dane County.

CERTIFICATION

I, _____ certify that
Printed or Typed Name and Title

Printed or Typed Name of Contractor

has complied fully with the requirements of Chapter 25.016 of the Dane County Ordinances “Equal Benefits Requirements”.

Signed _____

Date _____

For questions on this form, please contact Chuck Hicklin at 608-266-4109 or your contract representative at Dane County.

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 Manager 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 Manager is appointed by and responsible to Department. Public Works Project Manager 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 Manager is responsible for supervision, administration and management of field operations involved in construction phase of this Work.
 - 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. Unless otherwise specified, Contractor shall submit three (3) copies of all Shop Drawings for each submission, until receiving final approval. After final approval, provide five (5) additional copies for distribution and such other copies as may be required.

- B. Contractor shall submit, on an on-going basis and as directed, Product Data such as brochures that shall contain catalog cuts and specifications of all furnished mechanical and electrical equipment. After Architect / Engineer's approval, one (1) copy shall remain in Architect / Engineer's file, one (1) kept at Department's office and one (1) kept at job site by Contractor for reference purposes.
- C. Samples shall consist of physical examples furnished by Contractor in sufficient size and quantity to illustrate materials, equipment or workmanship, and to establish standards to compare the Work.
 - 1. Submit Samples in sufficient quantity (minimum of two (2)) to permit Architect / Engineer to make all necessary tests and of adequate size showing quality, type, color range, finish, and texture. Label each Sample stating material, type, color, thickness, size, project name, and Contractor's name.
 - 2. Submit transmittal letter requesting approval, and prepay transportation charges to Architect / Engineer's office on samples forwarded.
 - 3. Materials installed shall match approved Samples.
- D. Contractor shall review Shop Drawings and place their dated stamp thereon to evidence their review and approval and shall submit with reasonable promptness and in orderly sequence to cause no delay in the Work or in work of any other contractor. At time of submission, Contractor shall inform Architect / Engineer in writing of any deviation in Shop Drawings or Samples from requirements of Construction Documents. Architect / Engineer will not consider partial lists.
- E. Architect / Engineer will review and approve or reject Shop Drawings with reasonable promptness to cause no delay. Architect / Engineer's approval shall not relieve Contractor from responsibility for errors or omissions in Shop Drawings.
- F. 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.
- G. Contractor shall keep on site of the Work, approved or conformed copy of Shop Drawings and shall at all times give Department access thereto.
- H. By stamping and submitting Shop Drawings, Product Data and Samples, Contractor thereby represents that he or she has or will determine and verify all field measurements, field construction criteria, materials, catalog numbers, and similar data and that he or she has checked and coordinated each Shop Drawing, Product Data and Sample with requirements of the Work and of Construction Documents. Architect / Engineer shall return without examination, Shop Drawings, Product Data and Samples not so noted.
- I. All Shop Drawings from any one Contractor should be numbered consecutively and on cover sheet shall bear name and location of project, name of Contractor, date of submittal and date of each correction or revision and associated Specification section and page number.

5. CUTTING AND PATCHING

- A. 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. 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 maintain streets and sidewalks around the Work site in clean condition. 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.

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 Manager.
- 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 Manager 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 is 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. Authorized representatives and agents of County government shall have access at all times to the Work wherever it is in preparation or progress and Contractor shall provide facilities for such access and for inspection.
- 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. If Specifications, Architect / Engineer's, or Public Works Project Manager's instructions require any work to be specially tested or approved, Contractor shall give Architect / Engineer and Public Works Project Manager timely notice of its readiness for testing or inspection. Test all materials and equipment requiring testing in accordance with accepted or specified standards, as applicable. Architect / Engineer shall recommend laboratory or inspection agency and Department will select and pay for all initial laboratory inspection services. Should retesting be required, due to failure of initial testing, cost of such retesting shall be borne by Contractor.
- D. 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 Manager 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 by one of these methods:
1. Unit bid prices previously approved.
 2. Agreed lump sum based on actual cost of:
 - a) Labor, including foremen, and all fringe benefits that are associated with their wages.
 - b) Materials entering permanently into the Work.
 - c) Ownership or rental cost of construction tools and equipment during time of use on extra work.
 - d) Power and consumable supplies for operation of power equipment.
 - e) Workmen's Compensation Insurance, Contractor's Public Liability and Property Damage Insurance, and Comprehensive Automobile Liability Insurance.
 - f) Social Security and old age and unemployment contributions.
 - g) Add to cost under (2), fixed fee to be agreed upon, but not to exceed fifteen percent (15%) of actual cost of work performed with their own labor force. Fee shall be compensation to cover cost of supervision, overhead, bond, profit and any other general expense.
 - h) On that portion of the Work under (2) done under subcontract, Contractor may include not over seven and one-half percent (7½%) for supervision, overhead, bond, profit and any other general expense.
 - i) Department may require correct amount of costs with supporting vouchers; Contractor shall keep and present in such form as directed.
 3. Cost-plus work, with not-to-exceed dollar limit, based on actual cost of:
 - a) Labor, including foremen, and all fringe benefits that are associated with their wages.
 - b) Materials entering permanently into the Work.
 - c) Ownership or rental cost of construction tools and equipment during time of use on extra work. Rental cost cannot exceed fifty percent (50%) replacement value of rented equipment.
 - d) Power and consumable supplies for operation of power equipment.
 - e) Workmen's Compensation Insurance, Contractor's Public Liability and Property Damage Insurance, and Comprehensive Automobile Liability Insurance.
 - f) Social Security and old age and unemployment contributions.
 - g) To cost under (3), there shall be added fixed fee to be agreed upon but not to exceed fifteen percent (15%) of actual cost of work performed with their own labor force. Fee shall be compensation to cover cost of supervision, overhead, bond, profit, and any other general expense.
 - h) On that portion of the Work under (3) done under subcontract, Contractor may include not over seven and one-half percent (7½%) for supervision, overhead, bond, profit, and any other general expense.
 - i) Contractor shall keep and present, in such form as directed, correct amount of cost together with such supporting vouchers as may be required by Department.
- 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 Manager 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 Manager 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 Manager's approval they shall be reconstructed, made good, replaced or corrected, by Contractor at Contractor's expense. Immediately remove all rejected material from site.
- B. 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 Manager 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. Immediately after execution and delivery of Contract and before making first payment, Contractor shall notify all subcontractors to furnish all required information to develop Construction Schedule. Contractor and all subcontractors associated with the Work shall furnish following information from each Division of Specifications:
 - 1. List of construction activities;
 - 2. Start, finish and time required for completion of each activity;
 - 3. Sequential relationships between activities;
 - 4. Identify all long lead-time items, key events, meetings or activities such as required submittals, fabrication and delivery, procurement of materials, installation and testing;
 - 5. Weekly definition of extent of work and areas of activity for each trade or Subcontract; and
 - 6. Other information as determined by Public Works Project Manager.
- B. In addition to above requested items, 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. Progress Reporting:
 - 1. Contractor shall update and publish Construction Schedule on monthly basis. Revisions to Schedule shall be by Contractor and made in same detail as original Schedule and accompanied by explanation of reasons for revision; and shall be subject to approval by Department.
 - 2. 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.
 - 3. Contractor shall submit show actual percentage of each activity completed, estimated future progress, and anticipated completion time.
- 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 labor 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 Manager.
- 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 Manager.

25. PAYMENTS TO CONTRACTOR

- A. Contractor shall provide:
1. Detailed estimate giving complete breakdown of contract price by Specification Division; and
 2. Periodic itemized estimates of work done for purpose of making partial payments thereon.
- Submit these estimates for approval first to Architect / Engineer, then to Public Works Project Manager. Costs employed in making up any of these schedules are for determining basis of partial payments and not considered as fixing basis for additions to or deductions from Contract price.
- 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. Contractor shall submit for approval first to Architect / Engineer, and then to Public Works Project Manager all Application and Certificate for Payment forms. If requested, Application and Certificate for Payment shall be supported by such additional evidence as may be required, showing Contractor's right to payment claimed.
- D. 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.
- E. Payments by County will be due within forty-five (45) days after receipt by Department of Application and Certificate for Payment.

- F. 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, any time 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 Manager find that progress of the Work corresponds with Construction Schedule. If Architect / Engineer and Public Works Project Manager 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.
- G. 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.
- H. County will make final payment within sixty (60) days after final completion of the Work, and will constitute acceptance thereof. Submit Equal Benefits Compliance Payment Certification with final pay request. Payment may be denied if Certification is not included.
- I. 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.
- J. 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, workers, 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, 43 and 47, 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 MANAGER'S AUTHORITY

- A. Public Works Project Manager 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 Manager.

36. STATED ALLOWANCES

- A. Not Applicable

37. 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".

38. 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.

39. 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 Manager.
- 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.

40. 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.

41. 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.

42. 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.

43. 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 affect 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.

44. 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."

45. 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.

46. 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 Manager, 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.

47. 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, worker 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.

48. CLAIMS

- A. No claim may be made until Department's Assistant 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 Assistant Public Works Director the 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.

49. 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.

50. 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.


51. 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. 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 Public Works Project Manager for approval.


AIA Document G702™ – 1992

Application and Certificate for Payment

TO OWNER:	PROJECT:	APPLICATION NO.:	Distribution to:
		PERIOD TO:	OWNER <input type="checkbox"/>
FROM CONTRACTOR:	VIA ARCHITECT:	CONTRACT FOR:	ARCHITECT <input type="checkbox"/>
		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 + 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 now due.

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

CHANGE ORDER SUMMARY

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

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.

AMOUNT CERTIFIED \$ _____
(Attach explanation if amount certified differs from the amount applied. Initial 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.

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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 I on Contracts where variable retainage for line items may apply.

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

A LINE NO.	B DESCRIPTION OF WORK	C SCHEDULED VALUE	D WORK COMPLETED		F MATERIALS PRESENTLY STORED ON-SITE (D-OR E)	G TOTAL COMPLETED AND STORED TO DATE (D+A-F)	H % (G ÷ C)	I BALANCE TO FINISH (C - G)	J RETAINAGE (BY VARIABLE RATE)
			D FROM PREVIOUS APPLICATION (D + E)	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, 1983 and 1992 by The American Institute of Architects. All rights reserved. (AIA/Redline). 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 for 100 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 47, “Minimum Wages”, paragraph B. Following Prevailing Wage Rate Determination No. 201501188 is 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. Disclosure of Ownership (ERD-7777)
 - 2. Prime Contractor Affidavit of Compliance With Prevailing Wage Rate Determination (ERD-5724)
 - 3. List of Agents and Subcontractors (Page 2 - ERD-5724)
 - 4. Agent or Subcontractor Affidavit of Compliance With Prevailing Wage Rate Determination (ERD-10584)
 - 5. List of Agents and Subcontractors (Page 2 - ERD-10584)
 - 6. Request To Employ Subjourneyperson (ERD-10880)

- C. At a minimum, these wage rates must be displayed in a place where all workers can access them, but not inside the job trailer. If this isn't easily done based on job conditions, the State requires they be displayed at a library or other public building.

State of Wisconsin Department of Workforce Development Equal Rights Division	DEPARTMENTAL ORDER
ISSUE DATE: 4/1/2015	
PROJECT:	
CONSTRUCT C&D MATERIAL RECOVERY FACILITY MADISON CITY, DANE COUNTY, WI Determination No. 201501188 [Owner Project No. RFB NO. 315011]	
PROJECT OWNER:	REQUESTER:
JOHN WELCH, RECYCLING MANAGER / PROJECT MANAGER DANE COUNTY 1919 ALLIANT ENERGY CTR WAY MADISON, WI 53713	MIKE RUIPER, SPECIAL PROJECTS MANAGER DANE COUNTY PUBLIC WORKS 1919 ALLIANT ENERGY CENTER WAY MADISON, WI 53713
ADDITIONAL CONTACT:	NOTE: The Requester must provide a copy of this Project Determination and enclosures to the Project Owner and Additional Contact.
<p>The department received an application for prevailing wage rate determination for the above-captioned project. The department conducted a survey to determine the prevailing wage rate for the trade(s) or occupation(s) needed to complete the project. The survey's findings appear in the attached project determination.</p> <p>If you believe that the wage rate for any trade or occupation does not accurately reflect the prevailing wage rate in the city, village or town where the project is located, you may ask the department to conduct an administrative review of such wage rate. You must submit this request in writing within 30 days from the date indicated above. Additionally, your request must include wage rate information from at least three similar projects in the city, village or town where the proposed project is located and on which some work has been performed by the contested trade(s) during the current survey period and was previously considered by the department in issuing the attached determination. See DWD 290.10 of the Wisconsin Administrative Code and either s. 66.0903(3)(br), Stats., or s. 103.49(3)(c), Stats., for a complete explanation of the administrative review process.</p> <p>Enclosures</p>	
<p>It is hereby ordered that the prevailing wage rates set forth in the attached project determination shall only be applicable to the above referenced project. This order is a FINAL ORDER of the department unless a timely request for an administrative review is filed with the department.</p> <p>ISSUED BY:</p> <p style="text-align: center;"> Equal Rights Division Labor Standards Bureau Construction Wage Standards Section P.O. Box 8928, Madison, WI 53708-8928 (608)266-6861 </p> <p style="text-align: center;"> Web Site: http://dwd.wisconsin.gov/er/ </p>	

PREVAILING WAGE RATE DETERMINATION

Issued by the State of Wisconsin
Department of Workforce Development
Pursuant to s. 66.0903, Wis. Stats.
Issued On: 4/1/2015

DETERMINATION NUMBER: 201501188

EXPIRATION DATE: Prime Contracts MUST Be Awarded or Negotiated On Or Before 12/31/2015. If NOT, You MUST Reapply.

PROJECT NAME: CONSTRUCT C&D MATERIAL RECOVERY FACILITY
PROJECT NO: RFB NO. 315011

PROJECT LOCATION: MADISON CITY, DANE COUNTY, WI

CONTRACTING AGENCY: DANE COUNTY

CLASSIFICATION:	Contractors are responsible for correctly classifying their workers. Either call the Department of Workforce Development (DWD) with trade or classification questions or consult DWD's Dictionary of Occupational Classifications & Work Descriptions on the DWD website at: dwd.wisconsin.gov/er/prevailing_wage_rate/Dictionary/dictionary_main.htm .
OVERTIME:	<p>Time and one-half must be paid for all hours worked:</p> <ul style="list-style-type: none">- over 10 hours per day on prevailing wage projects- over 40 hours per calendar week- Saturday and Sunday- on all of the following holidays: January 1; the last Monday in May; July 4; the 1st Monday in September; the 4th Thursday in November; December 25;- The day before if January 1, July 4 or December 25 falls on a Saturday;- The day following if January 1, July 4 or December 25 falls on a Sunday. <p>Apply the time and one-half overtime calculation to whichever is higher between the Hourly Basic Rate listed on this project determination or the employee's regular hourly rate of pay. Add any applicable Premium or DOT Premium to the Hourly Basic Rate before calculating overtime.</p> <p>A DOT Premium (discussed below) may supersede this time and one-half requirement.</p>
FUTURE INCREASE:	When a specific trade or occupation requires a future increase, you MUST add the full hourly increase to the "TOTAL" on the effective date(s) indicated for the specific trade or occupation.
PREMIUM PAY:	If indicated for a specific trade or occupation, the full amount of such pay MUST be added to the "HOURLY BASIC RATE OF PAY" indicated for such trade or occupation, whenever such pay is applicable.
DOT PREMIUM:	This premium only applies to highway and bridge projects owned by the Wisconsin Department of Transportation and to the project type heading "Airport Pavement or State Highway Construction." DO NOT apply the premium calculation under any other project type on this determination.
APPRENTICES:	Pay apprentices a percentage of the applicable journey person's hourly basic rate of pay and hourly fringe benefit contributions specified in this determination. Obtain the appropriate percentage from each apprentice's contract or indenture.
SUBJOURNEY:	Subjourney wage rates may be available for some of the trades or occupations indicated below with the exception of laborers, truck drivers and heavy equipment operators. Any employer interested in using a subjourney classification on this project MUST complete Form ERD-10880 and request the applicable wage rate from the Department of Workforce Development PRIOR to using the subjourney worker on this project.

This document **MUST BE POSTED** by the **CONTRACTING AGENCY** in at least one conspicuous and easily accessible place **on the site of the project**. A local governmental unit may post this document at the place normally used to post public notices if there is no common site on the project. This document **MUST** remain posted during the entire time any worker is employed on the project and **MUST** be physically incorporated into the specifications and all contracts and subcontracts. If you have any questions, please write to the Equal Rights Division, Labor Standards Bureau, P.O. Box 8928, Madison, Wisconsin 53708 or call (608) 266-6861.

The following statutory provisions apply to local governmental unit projects of public works and are set forth below pursuant to the requirements of s. 66.0903(8), Stats.

s. 66.0903 (1) (f) & s. 103.49 (1) (c) "PREVAILING HOURS OF LABOR" for any trade or occupation in any area means 10 hours per day and 40 hours per week and may not include any hours worked on a Saturday or Sunday or on any of the following holidays:

1. January 1.
2. The last Monday in May.
3. July 4.
4. The first Monday in September.
5. The 4th Thursday in November.
6. December 25.
7. The day before if January 1, July 4 or December 25 falls on a Saturday.
8. The day following if January 1, July 4 or December 25 falls on a Sunday.

s. 66.0903 (10) RECORDS; INSPECTION; ENFORCEMENT.

(a) Each contractor, subcontractor, or contractor's or subcontractor's agent performing work on a project of public works that is subject to this section shall keep full and accurate records clearly indicating the name and trade or occupation of every person performing the work described in sub. (4) and an accurate record of the number of hours worked by each of those persons and the actual wages paid for the hours worked.

s. 66.0903 (11) LIABILITY AND PENALTIES.

(a) 1. Any contractor, subcontractor, or contractor's or subcontractor's agent who fails to pay the prevailing wage rate determined by the department under sub. (3) or who pays less than 1.5 times the hourly basic rate of pay for all hours worked in excess of the prevailing hours of labor is liable to any affected employee in the amount of his or her unpaid wages or his or her unpaid overtime compensation and in an additional amount as liquidated damages as provided under subd. 2., 3., whichever is applicable.

2. If the department determines upon inspection under sub. (10) (b) or (c) that a contractor, subcontractor, or contractor's or subcontractor's agent has failed to pay the prevailing wage rate determined by the department under sub. (3) or has paid less than 1.5 times the hourly basic rate of pay for all hours worked in excess of the prevailing hours of labor, the department shall order the contractor to pay to any affected employee the amount of his or her unpaid wages or his or her unpaid overtime compensation and an additional amount equal to 100 percent of the amount of those unpaid wages or that unpaid overtime compensation as liquidated damages within a period specified by the department in the order.

3. In addition to or in lieu of recovering the liability specified in subd. 1. as provided in subd. 2., any employee for and in behalf of that employee and other employees similarly situated may commence an action to recover that liability in any court of competent jurisdiction. If the court finds that a contractor, subcontractor, or contractor's or subcontractor's agent has failed to pay the prevailing wage rate determined by the department under sub. (3) or has paid less than 1.5 times the hourly basic rate of pay for all hours worked in excess of the prevailing hours of labor, the court shall order the contractor, subcontractor, or agent to pay to any affected employee the amount of his or her unpaid wages or his or her unpaid overtime compensation and an additional amount equal to 100 percent of the amount of those unpaid wages or that unpaid overtime compensation as liquidated damages.

5. No employee may be a party plaintiff to an action under subd. 3. unless the employee consents in writing to become a party and the consent is filed in the court in which the action is brought. Notwithstanding s. 814.04 (1), the court shall, in addition to any judgment awarded to the plaintiff, allow reasonable attorney fees and costs to be paid by the defendant.

BUILDING OR HEAVY CONSTRUCTION

Includes sheltered enclosures with walk-in access for the purpose of housing persons, employees, machinery, equipment or supplies and non-sheltered work such as canals, dams, dikes, reservoirs, storage tanks, etc. A sheltered enclosure need not be "habitable" in order to be considered a building. The installation of machinery and/or equipment, both above and below grade level, does not change a project's character as a building. On-site grading, utility work and landscaping are included within this definition. Residential buildings of four (4) stories or less, agricultural buildings, parking lots and driveways are NOT included within this definition.

SKILLED TRADES

Fringe Benefits Must Be Paid On <u>All</u> Hours Worked		HOURLY BASIC RATE OF PAY	HOURLY FRINGE BENEFITS	TOTAL
CODE	TRADE OR OCCUPATION	\$	\$	\$
101	Acoustic Ceiling Tile Installer Future Increase(s): Add \$1.42/hr on 6/1/2015; Add \$1.42/hr on 6/1/2016.	32.72	16.00	48.72
102	Boilermaker Future Increase(s): Add \$1.50/hr. on 01/01/2016	33.35	28.24	61.59
103	Bricklayer, Blocklayer or Stonemason Future Increase(s): Add \$1.40 on 06/01/2015; Add \$1.45 on 06/06/2016 Premium Increase(s): DOT PREMIUM: Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day.	32.82	18.66	51.48
104	Cabinet Installer Future Increase(s): Add \$1.42/hr on 6/1/2015; Add \$1.42/hr on 6/1/2016.	32.72	16.00	48.72
105	Carpenter Future Increase(s): Add \$1.42/hr on 6/1/2015; Add \$1.42/hr on 6/1/2016. Premium Increase(s): DOT PREMIUM: Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day.	32.72	16.00	48.72
106	Carpet Layer or Soft Floor Coverer Future Increase(s): Add \$1.42/hr on 6/1/2015; Add \$1.42/hr on 6/1/2016.	32.72	16.00	48.72
107	Cement Finisher	31.98	12.04	44.02
108	Drywall Taper or Finisher	26.05	18.23	44.28
109	Electrician Future Increase(s): Add \$1.20/hr on 6/1/15; Add \$1.25/hr on 6/1/16. Premium Increase(s): DOT PREMIUM: Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day.	34.82	19.67	54.49
110	Elevator Constructor	43.84	27.09	70.93

Fringe Benefits Must Be Paid On <u>All</u> Hours Worked		HOURLY BASIC RATE OF PAY	HOURLY FRINGE BENEFITS	TOTAL
CODE	TRADE OR OCCUPATION	\$	\$	\$
111	Fence Erector	18.00	6.09	24.09
112	Fire Sprinkler Fitter	36.79	18.81	55.60
113	Glazier Future Increase(s): Add \$.75/hr eff. 06/01/2015; Add \$.90/hr eff. 06/01/2016	37.07	14.42	51.49
114	Heat or Frost Insulator	33.43	25.81	59.24
115	Insulator (Batt or Blown) Future Increase(s): Add \$1.42/hr on 6/1/2015; Add \$1.42/hr on 6/1/2016.	32.72	16.00	48.72
116	Ironworker	31.50	20.01	51.51
117	Lather	31.40	15.90	47.30
118	Line Constructor (Electrical)	39.50	17.73	57.23
119	Marble Finisher	16.25	2.32	18.57
120	Marble Mason	32.09	18.04	50.13
121	Metal Building Erector	19.05	8.08	27.13
122	Millwright Future Increase(s): Add \$1.47/hr on 6/1/2015; Add \$1.47/hr on 6/1/2016.	34.44	16.07	50.51
123	Overhead Door Installer	27.46	1.98	29.44
124	Painter	25.75	16.60	42.35
125	Pavement Marking Operator	30.10	17.34	47.44
126	Piledriver Future Increase(s): Add \$1.50/hr on 6/1/2015; Add \$1.60/hr on 6/1/2016. Premium Increase(s): Add \$.65/hr for Piledriver Loftsmen; Add \$.75/hr for Sheet Piling Loftsmen. DOT PREMIUM: Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day.	30.11	26.51	56.62
127	Pipeline Fuser or Welder (Gas or Utility)	30.83	20.89	51.72
129	Plasterer Future Increase(s): Add \$1.56 on 06/01/2015; Add \$1.61 on 06/01/2016; Add \$1.66 on 06/01/2017	32.65	19.36	52.01
130	Plumber Future Increase(s): Add \$1.80 on 6/1/15	37.57	17.47	55.04

Fringe Benefits Must Be Paid On <u>All</u> Hours Worked		HOURLY BASIC RATE OF PAY	HOURLY FRINGE BENEFITS	TOTAL
CODE	TRADE OR OCCUPATION	\$	\$	\$
132	Refrigeration Mechanic Future Increase(s): Add \$1.80 on 6/1/15	44.20	18.26	62.46
133	Rofer or Waterproofofer	29.40	11.31	40.71
134	Sheet Metal Worker	34.45	22.54	56.99
135	Steamfitter Future Increase(s): Add \$1.80/hr on 6/1/15.	44.20	18.26	62.46
137	Teledata Technician or Installer Premium Increase(s): DOT PREMIUM: Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day.	22.50	12.74	35.24
138	Temperature Control Installer	42.95	15.04	57.99
139	Terrazzo Finisher	16.25	2.32	18.57
140	Terrazzo Mechanic	31.18	17.35	48.53
141	Tile Finisher	23.85	17.18	41.03
142	Tile Setter	29.81	17.18	46.99
143	Tuckpointer, Caulker or Cleaner	23.60	7.10	30.70
144	Underwater Diver (Except on Great Lakes)	35.40	15.90	51.30
146	Well Driller or Pump Installer	25.32	15.65	40.97
147	Siding Installer	36.17	19.44	55.61
150	Heavy Equipment Operator - ELECTRICAL LINE CONSTRUCTION ONLY	30.16	15.11	45.27
151	Light Equipment Operator -ELECTRICAL LINE CONSTRUCTION ONLY	31.60	26.76	58.36
152	Heavy Truck Driver - ELECTRICAL LINE CONSTRUCTION ONLY	27.65	14.49	42.14
153	Light Truck Driver - ELECTRICAL LINE CONSTRUCTION ONLY	27.83	15.01	42.84
154	Groundman - ELECTRICAL LINE CONSTRUCTION ONLY	21.90	9.83	31.73

TRUCK DRIVERS

Fringe Benefits Must Be Paid On <u>All</u> Hours Worked		HOURLY BASIC RATE OF PAY	HOURLY FRINGE BENEFITS	TOTAL
CODE	TRADE OR OCCUPATION	\$	\$	\$
201	Single Axle or Two Axle	32.89	18.96	51.85
203	Three or More Axle	18.00	21.99	39.99

Fringe Benefits Must Be Paid On <u>All</u> Hours Worked		HOURLY BASIC RATE OF PAY	HOURLY FRINGE BENEFITS	TOTAL
CODE	TRADE OR OCCUPATION	\$	\$	\$
204	Articulated, Euclid, Dumptor, Off Road Material Hauler Future Increase(s): Add \$1.60/hr on 6/2/2015; Add \$1.60/hr on 6/3/2016.	33.69	19.78	53.47
205	Pavement Marking Vehicle	20.85	11.02	31.87
207	Truck Mechanic	18.00	21.99	39.99

LABORERS

Fringe Benefits Must Be Paid On <u>All</u> Hours Worked		HOURLY BASIC RATE OF PAY	HOURLY FRINGE BENEFITS	TOTAL
CODE	TRADE OR OCCUPATION	\$	\$	\$
301	General Laborer Future Increase(s): Add \$1.35/hr eff. 06/01/2015; Add \$1.25/hr eff. 06/06/2016 Premium Increase(s): Add \$1.00/hr for certified welder; Add \$.25/hr for mason tender	24.97	15.12	40.09
302	Asbestos Abatement Worker	18.00	9.58	27.58
303	Landscaper	18.75	10.26	29.01
310	Gas or Utility Pipeline Laborer (Other Than Sewer and Water)	21.55	14.14	35.69
311	Fiber Optic Laborer (Outside, Other Than Concrete Encased) Premium Increase(s): DOT PREMIUMS: Pay two times the hourly basic rate on New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day.	18.82	14.16	32.98
314	Railroad Track Laborer	14.50	5.29	19.79
315	Final Construction Clean-Up Worker Future Increase(s): Add \$1.35/hr eff. 06/01/2015; Add \$1.25/hr eff. 06/06/2016	24.97	15.12	40.09

**HEAVY EQUIPMENT OPERATORS
SITE PREPARATION, UTILITY OR LANDSCAPING WORK ONLY**

Fringe Benefits Must Be Paid On <u>All</u> Hours Worked				
CODE	TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY	HOURLY FRINGE BENEFITS	TOTAL
		\$	\$	\$
501	Air Track, Rotary or Percussion Drilling Machine &/or Hammers, Blaster; Asphalt Milling Machine; Boring Machine (Directional, Horizontal or Vertical); Backhoe (Track Type) Having a Mfgr's Rated Capacity of 130,000 Lbs. or Over; Backhoe (Track Type) Having a Mfgr's Rated Capacity of Under 130,000 Lbs., Backhoe (Mini, 15,000 Lbs. & Under); Bulldozer or Endloader (Over 40 hp); Compactor (Self-Propelled 85 Ft Total Drum Width & Over, or Tractor Mounted, Towed & Light Equipment); Concrete Batch Plant, Batch Hopper; Concrete Breaker (Large, Auto, Vibratory/Sonic, Manual or Remote); Crane, Shovel, Dragline, Clamshells; Forklift (Machinery Moving or Steel Erection, 25 Ft & Over); Gradall (Cruz-Aire Type); Grader or Motor Patrol; Master Mechanic; Mechanic or Welder; Robotic Tool Carrier (With or Without Attachments); Scraper (Self Propelled or Tractor Drawn) 5 cu yds or More Capacity; Tractor or Truck Mounted Hydraulic Backhoe; Tractor or Truck Mounted Hydraulic Crane (10 Tons or Under); Tractor (Scraper, Dozer, Pusher, Loader); Trencher (Wheel Type or Chain Type Having Over 8 Inch Bucket). Future Increase(s): Add \$1.60/hr on 6/2/2015; Add \$1.60/hr on 6/3/2016.	33.69	19.78	53.47
502	Backfiller; Broom or Sweeper; Bulldozer or Endloader (Under 40 hp); Environmental Burner; Forestry Equipment, Timbco, Tree Shear, Tub Grinder, Processor; Jeep Digger; Screed (Milling Machine); Skid Rig; Straddle Carrier or Travel Lift; Stump Chipper; Trencher (Wheel Type or Chain Type Having 8 Inch Bucket & Under). Future Increase(s): Add \$1.60/hr on 6/2/2015; Add \$1.60/hr on 6/3/2016.	33.69	19.78	53.47
503	Air Compressor (&/or 400 CFM or Over); Augers (Vertical & Horizontal); Compactor (Self-Propelled 84 Ft Total Drum Width & Under, or Tractor Mounted, Towed & Light Equipment); Crusher, Screening or Wash Plant; Farm or Industrial Type Tractor; Forklift; Generator (&/or 150 KW or Over); Greaser; High Pressure Utility Locating Machine (Daylighting Machine); Mulcher; Oiler; Post Hole Digger or Driver; Pump (3 Inch or Over) or Well Points; Refrigeration Plant or Freeze Machine; Rock, Stone Breaker; Skid Steer Loader (With or Without Attachments); Vibratory Hammer or Extractor, Power Pack. Future Increase(s): Add \$1.60/hr on 6/2/2015; Add \$1.60/hr on 6/3/2016.	31.62	19.78	51.40
504	Work Performed on the Great Lakes Including Diver; Wet Tender or Hydraulic Dredge Engineer.	41.65	21.71	63.36
505	Work Performed on the Great Lakes Including Crane or Backhoe Operator; Assistant Hydraulic Dredge Engineer; Hydraulic Dredge Leverman or Diver's Tender; Mechanic or Welder; 70 Ton & Over Tug Operator. Premium Increase(s): Add \$.50/hr for Friction Crane, Lattice Boom or Crane Certification (CCO).	41.65	21.71	63.36

Fringe Benefits Must Be Paid On <u>All</u> Hours Worked				
CODE	TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY	HOURLY FRINGE BENEFITS	TOTAL
		\$	\$	\$
506	Work Performed on the Great Lakes Including Deck Equipment Operator or Machineryman (Maintains Cranes Over 50 Tons or Backhoes 115,000 Lbs. or More); Tug, Launch or Loader, Dozer or Like Equipment When Operated on a Barge, Breakwater Wall, Slip, Dock or Scow, Deck Machinery.	35.72	17.85	53.57
507	Work Performed on the Great Lakes Including Deck Equipment Operator, Machineryman or Fireman (Operates 4 Units or More or Maintains Cranes 50 Tons or Under or Backhoes 115,000 Lbs. or Under); Deck Hand, Deck Engineer or Assistant Tug Operator; Off Road Trucks - Great Lakes ONLY.	35.46	20.40	55.86

**HEAVY EQUIPMENT OPERATORS
EXCLUDING SITE PREPARATION, UTILITY, PAVING LANDSCAPING WORK**

Fringe Benefits Must Be Paid On <u>All</u> Hours Worked				
CODE	TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY	HOURLY FRINGE BENEFITS	TOTAL
		\$	\$	\$
508	Boring Machine (Directional); Crane, Tower Crane, Pedestal Tower or Derrick, With or Without Attachments, With a Lifting Capacity of Over 100 Tons, Self-Erecting Tower Crane With a Lifting Capacity of Over 4,000 Lbs., Crane With Boom Dollies; Crane, Tower Crane, Pedestal Tower or Derrick, With Boom, Leads &/or Jib Lengths Measuring 176 Ft or Over; Master Mechanic. Future Increase(s): Add \$1.60/hr on 6/2/2015; Add \$1.60/hr on 6/3/2016. Premium Increase(s): Add \$.50/hr for >200 Ton; Add \$1/hr at 300 Ton; Add \$1.50/hr at 400 Ton; Add \$2/hr at 500 Ton & Over.	36.67	19.78	56.45
509	Backhoe (Track Type) Having a Mfgr's Rated Capacity of 130,000 Lbs. or Over; Boring Machine (Horizontal or Vertical); Caisson Rig; Crane, Tower Crane, Portable Tower, Pedestal Tower or Derrick, With or Without Attachments, With a Lifting Capacity of 100 Tons or Under, Self-Erecting Tower Crane With A Lifting Capacity Of 4,000 Lbs. & Under; Crane, Tower Crane, Portable Tower, Pedestal Tower or Derrick, With Boom, Leads &/or Jib Lengths Measuring 175 Ft or Under; Pile Driver; Versi Lifts, Tri-Lifts & Gantrys (20,000 Lbs. & Over). Future Increase(s): Add \$1.60/hr on 6/2/2015; Add \$1.60/hr on 6/3/2016. Premium Increase(s): Add \$.25/hr for all >45 Ton lifting capacity cranes.	35.42	19.78	55.20
510	Backhoe (Track Type) Having a Mfgr.'s Rated Capacity of Under 130,000 Lbs., Backhoe (Mini, 15,000 Lbs. & Under); Concrete Bump Cutter, Grinder, Planing or Grooving Machine; Concrete Laser/Screed; Concrete Paver (Slipform); Concrete Pump (Over 46 Meter), Concrete Conveyor (Rotec or Bidwell Type); Concrete Slipform Placer Curb & Gutter Machine; Concrete Spreader & Distributor; Dredge (NOT Performing Work on the Great Lakes); Forklift (Machinery Moving or Steel Erection, 25 Ft & Over); Gradall (Cruz-Aire Type); Hydro-Blaster (10,000 PSI or Over); Milling Machine; Skid Rig; Traveling Crane (Bridge Type). Future Increase(s): Add \$1.60/hr on 6/2/2015; Add \$1.60/hr on 6/3/2016.	34.22	19.78	54.00

Fringe Benefits Must Be Paid On <u>All</u> Hours Worked		HOURLY BASIC RATE OF PAY	HOURLY FRINGE BENEFITS	TOTAL
CODE	TRADE OR OCCUPATION	\$	\$	\$
511	Air, Track, Rotary or Percussion Drilling Machine &/or Hammers, Blaster; Bulldozer or Endloader (Over 40 hp); Compactor (Self-Propelled 85 Ft Total Drum Width & Over, or Tractor Mounted, Towed & Light Equipment); Concrete Pump (46 Meter & Under), Concrete Conveyor (Rotec or Bidwell Type); Crane (Carry Deck, Mini) or Truck Mounted Hydraulic Crane (10 Tons or Under); Environmental Burner; Gantrys (Under 20,000 Lbs.); Grader or Motor Patrol; High Pressure Utility Locating Machine (Daylighting Machine); Manhoist; Material or Stack Hoist; Mechanic or Welder; Railroad Track Rail Leveling Machine, Tie Placer, Extractor, Tamper, Stone Leveler or Rehabilitation Equipment; Roller (Over 5 Ton); Scraper (Self Propelled or Tractor Drawn) 5 cu yd or More Capacity; Screed (Milling Machine); Sideboom; Straddle Carrier or Travel Lift; Tining or Curing Machine; Tractor (Scraper, Dozer, Pusher, Loader); Tractor or Truck Mounted Hydraulic Backhoe; Tractor or Truck Mounted Hydraulic Crane (10 Tons or Under); Trencher (Wheel Type or Chain Type Having Over 8-Inch Bucket). Future Increase(s): Add \$1.60/hr on 6/2/2015; Add \$1.60/hr on 6/3/2016.	33.69	19.78	53.47
512	Backfiller; Broom or Sweeper; Bulldozer or Endloader (Under 40 hp); Compactor (Self-Propelled 84 Ft Total Drum Width & Under, or Tractor Mounted, Towed & Light Equipment); Concrete Batch Plant, Batch Hopper; Concrete Breaker (Large, Auto, Vibratory/Sonic, Manual or Remote); Concrete Conveyor System; Concrete Finishing Machine (Road Type); Fireman (Pile Driver & Derrick NOT Performing Work on the Great Lakes); Grout Pump; Hoist (Tugger, Automatic); Industrial Locomotives; Jeep Digger; Lift Slab Machine; Mulcher; Roller (Rubber Tire, 5 Ton or Under); Screw or Gypsum Pumps; Stabilizing or Concrete Mixer (Self-Propelled or 14S or Over); Stump Chipper; Trencher (Wheel Type or Chain Type Having 8-Inch Bucket & Under); Winches & A-Frames. Future Increase(s): Add \$1.60/hr on 6/2/2015; Add \$1.60/hr on 6/3/2016.	31.62	19.78	51.40
513	Air Compressor (&/or 400 CFM or Over); Air, Electric or Hydraulic Jacking System; Augers (Vertical & Horizontal); Boatmen (NOT Performing Work on the Great Lakes); Boiler (Temporary Heat); Crusher, Screening or Wash Plant; Elevator; Farm or Industrial Type Tractor; Fireman (Asphalt Plant NOT Performing Work on the Great Lakes); Forklift; Generator (&/or 150 KW or Over); Greaser; Heaters (Mechanical); Loading Machine (Conveyor); Oiler; Post Hole Digger or Driver; Prestress Machine; Pump (3 Inch or Over) or Well Points; Refrigeration Plant or Freeze Machine; Robotic Tool Carrier (With or Without Attachments); Rock, Stone Breaker; Skid Steer Loader (With or Without Attachments); Vibratory Hammer or Extractor, Power Pack. Future Increase(s): Add \$1.60/hr on 6/2/2015; Add \$1.60/hr on 6/3/2016.	30.99	19.78	50.77
514	Gas or Utility Pipeline, Except Sewer & Water (Primary Equipment). Future Increase(s): Add \$1/hr on 6/1/2015; Add \$1/hr on 5/30/2016.	36.34	22.14	58.48
515	Gas or Utility Pipeline, Except Sewer & Water (Secondary Equipment). Future Increase(s): Add \$1.65/hr on 6/1/2015.	33.12	19.35	52.47
516	Fiber Optic Cable Equipment	28.89	17.95	46.84

SEWER, WATER OR TUNNEL CONSTRUCTION
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Includes those projects that primarily involve public sewer or water distribution, transmission or collection systems and related tunnel work (excluding buildings).

SKILLED TRADES

CODE	TRADE OR OCCUPATION	Fringe Benefits Must Be Paid On <u>All</u> Hours Worked		
		HOURLY BASIC RATE OF PAY	HOURLY FRINGE BENEFITS	TOTAL
		\$	\$	\$
103	Bricklayer, Blocklayer or Stonemason	32.09	18.04	50.13
105	Carpenter Future Increase(s): Add \$1.50/hr on 6/1/2015; Add \$1.65/hr on 6/1/2016. Premium Increase(s): DOT PREMIUM: Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day.	34.13	20.61	54.74
107	Cement Finisher Future Increase(s): Add \$1.87 on 6/1/15; Add \$1.75 on 6/1/16. Premium Increase(s): DOT PREMIUMS: 1) Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day. 2) Add \$1.40/hr when the Wisconsin Department of Transportation or responsible governing agency requires that work be performed at night under artificial illumination with traffic control and the work is completed after sunset and before sunrise.	35.18	16.78	51.96
109	Electrician Premium Increase(s): DOT PREMIUM: Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day.	33.93	22.77	56.70
111	Fence Erector	18.00	6.09	24.09
116	Ironworker	31.50	20.01	51.51
118	Line Constructor (Electrical)	39.50	17.73	57.23
125	Pavement Marking Operator	30.10	17.34	47.44
126	Piledriver	29.56	25.71	55.27
130	Plumber	21.50	0.00	21.50
135	Steamfitter	42.95	17.81	60.76
137	Teledata Technician or Installer	22.25	12.24	34.49
143	Tuckpointer, Caulker or Cleaner	23.60	7.10	30.70
144	Underwater Diver (Except on Great Lakes)	35.40	15.90	51.30

Fringe Benefits Must Be Paid On <u>All</u> Hours Worked		HOURLY BASIC RATE OF PAY	HOURLY FRINGE BENEFITS	TOTAL
CODE	TRADE OR OCCUPATION	\$	\$	\$
146	Well Driller or Pump Installer	25.32	15.65	40.97
150	Heavy Equipment Operator - ELECTRICAL LINE CONSTRUCTION ONLY	35.55	15.57	51.12
151	Light Equipment Operator -ELECTRICAL LINE CONSTRUCTION ONLY	31.60	15.19	46.79
152	Heavy Truck Driver - ELECTRICAL LINE CONSTRUCTION ONLY	27.65	13.44	41.09
153	Light Truck Driver - ELECTRICAL LINE CONSTRUCTION ONLY	25.68	13.28	38.96
154	Groundman - ELECTRICAL LINE CONSTRUCTION ONLY	21.75	12.97	34.72

TRUCK DRIVERS

Fringe Benefits Must Be Paid On <u>All</u> Hours Worked		HOURLY BASIC RATE OF PAY	HOURLY FRINGE BENEFITS	TOTAL
CODE	TRADE OR OCCUPATION	\$	\$	\$
201	Single Axle or Two Axle Future Increase(s): Add \$1.15/hr on 6/1/2015. Premium Increase(s): DOT PREMIUM: Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day.	25.18	18.31	43.49
203	Three or More Axle	19.50	4.97	24.47
204	Articulated, Euclid, Dumptor, Off Road Material Hauler	32.89	18.96	51.85
205	Pavement Marking Vehicle	20.85	11.02	31.87
207	Truck Mechanic	19.50	4.97	24.47

LABORERS

Fringe Benefits Must Be Paid On <u>All</u> Hours Worked		HOURLY BASIC RATE OF PAY	HOURLY FRINGE BENEFITS	TOTAL
CODE	TRADE OR OCCUPATION	\$	\$	\$
301	General Laborer Future Increase(s): Add \$1.35/hr eff. 06/01/2015; Add \$1.25/hr eff. 06/06/2016 Premium Increase(s): Add \$.20 for blaster, bracer, manhole builder, caulker, bottomman and power tool; Add \$.55 for pipelayer; Add \$1.00 for tunnel work 0-15 lbs. compressed air; Add \$2.00 for over 15-30 lbs. compressed air; Add \$3.00 for over 30 lbs. compressed air.	26.34	15.13	41.47
303	Landscaper	39.43	0.00	39.43

Fringe Benefits Must Be Paid On <u>All</u> Hours Worked				
CODE	TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY	HOURLY FRINGE BENEFITS	TOTAL
		\$	\$	\$
304	Flagperson or Traffic Control Person	31.95	0.00	31.95
311	Fiber Optic Laborer (Outside, Other Than Concrete Encased)	18.33	13.65	31.98
314	Railroad Track Laborer	14.50	5.29	19.79

**HEAVY EQUIPMENT OPERATORS
SEWER, WATER OR TUNNEL WORK**

Fringe Benefits Must Be Paid On <u>All</u> Hours Worked				
CODE	TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY	HOURLY FRINGE BENEFITS	TOTAL
		\$	\$	\$
521	Backhoe (Track Type) Having a Mfgr.'s Rated Capacity of 130,000 Lbs. or Over; Caisson Rig; Crane, Tower Crane, Pedestal Tower or Derrick, With Boom, Leads &/or Jib Lengths Measuring 176 Ft or Over; Crane, Tower Crane, Pedestal Tower or Derrick, With or Without Attachments, With a Lifting Capacity of Over 100 Tons, Self-Erecting Tower Crane With a Lifting Capacity Of Over 4,000 Lbs., Crane With Boom Dollies; Master Mechanic; Pile Driver. Future Increase(s): Add \$1.55/hr on 6/1/2015. Premium Increase(s): Add \$.25/hr for operating tower crane.	37.24	20.10	57.34
522	Backhoe (Track Type) Having a Mfgr.'s Rated Capacity of Under 130,000 Lbs., Backhoe (Mini, 15,000 Lbs. & Under); Boring Machine (Directional); Concrete Bump Cutter, Grinder, Planing or Grooving Machine; Concrete Laser/Screed; Concrete Paver (Slipform); Concrete Pump (Over 46 Meter), Concrete Conveyor (Rotec or Bidwell Type); Concrete Spreader & Distributor; Crane, Tower Crane, Portable Tower, Pedestal Tower or Derrick, With Boom, Leads &/or Jib Lengths Measuring 175 Ft or Under; Crane, Tower Crane, Portable Tower, Pedestal Tower or Derrick, With or Without Attachments, With a Lifting Capacity of 100 Tons or Under, Self-Erecting Tower Crane With a Lifting Capacity of 4,000 Lbs. & Under; Dredge (NOT Performing Work on the Great Lakes); Milling Machine; Skid Rig; Telehandler; Traveling Crane (Bridge Type). Future Increase(s): Add \$1.60/hr on 6/2/2015; Add \$1.60/hr on 6/3/2016.	34.22	19.78	54.00
523	Air Track, Rotary or Percussion Drilling Machine &/or Hammers, Blaster; Boring Machine (Horizontal or Vertical); Bulldozer or Endloader (Over 40 hp); Crane (Carry Deck, Mini) or Truck Mounted Hydraulic Crane (10 Tons or Under); Concrete Pump (46 Meter & Under), Concrete Conveyor (Rotec or Bidwell Type); Concrete Slipform Placer Curb & Gutter Machine; Gradall (Cruz-Aire Type); Grader or Motor Patrol; Hydro-Blaster (10,000 PSI or Over); Manhoist; Material or Stack Hoist; Mechanic or Welder; Roller (Over 5 Ton); Scraper (Self Propelled or Tractor Drawn) 5 cu yd or More Capacity; Screed (Milling Machine); Sideboom; Straddle Carrier or Travel Lift; Tractor (Scraper, Dozer, Pusher, Loader); Tractor or Truck Mounted Hydraulic Backhoe; Tractor or Truck Mounted Hydraulic Crane (10 Tons or Under); Trencher (Wheel Type or Chain Type Having Over 8-Inch Bucket). Future Increase(s): Add \$1.60/hr on 6/2/2015; Add \$1.60/hr on 6/3/2016.	33.69	19.78	53.47

Fringe Benefits Must Be Paid On <u>All</u> Hours Worked		HOURLY BASIC RATE OF PAY	HOURLY FRINGE BENEFITS	TOTAL
CODE	TRADE OR OCCUPATION	\$	\$	\$
524	Backfiller; Broom or Sweeper; Bulldozer or Endloader (Under 40 hp); Compactor (Self-Propelled 85 Ft Total Drum Width & Over, or Tractor Mounted, Towed & Light Equipment); Concrete Batch Plant, Batch Hopper; Concrete Breaker (Large, Auto, Vibratory/Sonic, Manual or Remote); Concrete Conveyor System; Concrete Finishing Machine (Road Type); Environmental Burner; Fireman (Pile Driver & Derrick NOT Performing Work on the Great Lakes); Forestry Equipment, Timbco, Tree Shear, Tub Grinder, Processor; Hoist (Tugger, Automatic); Grout Pump; Jeep Digger; Lift Slab Machine; Mulcher; Power Subgrader; Pump (3 Inch or Over) or Well Points; Robotic Tool Carrier (With or Without Attachments); Roller (Rubber Tire, 5 Ton or Under); Screw or Gypsum Pumps; Stabilizing or Concrete Mixer (Self-Propelled or 14S or Over); Stump Chipper; Tining or Curing Machine; Trencher (Wheel Type or Chain Type Having 8-Inch Bucket & Under); Winches & A-Frames.	30.82	18.96	49.78
525	Air Compressor (&/or 400 CFM or Over); Air, Electric or Hydraulic Jacking System; Augers (Vertical & Horizontal); Compactor (Self-Propelled 84 Ft Total Drum Width & Under, or Tractor Mounted, Towed & Light Equipment); Crusher, Screening or Wash Plant; Farm or Industrial Type Tractor; Fireman (Asphalt Plant NOT Performing Work on the Great Lakes); Generator (&/or 150 KW or Over); Heaters (Mechanical); High Pressure Utility Locating Machine (Daylighting Machine); Loading Machine (Conveyor); Post Hole Digger or Driver; Refrigeration Plant or Freeze Machine; Rock, Stone Breaker; Skid Steer Loader (With or Without Attachments); Vibratory Hammer or Extractor, Power Pack.	30.69	18.46	49.15
526	Boiler (Temporary Heat); Forklift; Greaser; Oiler.	30.19	18.96	49.15
527	Work Performed on the Great Lakes Including Diver; Wet Tender or Hydraulic Dredge Engineer.	41.65	21.71	63.36
528	Work Performed on the Great Lakes Including 70 Ton & Over Tug Operator; Assistant Hydraulic Dredge Engineer; Crane or Backhoe Operator; Hydraulic Dredge Leverman or Diver's Tender; Mechanic or Welder.	41.65	21.71	63.36
529	Work Performed on the Great Lakes Including Deck Equipment Operator or Machineryman (Maintains Cranes Over 50 Tons or Backhoes 115,000 Lbs. or More); Tug, Launch or Loader, Dozer or Like Equipment When Operated on a Barge, Breakwater Wall, Slip, Dock or Scow, Deck Machinery.	35.72	17.85	53.57
530	Work Performed on the Great Lakes Including Deck Equipment Operator; Machineryman or Fireman (Operates 4 Units or More or Maintains Cranes 50 Tons or Under or Backhoes 115,000 Lbs. or Under), Deck Hand, Deck Engineer or Assistant Tug Operator; Off Road Trucks - Great Lakes ONLY.	35.46	20.40	55.86

LOCAL STREET OR MISCELLANEOUS PAVING CONSTRUCTION
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Includes roads, streets, alleys, trails, bridges, paths, racetracks, parking lots and driveways (except residential or agricultural), public sidewalks or other similar projects (excluding projects awarded by the Wisconsin Department of Transportation).

SKILLED TRADES

CODE	TRADE OR OCCUPATION	HOURLY BASIC RATE OF PAY	HOURLY FRINGE BENEFITS	TOTAL
		\$	\$	\$
103	Bricklayer, Blocklayer or Stonemason	32.09	18.04	50.13
105	Carpenter Future Increase(s): Add \$1.42/hr on 6/1/2015; Add \$1.42/hr on 6/1/2016. Premium Increase(s): DOT PREMIUM: Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day.	32.72	16.00	48.72
107	Cement Finisher Future Increase(s): Add \$1.87 on 6/1/15; Add \$1.75 on 6/1/16. Premium Increase(s): DOT PREMIUMS: 1) Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day. 2) Add \$1.40/hr when the Wisconsin Department of Transportation or responsible governing agency requires that work be performed at night under artificial illumination with traffic control and the work is completed after sunset and before sunrise.	35.18	16.78	51.96
109	Electrician	35.72	19.17	54.89
111	Fence Erector	18.00	6.09	24.09
116	Ironworker	31.50	20.01	51.51
118	Line Constructor (Electrical)	39.50	17.73	57.23
124	Painter	25.75	16.60	42.35
125	Pavement Marking Operator	30.10	17.34	47.44
126	Piledriver	29.56	25.71	55.27
133	Rofer or Waterproofer	29.40	11.31	40.71
137	Teledata Technician or Installer	22.25	12.24	34.49
143	Tuckpointer, Caulker or Cleaner	23.60	7.10	30.70
144	Underwater Diver (Except on Great Lakes)	35.40	15.90	51.30
150	Heavy Equipment Operator - ELECTRICAL LINE CONSTRUCTION ONLY	35.55	15.57	51.12

Fringe Benefits Must Be Paid On <u>All</u> Hours Worked		HOURLY BASIC RATE OF PAY	HOURLY FRINGE BENEFITS	TOTAL
CODE	TRADE OR OCCUPATION	\$	\$	\$
151	Light Equipment Operator -ELECTRICAL LINE CONSTRUCTION ONLY	31.60	15.19	46.79
152	Heavy Truck Driver - ELECTRICAL LINE CONSTRUCTION ONLY	27.65	13.44	41.09
153	Light Truck Driver - ELECTRICAL LINE CONSTRUCTION ONLY	25.68	13.28	38.96
154	Groundman - ELECTRICAL LINE CONSTRUCTION ONLY	21.75	12.97	34.72

TRUCK DRIVERS

Fringe Benefits Must Be Paid On <u>All</u> Hours Worked		HOURLY BASIC RATE OF PAY	HOURLY FRINGE BENEFITS	TOTAL
CODE	TRADE OR OCCUPATION	\$	\$	\$
201	Single Axle or Two Axle Future Increase(s): Add \$1.15/hr on 6/1/2015. Premium Increase(s): DOT PREMIUM: Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day.	25.18	18.31	43.49
203	Three or More Axle	16.00	0.00	16.00
204	Articulated, Euclid, Dumptor, Off Road Material Hauler Future Increase(s): Add \$1.60/hr on 6/2/2015; Add \$1.60/hr on 6/3/2016.	33.69	19.78	53.47
205	Pavement Marking Vehicle	20.85	11.02	31.87
206	Shadow or Pilot Vehicle	24.37	17.77	42.14
207	Truck Mechanic	16.00	0.00	16.00

LABORERS

Fringe Benefits Must Be Paid On <u>All</u> Hours Worked		HOURLY BASIC RATE OF PAY	HOURLY FRINGE BENEFITS	TOTAL
CODE	TRADE OR OCCUPATION	\$	\$	\$
301	General Laborer	29.32	12.44	41.76
303	Landscaper Future Increase(s): Add \$1.05/hr eff. 06/01/2015; Add \$1.00/hr eff. 06/01/2016; Add \$1.00/hr eff. 06/01/2017 Premium Increase(s):	30.13	15.14	45.27

Fringe Benefits Must Be Paid On All Hours Worked

<u>CODE</u>	<u>TRADE OR OCCUPATION</u>	<u>HOURLY BASIC RATE OF PAY</u> \$	<u>HOURLY FRINGE BENEFITS</u> \$	<u>TOTAL</u> \$
	DOT PREMIUMS: 1) Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day. 2) Add \$1.25/hr for work on projects involving temporary traffic control setup, for lane and shoulder closures, when work under artificial illumination conditions is necessary as required by the project provisions (including prep time prior to and/or cleanup after such time period).			
304	Flagperson or Traffic Control Person	19.06	14.29	33.35
311	Fiber Optic Laborer (Outside, Other Than Concrete Encased)	18.33	13.65	31.98
314	Railroad Track Laborer	14.50	5.29	19.79

**HEAVY EQUIPMENT OPERATORS
CONCRETE PAVEMENT OR BRIDGE WORK**

Fringe Benefits Must Be Paid On All Hours Worked

<u>CODE</u>	<u>TRADE OR OCCUPATION</u>	<u>HOURLY BASIC RATE OF PAY</u> \$	<u>HOURLY FRINGE BENEFITS</u> \$	<u>TOTAL</u> \$
541	Crane, Tower Crane, Pedestal Tower or Derrick, With or Without Attachments, With a Lifting Capacity of Over 100 Tons, Self-Erecting Tower Crane With a Lifting Capacity Of Over 4,000 Lbs., Crane With Boom Dollies; Crane, Tower Crane, Pedestal Tower or Derrick, With Boom, Leads &/or Jib Lengths Measuring 176 Ft or Over; Master Mechanic. Future Increase(s): Add \$1.25/hr on 6/1/2015; Add \$1.30/hr on 6/1/2016; Add \$1.25/hr on 6/1/2017. Premium Increase(s): DOT PREMIUMS: 1) Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day. 2) Add \$1.50/hr night work premium. See DOT'S website for details about the applicability of this night work premium at: http://www.dot.wi.gov/business/civilrights/laborwages/pwc.htm .	37.72	21.15	58.87

Fringe Benefits Must Be Paid On <u>All</u> Hours Worked		HOURLY BASIC RATE OF PAY	HOURLY FRINGE BENEFITS	TOTAL
CODE	TRADE OR OCCUPATION	\$	\$	\$
542	<p>Backhoe (Track Type) Having a Mfgr.'s Rated Capacity of 130,000 Lbs. or Over; Caisson Rig; Crane, Tower Crane, Portable Tower, Pedestal Tower or Derrick, With or Without Attachments, With a Lifting Capacity of 100 Tons or Under, Self-Erecting Tower Crane With a Lifting Capacity of 4,000 Lbs. & Under; Crane, Tower Crane Portable Tower, Pedestal Tower or Derrick, With Boom, Leads &/or Jib Lengths Measuring 175 Ft or Under; Dredge (NOT Performing Work on the Great Lakes); Licensed Boat Pilot (NOT Performing Work on the Great Lakes); Pile Driver.</p> <p>Future Increase(s): Add \$1.25/hr on 6/1/2015; Add \$1.30/hr on 6/1/2016; Add \$1.25/hr on 6/1/2017.</p> <p>Premium Increase(s): DOT PREMIUMS: 1) Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day. 2) Add \$1.50/hr night work premium. See DOT'S website for details about the applicability of this night work premium at: http://www.dot.wi.gov/business/civilrights/laborwages/pwc.htm.</p>	37.22	21.15	58.37
543	<p>Air Track, Rotary or Percussion Drilling Machine &/or Hammers, Blaster; Automatic Subgrader (Concrete); Backhoe (Track Type) Having a Mfgr.'s Rated Capacity of Under 130,000 Lbs., Backhoe (Mini, 15,000 Lbs. & Under); Boring Machine (Directional, Horizontal or Vertical); Bridge (Bidwell) Paver; Bulldozer or Endloader; Concrete Batch Plant, Batch Hopper; Concrete Breaker (Large, Auto, Vibratory/Sonic, Manual or Remote); Concrete Bump Cutter, Grinder, Planing or Grooving Machine; Concrete Conveyor System; Concrete Laser/Screed; Concrete Paver (Slipform); Concrete Pump, Concrete Conveyor (Rotec or Bidwell Type); Concrete Slipform Placer Curb & Gutter Machine; Concrete Spreader & Distributor; Crane (Carry Deck, Mini) or Truck Mounted Hydraulic Crane (10 Tons or Under); Crane With a Lifting Capacity of 25 Tons or Under; Forestry Equipment, Timbco, Tree Shear, Tub Grinder, Processor; Gradall (Cruz-Aire Type); Grader or Motor Patrol; Grout Pump; Hydro-Blaster (10,000 PSI or Over); Loading Machine (Conveyor); Manhoist; Material or Stack Hoist; Mechanic or Welder; Milling Machine; Post Hole Digger or Driver; Scraper (Self Propelled or Tractor Drawn) 5 cu yds or More Capacity; Shoulder Widener; Sideboom; Skid Rig; Stabilizing or Concrete Mixer (Self-Propelled or 14S or Over); Straddle Carrier or Travel Lift; Tractor (Scraper, Dozer, Pusher, Loader); Tractor or Truck Mounted Hydraulic Backhoe; Trencher (Wheel Type or Chain Type); Tube Finisher; Tugger (NOT Performing Work on the Great Lakes); Winches & A-Frames.</p>	35.72	17.85	53.57

Fringe Benefits Must Be Paid On <u>All</u> Hours Worked		HOURLY BASIC RATE OF PAY	HOURLY FRINGE BENEFITS	TOTAL
CODE	TRADE OR OCCUPATION	\$	\$	\$
544	Backfiller; Belting, Burlap, Texturing Machine; Broom or Sweeper; Compactor (Self-Propelled or Tractor Mounted, Towed & Light Equipment); Concrete Finishing Machine (Road Type); Environmental Burner; Farm or Industrial Type Tractor; Fireman (Pile Driver & Derrick NOT Performing Work on the Great Lakes); Forklift; Greaser; Jeep Digger; Joint Sawyer (Multiple Blade); Launch (NOT Performing Work on the Great Lakes); Lift Slab Machine; Mechanical Float; Mulcher; Power Subgrader; Robotic Tool Carrier (With or Without Attachments); Self Propelled Chip Spreader; Shouldering Machine; Skid Steer Loader (With or Without Attachments); Telehandler; Tining or Curing Machine. Future Increase(s): Add \$1.25/hr on 6/1/2015; Add \$1.30/hr on 6/1/2016; Add \$1.25/hr on 6/1/2017. Premium Increase(s): DOT PREMIUMS: 1) Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day. 2) Add \$1.50/hr night work premium. See DOT'S website for details about the applicability of this night work premium at: http://www.dot.wi.gov/business/civilrights/laborwages/pwc.htm .	36.46	21.15	57.61
545	Air Compressor (&/or 400 CFM or Over); Air, Electric or Hydraulic Jacking System; Automatic Belt Conveyor & Surge Bin; Boiler (Temporary Heat); Concrete Proportioning Plant; Crusher, Screening or Wash Plant; Generator (&/or 150 KW or Over); Heaters (Mechanical); High Pressure Utility Locating Machine (Daylighting Machine); Mudjack; Oiler; Prestress Machine; Pug Mill; Pump (3 Inch or Over) or Well Points; Rock, Stone Breaker; Screed (Milling Machine); Stump Chipper; Tank Car Heaters; Vibratory Hammer or Extractor, Power Pack.	35.17	20.40	55.57
546	Fiber Optic Cable Equipment.	28.89	17.95	46.84
547	Work Performed on the Great Lakes Including Diver; Wet Tender or Hydraulic Dredge Engineer.	41.65	21.71	63.36
548	Work Performed on the Great Lakes Including 70 Ton & Over Tug Operator; Assistant Hydraulic Dredge Engineer; Crane or Backhoe Operator; Hydraulic Dredge Leverman or Diver's Tender; Mechanic or Welder.	41.65	21.71	63.36
549	Work Performed on the Great Lakes Including Deck Equipment Operator or Machineryman (Maintains Cranes Over 50 Tons or Backhoes 115,000 Lbs. or more); Tug, Launch or Loader, Dozer or Like Equipment When Operated on a Barge, Breakwater Wall, Slip, Dock or Scow, Deck Machinery.	35.72	17.85	53.57
550	Work Performed on the Great Lakes Including Deck Equipment Operator; Machineryman or Fireman (Operates 4 Units or More or Maintains Cranes 50 Tons or Under or Backhoes 115,000 Lbs. or Under); Deck Hand, Deck Engineer or Assistant Tug Operator; Off Road Trucks - Great Lakes ONLY.	35.46	20.40	55.86

**HEAVY EQUIPMENT OPERATORS
ASPHALT PAVEMENT OR OTHER WORK**

Fringe Benefits Must Be Paid On <u>All</u> Hours Worked		HOURLY BASIC RATE OF PAY	HOURLY FRINGE BENEFITS	TOTAL
CODE	TRADE OR OCCUPATION	\$	\$	\$
551	Crane, Tower Crane, Pedestal Tower or Derrick, With or Without Attachments, With a Lifting Capacity of Over 100 Tons, Self Erecting Tower Crane With a Lifting Capacity of Over 4,000 Lbs., Crane With Boom Dollies; Crane, Tower Crane, Pedestal Tower or Derrick, With Boom, Leads and/or Jib Lengths Measuring 176 Ft or Over; Master Mechanic.	36.72	20.40	57.12
552	Backhoe (Track Type) Having a Mfgr.'s Rated Capacity of 130,000 Lbs. or Over; Caisson Rig; Crane, Tower Crane, Portable Tower, Pedestal Tower or Derrick, With or Without Attachments, With a Lifting Capacity of 100 Tons or Under, Self-Erecting Tower Crane With a Lifting Capacity Of 4,000 Lbs. & Under; Crane, Tower Crane, Portable Tower, Pedestal Tower or Derrick, With Boom, Leads &/or Jib Lengths Measuring 175 Ft or Under; Dredge (NOT Performing Work on the Great Lakes); Licensed Boat Pilot (NOT Performing Work on the Great Lakes); Pile Driver. Future Increase(s): Add \$1.25/hr on 6/1/2015; Add \$1.30/hr on 6/1/2016; Add \$1.25/hr on 6/1/2017. Premium Increase(s): DOT PREMIUMS: 1) Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day. 2) Add \$1.50/hr night work premium. See DOT'S website for details about the applicability of this night work premium at: http://www.dot.wi.gov/business/civilrights/laborwages/pwc.htm .	37.22	21.15	58.37
553	Air, Track, Rotary or Percussion Drilling Machine &/or Hammers, Blaster; Asphalt Heater, Planer & Scarifier; Asphalt Milling Machine; Asphalt Screed; Backhoe (Track Type) Having a Mfgr.'s Rated Capacity of Under 130,000 Lbs., Backhoe (Mini, 15,000 Lbs. & Under); Bituminous (Asphalt) Plant & Paver, Screed; Boring Machine (Directional, Horizontal or Vertical); Bulldozer or Endloader; Concrete Breaker (Large, Auto, Vibratory/Sonic, Manual or Remote); Concrete Conveyor System; Concrete Laser/Screed; Concrete Slipform Placer Curb & Gutter Machine; Crane (Carry Deck, Mini) or Truck Mounted Hydraulic Crane (10 Tons or Under); Crane With a Lifting Capacity of 25 Tons or Under; Forestry Equipment, Timbco, Tree Shear, Tub Grinder, Processor; Gradall (Cruz-Aire Type); Grader or Motor Patrol; Hydro-Blaster (10,000 PSI or Over); Loading Machine (Conveyor); Manhoist; Material or Stack Hoist; Mechanic or Welder; Milling Machine; Post Hole Digger or Driver; Railroad Track Rail Leveling Machine, Tie Placer, Extractor, Tamper, Stone Leveler or Rehabilitation Equipment; Roller (Over 5 Ton); Scraper (Self Propelled or Tractor Drawn) 5 cu yds or More Capacity; Shoulder Widener; Sideboom; Skid Rig; Stabilizing or Concrete Mixer (Self-Propelled or 14S or Over); Tractor (Scraper, Dozer, Pusher, Loader); Tractor or Truck Mounted Hydraulic Backhoe; Trencher (Wheel Type or Chain Type); Tube Finisher; Tugger (NOT Performing Work on the Great Lakes); Winches & A-Frames. Future Increase(s): Add \$1.60/hr on 6/2/2015; Add \$1.60/hr on 6/3/2016.	33.69	19.78	53.47

Fringe Benefits Must Be Paid On All Hours Worked

<u>CODE</u>	<u>TRADE OR OCCUPATION</u>	<u>HOURLY BASIC RATE OF PAY</u> \$	<u>HOURLY FRINGE BENEFITS</u> \$	<u>TOTAL</u> \$
554	Backfiller; Broom or Sweeper; Compactor (Self-Propelled or Tractor Mounted, Towed & Light Equipment); Concrete Finishing Machine (Road Type); Environmental Burner; Farm or Industrial Type Tractor; Fireman (Asphalt Plant, Pile Driver & Derrick NOT Performing Work on the Great Lakes); Forklift; Greaser; Hoist (Tugger, Automatic); Jeep Digger; Joint Sawyer (Multiple Blade); Launch (NOT Performing Work on the Great Lakes); Lift Slab Machine; Mechanical Float; Mulcher; Power Subgrader; Robotic Tool Carrier (With or Without Attachments); Roller (Rubber Tire, 5 Ton or Under); Self-Propelled Chip Spreader; Shouldering Machine; Skid Steer Loader (With or Without Attachments); Telehandler. Future Increase(s): Add \$1.25/hr on 6/1/2015; Add \$1.30/hr on 6/1/2016; Add \$1.25/hr on 6/1/2017.	36.17	20.80	56.97
555	Air Compressor (&/or 400 CFM or Over); Air, Electric or Hydraulic Jacking System; Augers (Vertical & Horizontal); Automatic Belt Conveyor & Surge Bin; Boiler (Temporary Heat); Crusher, Screening or Wash Plant; Generator (&/or 150 KW or Over); Heaters (Mechanical); High Pressure Utility Locating Machine (Daylighting Machine); Mudjack; Oiler; Prestress Machine; Pug Mill; Pump (3 Inch or Over) or Well Points; Rock, Stone Breaker; Screed (Milling Machine); Stump Chipper; Tank Car Heaters; Vibratory Hammer or Extractor, Power Pack. Future Increase(s): Add \$1.25/hr on 6/1/2015; Add \$1.30/hr on 6/1/2016; Add \$1.25/hr on 6/1/2017. Premium Increase(s): DOT PREMIUMS: 1) Pay two times the hourly basic rate on Sunday, New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day & Christmas Day. 2) Add \$1.50/hr night work premium. See DOT'S website for details about the applicability of this night work premium at: http://www.dot.wi.gov/business/civilrights/laborwages/pwc.htm .	36.17	21.15	57.32
556	Fiber Optic Cable Equipment.	27.89	17.20	45.09

***** END OF RATES *****

The documents following the Prevailing Wage Rate Determination consist of eighteen pages (including this one) of various forms/documents that will be used throughout the completion of the project. The chart below lists the form number, form/document name, the party who uses the document, and the document's number of pages. If you have any questions regarding these forms please call the Prevailing Wage Office at (608)266-6861.

ERD Form Number	Form Name	Party Who Uses the Form	Pages
	Prevailing Wage - Public Entity Project Owners	Explanation of project owner responsibilities	2
16056	Post the White Sheet	Contracting agency	1
10908	Consolidated List of Debarred Contractors	Any party contracting someone to complete work on a prevailing wage project	3
	Prevailing Wage – Contractors	Explanation of contractor responsibilities	2
7777	Disclosure of Ownership	Contractors that meet the criteria set out in (3)(A)&(B) of the form	1
5724	Prime Contractor Affidavit of Compliance	Prime contractor files with contracting agency upon completion of the work before receiving final payment	2
10584	Agent or Subcontractor Affidavit of Compliance	Subcontractors file with their awarding contractor upon completion of their work on the project before receiving final payment	2
10880	Request to Employ Subjourneyperson	Contractors wishing to employ a subjourneyperson(s)	1
	Additional General Prevailing Wage Law Information	General information for public entity or any other interested party	3

10/01/2014

PREVAILING WAGE – Public Entity Project Owners

Any public works project that has a total estimated project cost that equals or exceeds single-trade or multiple-trade project thresholds requires a prevailing wage rate determination issued by the Department of Workforce Development (DWD). Public works include erecting, constructing, remodeling, repairing, demolishing, alterations, painting and decorating projects for a local governmental unit or state agency. State law excludes minor service or maintenance work, warranty work, or work under a supply-and-installation contract. There is a statutory definition for most of these exclusions. The prevailing wage law that applies to local governmental units is §66.0903, Wis. Stats. The prevailing wage law that applies to state agencies is §103.49, Wis. Stats. The applicable administrative rules for all public entities are DWD 290 and DWD 294, Wis. Adm. Code.

Thresholds

- A “single-trade project of public works” means a project in which a single trade accounts for 85% or more of the total labor cost of the project. The single trade threshold is \$48,000.
- A “multiple-trade project of public works” means a project in which no single trade accounts for 85% or more of the total labor cost of the project.
- (a) The multiple-trade threshold is \$100,000, unless a municipality falls under the description in (b).
 - (b) The multiple-trade threshold of \$234,000 applies to public works projects erected, constructed, repaired, remodeled, or demolished by a private contractor for •a city or village with a population less than 2500 or •a town.

A local governmental unit or state agency that has a public works project that equals or exceeds the prevailing wage thresholds must do all of the following:

- Request a prevailing wage rate determination for the project from DWD at least 30 days before soliciting bids or negotiating contracts. An Application for Prevailing Wage Rate Determination is available on the DWD website: http://dwd.wisconsin.gov/er/prevailing_wage_rate/default.htm
To avoid waiting for a project determination use the on-line application system that permits the user to generate a determination immediately and save all documents in PDF form to the user’s computer. Use this project determination on line application at the following address:

http://dwd.wisconsin.gov/er/prevaling_wage_rate/pw_online_determinations.htm

- Tell potential contractors the project is subject to state prevailing wage law when soliciting bids.
- Include the prevailing wage rate determination in the construction contract, or if there is no written contract, provide a copy of the project determination to each prime contractor.
- Award contracts to contractors who do *not* appear on the “Consolidated List of Debarred Contractors.”
- Notify contractors that they are required to have a written substance abuse testing program in place that fulfills the requirements of §103.503, Wis. Stats., before commencing work on the prevailing wage project.
- Post the prevailing wage rate determination on the project site. (This document is often referred to as “the white sheet.”)
- Notify project contractors that if DWD finds that a contractor violated the prevailing wage law, DWD will assess liquidated damages of 100% of the wages owed to employees.
- Obtain an Affidavit of Compliance from each prime contractor before making final payment for the project.

If the total estimated cost of the project exceeds the prevailing wage thresholds, a local governmental unit or state agency also must obtain a prevailing wage rate determination under the following circumstances:

- when a completed facility is leased, purchased, lease-purchased or otherwise acquired by or dedicated to a public entity in lieu of the public entity contracting for the project,
- when one public entity does work for another public entity,
- when a *private* entity will construct a road, street, bridge, sanitary sewer or water main project and dedicate it to a local governmental unit or the state for its ownership or maintenance (except for some residential subdivisions).

For more information, visit the prevailing wage website: http://dwd.wisconsin.gov/er/prevaling_wage_rate/default.htm. For further assistance, call the Equal Rights Division at 608-266-6861 and ask for prevailing wage.

POST THE WHITE SHEET

As the public entity receiving this prevailing wage rate determination, **YOU ARE REQUIRED** by law to post the prevailing wage rate determination (i.e., white sheet) in at least one conspicuous and easily accessible place on the project site that is available to all construction workers. The white sheet must remain posted from the onset of the project until all construction labor on the project has been completed.

[See, Wis. Admin. Code §DWD 290.12(1)]

Posting the white sheet inside the general contractor's trailer does not meet this requirement. That placement is not available/accessible to all workers and is not a location over which you have control.

If you have questions about posting, please call (608)266-6861 and ask for prevailing wage intake.

State of Wisconsin - Department of Workforce Development

This list has been prepared in accordance with the provisions of §§66.0903(12) and 103.49(7), Wis. Stats., and Chapter DWD 294 of the Wisconsin Administrative Code. All contractors on this list were found to have committed a "debarable offense" related to certain labor standard provisions determined or established for a state or local public works project. No state agency, local governmental unit or owner or developer may knowingly solicit bids from, negotiate with or award any contracts to or approve or allow any subcontracts with a debarred contractor, including all divisions, affiliates or other organizational elements of such contractor that are engaged in construction business activities, until the debarment is terminated. The name of each debarred contractor must remain on this list for a period of three (3) years from the termination date indicated below. The contractor is, however, only "debarred" from the "effective date" through the "termination date" indicated for that contractor. Questions regarding this list should be addressed to Julie Eckenwalder, Equal Rights Division, P. O. Box 8928, Madison, WI 53708 or call (608) 266-3148. Deaf, hearing or speech-impaired callers may contact the department by calling its TDD number (608) 264-8752.

<u>Name of Contractor</u>	<u>Address</u>	<u>Effective Date</u>	<u>Termination Date</u>	<u>Cause Code</u>	<u>Date of Violation(s)</u>	<u>Limitations/Deviations</u>
A-1 Duran Roofing & Insulation Services, Inc.	3700 N Fratney St Milwaukee, WI 53212	11/1/14	10/31/17	1, 2 and 4	2011- 2012	None
Abel, Mike	8095 NW 64 th St Miami, FL 33166					
	See, Abel Electric, Inc					
Abel Electric, Inc	3385 Belmar Rd Green Bay, WI 54313	9/1/12	8/31/15	1	2011	None
Arnie Christiansen Mason Contractors, LLC	2304 65 th Dr Franksville, WI 53126	9/1/14	8/31/16	1, 2 and 4	2011	None
Atkins, Scott	See, Freedom Insulation, Inc					
Boecker, Roger	See, R-Way Pumping, Inc					
Brechtl, Mark G	See, Ecodec, Inc					
Cargill Heating and Air Conditioning Company, Inc	3049 Edgewater La La Crosse, WI 54603	3/1/14	2/28/17	1 and 2	2011	None
Castlerock Commercial Construction, Inc	PO Box 11699 Milwaukee, WI 53211-0699	2/1/12	1/31/15	1, 2 and 4	2009 & 2010	None

<u>Name of Contractor</u>	<u>Address</u>	<u>Effective Date</u>	<u>Termination Date</u>	<u>Cause Code</u>	<u>Date of Violation(s)</u>	<u>Limitations/Deviations</u>
Christiansen, Andy	See, Arnie Christiansen Mason Contractors, LLC					
Christiansen, Arnold	See, Arnie Christiansen Mason Contractors, LLC					
Darnick, Gregory L	See, Darnick Trucking, LLC					
Darnick Trucking, LLC	W914 County Rd V Berlin, WI 54923	11/1/14	10/31/15	1, 2 and 4	2012 & 2013	None
Dem/Ex Group, Inc	805 S Adams St Manito, IL 61546	12/1/11	11/30/14	1 and 2	2010	None
Duran, Bernardo	See, A-1 Duran Roofing & Insulation Services and RRS2 Inc					
Ecodec, Inc	5106 Wintergreen Dr Madison, WI 53704	10/1/14	9/30/17	1	2011 & 2012	None
Fisher, Ed &/or Fisher, Rhonda	See, Dem/Ex Group, Inc					
Freedom Insulation, Inc	117925 219th Ave Chippewa Falls, WI 54729	9/1/11	8/31/14	1	2008- 2010	None
Galstad, Michael E (aka Michael Earl Galstad)	See, Cargill Heating and Air Conditioning Company, Inc					
Gjolaj, Ded	See, Horizon Bros Painting Corp					
Horizon Bros Painting Corp	1053 Kendra La Howell, MI 48843	10/1/14	9/30/16	4	2012	None
JT Roofing, Inc	350 Tower Dr Saukville, WI 53080	6/1/12	5/31/15	1, 2 and 4	2007 & 2008	None

<u>Name of Contractor</u>	<u>Address</u>	<u>Effective Date</u>	<u>Termination Date</u>	<u>Cause Code</u>	<u>Date of Violation(s)</u>	<u>Limitations/Deviations</u>
Jinkins, Richard	See, Castlerock Commercial Construction, Inc					
Oden, Cassie	See, A-1 Duran Roofing & Insulation Services and RRS2 Inc					
Ofstie, Darin	See, Precision Excavating and Grading, LLC					
Peret, Robert	See, A-1 Duran Roofing & Insulation Services and RRS2 Inc					
Precision Excavating and Grading, LLC or Precision Excavating Enterprises, LLC	2104 Pierce Saint Croix Rd Baldwin, WI 54002	5/1/11	4/30/14	1, 2 and 4	2006- 2008	None
R-Way Pumping, Inc	3023 Lake Maria Rd Freeport, MN 56331	3/1/12	2/28/15	1, 2 and 4	2008	None
RRS2 Inc	133 N Jackson St, #427 Milwaukee, WI 53202 or 1313 N Franklin Pl, #805 Milwaukee, WI 53202	11/1/14	10/31/17	1, 2 and 4	2011- 2012	None
Thull, Gerald T	See, JT Roofing, Inc					

Cause Code: 1 = Failure to Pay Straight Time 2 = Failure to Pay Overtime 3 = Kickback 4 = Payroll Records.

PREVAILING WAGE – Contractors

Any public works project that has a total estimated project cost that equals or exceeds prevailing wage project thresholds requires a prevailing wage rate determination issued by the Department of Workforce Development (DWD). Public works include erecting, constructing, remodeling, repairing, demolishing, alterations, painting and decorating projects for a local governmental unit or state agency. State law excludes minor service or maintenance work, warranty work, or work under a supply-and-installation contract. There is a statutory definition for most of these exclusions. The prevailing wage laws that apply to local governmental units and their contractors are §§66.0903 and 103.503, Wis. Stats. The prevailing wage laws that apply to state agencies and their contractors are §§103.49 and 103.503, Wis. Stats. The applicable administrative rules for all prevailing wage projects are DWD 290 and DWD 294, Wis. Adm. Code. These laws include provisions that apply to all contractors and subcontractors working on prevailing wage projects.

Any contractor or subcontractor working on a local governmental unit or state agency's public works project that equals or exceeds current prevailing wage project thresholds must do all of the following:

- Receive and review the project's prevailing wage rate determination (i.e., white sheet).
- Tell subcontractors the project is subject to state prevailing wage law and include the prevailing wage rate determination in the construction contract, or if there is no written contract, provide a copy of the project determination to each subcontractor.
- Hire subcontractors who do *not* appear on the "Consolidated List of Debarred Contractors."
- Have a written substance abuse testing program in place that fulfills the requirements of §103.503, Wis. Stats., before commencing work on the project.

- Notify subcontractors that if DWD finds that a contractor or subcontractor violated the prevailing wage law, DWD will assess liquidated damages of 100% of the wages owed to employees.
- Apply to DWD for subjourney wage rates prior to employing these individuals on the project.
- Receive and retain a completed Affidavit of Compliance from each subcontractor brought on to the project before providing final payment to those subcontractors.
- Submit a completed Affidavit of Compliance to the contractor who brought the subcontractor on to the project before receiving final payment for the project.
- Maintain payroll records for 3 years that comply with §§66.0903(10)(a) or 103.49(5)(a), Stats. and DWD 274.06.
- Respond to requests from DWD or the project owner to provide payroll records and/or respond to prevailing wage complaints filed by employees or third parties.

For more information, visit the prevailing wage website: http://dwd.wisconsin.gov/er/prevailing_wage_rate/default.htm. For further assistance, call the Equal Rights Division at 608-266-6861 and ask for prevailing wage.

Disclosure of Ownership

The statutory authority for the use of this form is prescribed in Sections 66.0903(12)(d), 66.0904(10)(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, local governmental unit, or developer, investor or owner on a project subject to Section 66.0903, 66.0904 or 103.49, Wisconsin Statutes, the contractor shall disclose to such state agency, local governmental unit, or developer, investor or owner, 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), 66.0904(2), 103.49(2) and 103.50(2), Wisconsin Statutes.
- (3) This form must ONLY be filed, with the state agency project owner, local governmental unit project owner, or developer, investor or owner of a publicly funded private construction project 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; or
 - (2) 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

Business Name			
Street Address or P O Box	City	State	Zip Code
Business Name			
Street Address or P O Box	City	State	Zip Code
Business Name			
Street Address or P O Box	City	State	Zip Code
Business Name			
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			
Authorized Officer Signature		Date Signed	
Corporation, Partnership or Sole Proprietorship Name			
Street Address or P O Box	City	State	Zip Code

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

Prime Contractor Affidavit of Compliance With Prevailing Wage Rate Determination

Authorization for this form is provided under Sections 66.0903(9)(c), 66.0904(7)(c) and 103.49(4r)(c) 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)	Project Name		
	DWD Determination Number	Project Number (if applicable)	
)SS	Date Determination Issued	Date of Contract	
County Of)	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), 66.0904(7)(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 all the 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, Business, State Agency or Local Governmental Unit				
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		
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), 66.0904(7)(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, Section 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	
	DWD Determination Number	Project Number (if applicable)
	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), 66.0904(7)(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, Business, State Agency or Local Governmental Unit				
Street Address or PO Box	City	State	Zip Code	Telephone Number ()
Print Name of Authorized Officer			Date Signed	
Authorized Officer Signature				

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

Request to Employ Subjourneyperson

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). 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 use a subjourneyperson(s) on the following prevailing wage project, in accordance with the provisions of Section DWD 290.025, Wisconsin Administrative Code.

1. Name of Project Appearing on the Project Determination	
County	City, Village or Town
DWD Project Determination Number	Project Number (if applicable)
2. Job Classification(s) for which you request a subjourney rate (i.e., carpenter, electrician, plumber, etc.)	
a.	b.
c.	d.
3. Employer Name (Print)	
Address	Requester Name (Print)
Telephone Number ()	City
	State
	Zip Code
Email address (if you prefer to receive your response via email)	Fax Number (if you prefer to receive your response via fax) ()
READ CAREFULLY: I understand that this request is ONLY applicable to the project and job classification(s) listed above and that subjourney employees primarily work under the direction of and assist a skilled trade employee by frequently using the tools of a skilled trade and will NOT regularly perform the duties of a general laborer, heavy equipment operator or truck driver. If the subjourney employee regularly performs the work of a different trade or occupation, he/she will be compensated for such work at the applicable journeyperson prevailing wage rate. I agree to compensate subjourney employees in strict accordance with the directions received from the DWD.	
Requester Signature	Date Signed

MAIL the completed request to:
 EQUAL RIGHTS DIVISION, LABOR STANDARDS BUREAU
 PO BOX 8928, MADISON WI 53708

OR

FAX the completed request to: (608) 267-4592 / **DO NOT e-mail your request.**
 Call (608) 266-6861 for assistance in completing this form.

ADDITIONAL GENERAL PREVAILING WAGE LAW INFORMATION

(This document updated February 2014)

For prevailing wage laws and frequently asked questions, refer to the prevailing wage website at:
http://dwd.wisconsin.gov/er/prevailing_wage_rate/default.htm

Topic	Who's affected?	Brief description of requirement under §66.0903 or §103.49
Non-applicability	All public entities	Prevailing wage rates do not apply to minor service or maintenance work, warranty work, or work under a supply and installation contract.
Non-applicability: Minor service or maintenance work	Local governmental units & Contractors	Minor service or maintenance work means a project of public works that is limited to <ul style="list-style-type: none"> • minor crack filling, chip or slurry sealing, or other minor pavement patching, not including overlays, that has a projected life span of no longer than 5 years or that is performed for a TOWN and is not funded under §86.31, regardless of projected life span; • the depositing of gravel on an existing gravel road applied solely to maintain the road; • road shoulder maintenance; • cleaning of drainage or sewer ditches or structures; or • any other limited, minor work on public facilities or equipment that is routinely performed to prevent breakdown or deterioration.
Non-applicability: Minor service or maintenance work	State agencies	Minor service or maintenance work means a project of public works that is limited to <ul style="list-style-type: none"> • minor crack filling, chip or slurry sealing, or other minor pavement patching, not including overlays, that has a projected life span of no longer than 5 years; • cleaning of drainage or sewer ditches or structures; or • any other limited, minor work on public facilities or equipment that is routinely performed to prevent breakdown or deterioration.
Non-applicability: Supply & installation contract	All public entities	Supply and installation contract means a contract under which the material is installed by means of simple fasteners or connectors such as screws or nuts and bolts and no other work is performed on the site of the project of public works, and the total labor cost to install the material does not exceed 20 percent of the total cost of the contract.
Non-applicability: Work which a contractor or individual donates to a public entity	All public entities	Prevailing wage laws §§66.0903 & 103.49, Stats., do not apply to work performed on a project of public works for which the local governmental unit or the state or the state agency contracting for the project is not required to compensate any contractor, subcontractor, contractor's or subcontractor's agent, or individual for performing the work.

Topic	Who's affected?	Brief description of requirement under §66.0903 or §103.49
Non-applicability: Residential	All public entities	A prevailing wage rate determination is not required for the erection, construction, repair, remodeling, or demolition of a residential property containing 2 dwelling units or less.
Non-applicability: Residential subdivision infrastructure	All public entities	A prevailing wage rate determination is not required for a road, street, bridge, sanitary sewer, or water main project that is a part of a development in which at least 90 percent of the lots contain or will contain 2 dwelling units or less, as determined by the local governmental unit at the time of approval of the development, and that, on completion, is acquired by, or dedicated to, a local governmental unit (including under §236.13(2), Stats.), or the state, for ownership or maintenance by the local governmental unit or the state.
Electronic certified payroll record	Contractors	The requirement that every contractor on a prevailing wage project submit to DWD monthly a certified record of employees who worked on the project and that DWD post these certified records on its Internet website was discontinued effective July 1, 2011. Contractors are still required to maintain payroll records and provide them upon request from DWD &/or the project owner.
Payroll record inspection request by any person	Contractors & Complainants	Any person may request DWD to inspect the payroll records of any contractor working on a prevailing wage project. On receipt of such a request, the contractor must submit to DWD a certified record of its payroll records, other than personally identifiable information relating to an employee of the contractor, for no longer than a 4-week period. DWD may request records from a contractor under this provision no more than once per calendar quarter for each project of public works on which the contractor is performing work. The department may not charge a requester a fee for obtaining that information. DWD must make these certified records available for public inspection.
Statewide uniformity	Local governmental units	A local governmental unit may not enact & administer a prevailing wage ordinance/provision for public works or publicly funded private construction projects. Any extant laws to that effect are void.
Substance Abuse Testing	Contractors & Workers	Before commencing work on a prevailing wage project, a contractor must have a written substance abuse testing program in place that complies with §103.503, Wis. Stats. No employee may use, possess, attempt to possess, distribute, deliver, or be under the influence of a drug or under the influence of alcohol while performing work on a prevailing wage project.

Topic	Who's affected	Brief description of requirement under §66.0903 or §103.49
Covered employees	Truck drivers & Other workers & Contractors	<p>A laborer, worker, mechanic, or truck driver who is employed to process, manufacture, pick up, or deliver materials or products from a commercial establishment that has a fixed place of business from which the establishment supplies processed or manufactured materials or products or from a facility that is not dedicated exclusively, or nearly so, to a project of public works is NOT entitled to receive the prevailing wage rate UNLESS any of the following applies:</p> <ol style="list-style-type: none"> 1) the laborer, worker, mechanic, or truck driver is employed to go to the source of mineral aggregate such as sand, gravel, or stone and deliver that mineral aggregate to the site of a project of public works by depositing the material directly in final place, from the transporting vehicle or through spreaders from the transporting vehicle. 2) the laborer, worker, mechanic, or truck driver is employed to go to the site of a project of public works, pick up excavated material or spoil from the site of the project, and transport that excavated material or spoil away from the site of the project.

SECTION 01 00 00

BASIC REQUIREMENTS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Conditions of the Contract and portions of Division One of this Project Manual apply to this Section as though repeated herein.

1.02 SECTION SUMMARY

A. Section Includes:

1. Section Summary
2. Summary of the Work
3. Contractor Use of Premises
4. Applications for Payment
5. Alternates
6. Informational Bids
7. Unit Prices
8. Coordination
9. Cutting and Patching
10. Conferences
11. Progress Meetings
12. Submittal Procedures
13. Proposed Products List
14. Mock-Ups
15. Manufacturers' Instructions
16. Manufacturers' Certificates
17. Quality Assurance / Quality Control of Installation
18. Progress Cleaning
19. Temporary Facilities and Controls
20. Cold Weather Protection
21. Enclosures
22. Protection of Installed Work
23. Project Identification Sign
24. Products
25. Transportation, Handling, Storage and Protection
26. Equals and Substitutions
27. Starting Systems
28. Demonstration and Instructions
29. Contract Closeout Procedures
30. Adjusting
31. Operation and Maintenance Data
32. Spare Parts and Maintenance Materials
33. As-Built Drawings and Specifications

1.03 SUMMARY OF THE WORK

- A. Description: Perform the Work as specified and detailed in the Construction Documents package. Contractor is to provide construction services for a pre-engineered metal building addition of approximately 7,800 square feet, renovation of existing to add sorting and processing equipment (by Others under separate contract), restrooms, equipment and site improvements in Madison, Wisconsin. Along with Owner, coordinate with processing equipment Contractor solicited under

a separate bid.

- B. Work by Owner: Refer to Instructions to Bidders, Article 19.
 - 1. Soil Testing
 - 2. Concrete Testing
 - 3. Pavement marking and wheel stops
 - 4. Testing and Balancing for HVAC, Specification Section 23 05 93, will be contracted separately by Owner.
 - 5. Refer to General Conditions Article 16 for scope of testing of materials by Owner.
 - 6. Refer to General Conditions Article 12 for scope of permits and surveying provided by Owner.
- C. Permits: Prior to commencement of the Work, Contractor to secure any and all necessary permits for completion of the Work and facility occupancy except those noted to be provided by Owner in Article 12 of the General Conditions.
- D. Examination of Plans, Specification and Site: If in the opinion of the Contractor there are omissions or errors in the plans or specifications, the Contractor shall request clarification per the Instructions to Bidders, Article 3, Interpretation. In lieu of written clarification by addendum, resolve all conflicts in favor of the greater quantity or better quality.

1.04 CONTRACTOR USE OF PREMISES

- A. Refer to General Conditions Article 7. Limit use of premises to allow work by Contractors or Subcontractors, work by Owner, and access by Owner.
- B. Construction activities with significant noise or temporary disruption of services will be required to be coordinated and scheduled with Owner.
- C. Provide Vehicular Access, Parking, Barriers, Enclosures and Fencing as indicated on the site plan. Protect Work from theft, vandalism and unauthorized entry.

1.05 APPLICATIONS FOR PAYMENT

- A. Refer to General Conditions Article 25. Submit two (2) copies of each application on AIA G702™ and G703™ forms or approved Contractors invoice form.
- B. Content and Format: Utilize Schedule of Values for listing items in Application for Payment.
- C. Payment Period: Monthly.

1.06 ALTERNATES

- A. Refer to Instructions to Bidders Article 15.
- B. Coordinate related work and modify surrounding work as required.
- C. Schedule of Alternates:
 - 1. Alternate Bid #1: Hangar Door. State addition to the base bid to provide the Hangar Door as shown on the drawings and specification Section 08 34 16.
 - 2. Alternate Bid #2: LED Lighting. State addition to or deduction from the base bid to provide LED fixtures as scheduled in the Alternate Bid LED Light Fixture Schedule as shown on the electrical drawings.

3. Alternate Bid #3: Overhead Crane System. State addition to the base bid to provide the Overhead Crane System as shown on the drawings and specification Section 11 90 01
4. Alternate Bid #4A: Wood Grinder Feeder. State addition to the base bid to increase the 350 HP wood grinder motor feeder to a 500 HP grinder motor feeder as shown on the drawings and specifications.
5. Alternate Bid #4B: Wood Grinder Feeder. State addition to the base bid to increase the 350 HP wood grinder motor feeder to a 700 HP grinder motor feeder as shown on the drawings and specifications.
6. Alternate Bid #5: Bunker Walls Without Steel Liner. State deduction to base bid to eliminate the steel liners on the bunker walls under the sorting platform as shown on the drawings and specifications.
7. Alternate Bid #6: Electrical Service Size Reduction. State deduction to base bid to reduce the new electrical service size from 2500 amp, 480 volt, 3 phase to 2000 amp, 480 volt, 3 phase as described in the drawings and specifications.

1.07 INFORMATIONAL BIDS

- A. Refer to Instructions to Bidders Article 16 and Invitation to Bid.

1.08 UNIT PRICES

- A. Refer to Instructions to Bidders Article 17.
- B. Coordinate related work and modify surrounding work as required.
- C. Schedule of Unit Prices:
 1. Unit Price 1: Cut and Haul Additional Unsuitable Soils from Site
Provide price per cubic yard for cutting, loading, hauling unsuitable soil encountered, as determined by the soil testing agency, Engineer or Owner. Cut and Haul Additional Unsuitable Soils from Site volume will be measured jointly in the field by Engineer or Owner and Contractor. Refer to section 31 20 00 Excavating, Backfilling and Compaction.
 2. Unit Price 2: Furnish and Install 3" Dense Graded Base
Provide price per cubic yard for providing, placing and compacting 3" Dense Graded Base material to stabilize a soft subgrade in accordance with the project specifications. Furnish and Install Coarse Aggregate Material will be measured based on weight determined by quarry scale or site scale. Refer to section 31 20 00 Excavating, Backfilling and Compaction.

1.09 COORDINATION

- A. Coordinate scheduling, submittals, and work of various sections of Specifications to assure efficient and orderly sequence of installation of interdependent construction elements.
- B. Verify utility requirement characteristics of operating equipment are compatible with building utilities.
- C. Coordinate space requirements and installation of mechanical and electrical work that are indicated diagrammatically on Drawings.
- D. Coordinate work by Owner.
- E. The Contractor shall immediately upon entering the site for purpose of beginning work, locate general reference points and take such action as necessary to prevent their destruction. Contractor shall lay out its work and be responsible for all lines, elevations and measurements of the building and other work executed under its Contract. Contractor must exercise proper precaution to verify

dimensions on the drawings before laying out work and will be held responsible for any error resulting from failure to exercise such precaution.

As work progresses, the Contractor shall lay out on forms and the floor, the locations of all partitions, walls and fix column centerlines as a guide to all trades.

If property line stakes, benchmarks or datum point are lost, displaced or disturbed through neglect of the Contractor, the Contractor responsible shall pay the cost of restoration.

Contractor shall verify grades, lines, level, locations and dimensions as shown on drawings and report any errors or inconsistencies to the Public Works Project Manager and the Architect/Engineer before commencing work. Starting of work shall imply acceptance of existing conditions.

1.10 CUTTING AND PATCHING

- A. Employ a skilled and experienced installer to perform cutting and patching new work; restore work with new Products.
- B. Submit written request in advance of cutting or altering structural or building enclosure elements.
- C. Fit work tight to adjacent elements. Maintain integrity of wall, ceiling, or floor construction; completely seal voids.
- D. Refinish surfaces to match adjacent finishes.

1.11 CONFERENCES

- A. Dane County Department Public Works, Highway & Transportation will schedule a preconstruction conference after Award of Contract for all affected parties.
- B. When required in individual Specification section, convene a pre-installation conference at project site prior to commencing work of the section.

1.12 PROGRESS MEETINGS

- A. Architect/Engineer shall schedule and administer meetings throughout progress of the Work at minimum of two (2) per month.
- B. Architect/Engineer shall preside at meetings, record minutes, and distribute copies within three (3) days to those affected by decisions made.

1.13 SUBMITTAL PROCEDURES

- A. Contractor shall submit per General Conditions of the Contract Article 4. Contractor to electronically submit shop drawings for each submission. Printed copies to be submitted upon request.
- B. The Contractor shall submit at the pre-construction meeting a list of all known submittals required for the project.
- C. Submittal form to identify Project, Contractor, SubContractor or supplier; pertinent Construction Documents references, and submittal number. Submittals shall be organized by specification section, combined submittals will not be accepted. Contractor shall coordinate submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.

- D. Identify variations from Construction Documents and Product or system limitations that may be detrimental to successful performance of completing the Work.
- E. Include written warranties in all submittals per technical specification section. Include written warranties in Operation and Maintenance manual.
- F. Product Data to identify applicable products, models, options, and other data. Supplement manufacturer's standard data to provide information unique to this Project.
- G. Submit samples to illustrate functional and aesthetic characteristics of the Product. Submit samples of finishes from the full range of manufacturers' standard colors, textures, and patterns for Architect/Engineer's selection.
- H. Revise and resubmit submittals as required until receiving final approval; identify all changes made since previous submittal.

1.14 PROPOSED PRODUCTS LIST

- A. Within fifteen (15) days after date of Award of Contract, submit complete list of major Products proposed for use, with name of manufacturer, trade name, and model number of each Product.

1.15 MOCK-UP

- A. Notify Architect/Engineer 7 days in advance of the dates and times when mock-up will be prepared. Incorporate only previously submitted and approved materials representing the range of color specified.
- B. Refer to individual specification sections for additional mock-up requirements. Mock-up to reflect details within the Contract Documents.
- C. Approval of mock-ups does not constitute approval of deviations from the Contract Documents contained in the mock-ups unless Architect specifically approves such deviations in writing.

1.16 MANUFACTURERS' INSTRUCTIONS

- A. When specified in individual Specification sections, submit manufacturers' printed instructions for delivery, storage, assembly, installation, start-up, adjusting, and finishing, in quantities specified for Product Data.

1.17 MANUFACTURERS' CERTIFICATES

- A. When specified in individual Specification sections, submit manufacturers' certificate to Public Works Project Engineer and Architect/Engineer for review, 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.

1.18 QUALITY ASSURANCE / QUALITY 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 manufacturers' instructions.

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

1.19 PROGRESS CLEANING

- 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, crawl spaces and other remote or close spaces prior to enclosing spaces.
- C. Broom and vacuum clean interior areas prior to start of surface finishing, and continue cleaning to eliminate dust, debris and protect finished surfaces.

1.20 TEMPORARY FACILITIES AND CONTROLS

- A. Contractor shall provide and maintain a temporary watertight office where directed by the Public Works Project Manager. The office shall be equipped with a table suitable for examination of plans. Provide and maintain artificial light, a minimum of 40 foot-candles and two duplex outlets where directed. Exterior office shall be of neat appearance as deemed by the Public Works Project Manager. Provide fire extinguishers and heating, cooling and ventilation. Provide a table and chairs to accommodate construction progress meeting attendees. If other offices are provided, locate as agreed to by the Contractor and approved by the Public Works Project Manager.

- B. Contractor shall provide and maintain sanitary temporary toilets, located where directed by Public Works Project Manager, in sufficient number required for the force employed. The toilets shall comply with International Building Code Chapter 29 on Plumbing Systems. Toilets shall be self-contained chemical type.

- C. Temporary Water Service:

Owner will pay for 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.

Extend branch piping with outlets located so water is available by hoses with threaded connections. Provide temporary pipe insulation to prevent freezing.

- D. Temporary Electricity:

Owner will pay cost of energy used. Exercise measures to conserve energy. Utilize Owner's existing power service.

Provide temporary electric feeder from electrical service as directed by Owner. Do not disrupt Owner's use of service.

Complement existing power service capacity and characteristics as required for construction operations.

Provide power outlets, with branch wiring distribution boxes located as required for construction operations. Provide flexible power cords as required for portable construction tools and equipment.

Provide main service disconnect and over-current protection at convenient location.

Existing building convenience receptacles may not be utilized during construction.

- E. Temporary Lighting for Construction Purposes: Provide and maintain HID lighting for construction operations to a minimum level of 0.25 watt/sq. ft.

Provide and maintain 0.1 watt/sq. ft. lighting to exterior staging and storage areas after dark for security purposes.

Provide and maintain 0.25 watt/sq. ft. HID lighting to interior work areas after dark for security purposes.

Provide branch wiring from power source to distribution boxes with lighting conductors, pigtails, and lamps for specified lighting levels.

Maintain lighting and provide routine repairs.

Permanent building lighting may be utilized during construction with written permission of Division 26. Such usage shall not shorten guarantee period.

- F. Removal of Utilities, Facilities and Controls: Remove temporary utilities, equipment, facilities, materials, prior to Substantial Completion inspection.

Remove underground installations to minimum depth of 2 feet.

Clean and repair damage caused by installation or use of temporary work.

- G. Traffic Regulation: Post signage and provide traffic, cones, drums, flares, lights and trained flag persons as approved by authority having jurisdiction.

Consult with Dane County Public Works Project Manager and authority having jurisdiction to establish public thoroughfares to be used for haul routes and site access. Remove equipment at Substantial Completion and restore site.

- H. Water Control: Grade site to drain. Maintain excavations free of water. Provide, operate and maintain pumping equipment. Protect the site from puddling or running water.

- I. Dust Control: Execute Work by methods to minimize razing dust from construction operations. Provide positive means to prevent air-borne dust from dispersing into atmosphere.

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

- K. Pest and Rodent Control: Provide methods, means and facilities to prevent pests, insects and rodents from entering facility or damaging the Work.

1.21 COLD WEATHER PROTECTION

- A. All heating and protective covering, required to protect the work from injury due to freezing and moisture during the construction period and prior to enclosure of the building, shall be classed as COLD WEATHER PROTECTION. Such protection shall be provided and paid for by the Contractor.

- B. Provide and pay for heating devices and heat as need to maintain specified conditions for construction operations. Heat required to protect materials from injury due to freezing during the construction period prior to enclosure, shall be provided by means of portable heating units intended for this purpose. All heating units must be approved types. Proper ventilation must be provided. The use of temporary units whose product of combustion will damage fresh concrete, mortar or other building materials, will not be allowed. Use of coke or oil salamanders is prohibited. Heating units and the area surrounding the units shall be kept in a clean and safe condition.
- C. Equipment installed as a part of this project is not allowed to be used for building conditioning prior to Commissioning or Substantial Completion as determined by the Public Works Project Manager.

1.22 ENCLOSURE

- A. Before the building, or portion thereof, can be considered enclosed, the Contractor shall have advanced the construction of the building to conform with the following requirements.
- B. The exterior walls should be erected to full thickness and height shall extend to the top of the horizontal level which encloses the space intended to receive heat. If erection of full thick walls is not feasible, erection of back-up wall only will be accepted if approved weatherproofing of back up materials is provided to avoid damage to back-up materials. The entire overhead enclosure shall be made weatherproof.
- C. Provide approved translucent material for temporary enclosure of window openings if they have not been glazed. Plain or reinforced polyethylene film or other suitable translucent material will be acceptable, provided it is installed in or on a well-fitting rigid wood frame and kept in good repair. This means of temporary enclosure shall be used for other minor openings in walls.
- D. Construct temporary walls as required to protect contents and to separate interior enclosed sections from the interior open section of the building during construction. Temporary wall enclosure shall consist of plywood panels, at least 3/8" thick, fastened to wood framework, consisting of 2x4 studs spaced 24" o.c., securely spiked to wood plates, to and bottom. Temporary walls must provide protection from dirt, dust, and drafts. Make suitable provisions for passage of air to permit proper drying out of the building.
- E. Temporary enclosure shall provide for an orderly expansion of areas of work which are advantageous to the progress of the work and approved by the Public Works Project Manager.
- F. Provide and pay for cooling devices and cooling as needed to maintain specified conditions for construction operations. This includes dehumidification or temporary ventilation. Equipment installed as a part of this project is not allowed to be used for building conditioning prior to Commissioning or Substantial Completion as determined by the Public Works Project Manager.

1.23 PROTECTION OF INSTALLED WORK

- A. Protect installed work and provide special protection where specified in individual Specification sections.

1.24 PROJECT IDENTIFICATION SIGN

- A. Provide and install a project sign, 32 sq ft, bottom of sign 6 feet above ground. Content: Project, Owner and logo, names and title of Engineer, Architect and consultants, name of General Contractor and major Subcontractors, and rendering provided by Architect. Provide a submittal of project sign and installation methods for Architect approval. Remove sign and all supports upon project completion, restore area.

1.25 PRODUCTS

- A. Products: Means new material, machinery, components, equipment, fixtures, and systems forming the Work, but does not include machinery and equipment used for preparation, fabrication, conveying and erection of the Work. Products may also include existing materials or components specifically identified for reuse.
- B. Do not use materials and equipment removed from existing premises, except as specifically identified or allowed by Construction Documents.

1.26 TRANSPORTATION, HANDLING, STORAGE AND PROTECTION

- A. Transport, handle, store and protect Products in accordance with manufacturer's instructions.

1.27 EQUALS AND SUBSTITUTIONS

- A. Where definite material is specified, it is not intention to discriminate against "equal" product made by another manufacturer. Intention is to set definite standard of material quality. Material, equipment, or processes offered for use as an 'Equal' or 'Substitution' may be proposed by the Contractor in writing. Contractor shall submit said materials specifications electronically for Architect/Engineer and Public Works Project Manager approval prior to Bid Opening. Public Works Project Manager will provide decision on requested equal or substitution request prior to Bid Opening for submittals received at least ten (10) days prior to Bid Opening. Decisions on submittals made later than (10) days prior to Bid Opening may not be made prior to Bid Opening.
- B. Products and materials that are not specified, but have been approved for use by the Architect/Engineer and Public Works Project Manager shall be identified in addenda to all bidding Contractors.
- C. Document each request with complete data substantiating compliance of proposed Substitution with Construction Documents.

1.28 STARTING SYSTEMS

- A. Provide written notification Architect/Engineer and Public Works Project Manager prior to start-up of each equipment item or system.
- B. Ensure that each piece of equipment or system is ready for operation.
- C. Execute start-up under supervision of responsible persons in accordance with manufacturers' instructions.
- D. Submit written report that equipment or system has been properly installed and is functioning correctly.

1.29 DEMONSTRATION AND INSTRUCTIONS

- A. Demonstrate operation and maintenance of Products to Owner's personnel prior to date of final inspection.
- B. Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shutdown of each item of equipment at agreed-upon times, at designated location.

1.30 CONTRACT CLOSEOUT PROCEDURES

- A. Submit written certification that Construction Documents have been reviewed, the Work has been inspected, and the Work is complete in accordance with Construction Documents and ready for Architect/Engineer observation and Public Works Project Manager's inspection. Submit a list of any items that are not complete for Architect/Engineer review prior to scheduling substantial and final completion site visits.
- B. Execute final cleaning prior to final inspection.
- C. Submit final Application for Payment identifying total adjusted Contract Sum / Price, previous payments, and amount remaining due.

1.31 ADJUSTING

- A. Adjust operating Products and equipment to ensure smooth and unhindered operation.

1.32 OPERATION AND MAINTENANCE DATA

- A. Assemble a complete set of operation and maintenance data and warranties for all products and mechanical and electrical equipment supplied and installed in project. Submit (2) printed copies organized in 3 ring binders by specification section and electronically in PDF format with bookmarks by specification section. Identify with project name and 'Operation and Maintenance Manual'.

1.33 SPARE PARTS AND MAINTENANCE MATERIALS

- A. Provide Products, spare parts, maintenance and extra materials in quantities specified in individual Specification Sections.
- B. Deliver to the Work site and place in location as directed.

1.34 AS-BUILT DRAWINGS AND SPECIFICATIONS

- A. Contractor-produced Drawings and Specifications shall remain property of Contractor whether Project for which they are made is executed or not. Contractor shall furnish Public Works Project Manager with original tracings of drawings and prints of specifications in reproducible format, one set of Drawings and Specifications and one set of as-builts drawings in AutoCAD 2010 (or lower) format on CD.

PART 2 PRODUCTS

2.01 Not Used.

PART 3 EXECUTION

3.01 Not Used.

END OF SECTION

SECTION 01 74 19

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

- B. Related Sections:
 - 1. Section 01 00 00 - Basic Requirements
 - 2. Section 02 41 19 – Selective Demolition

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 Manager 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 Manager 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/pwht/recycle/categories.aspx lists current information for Dane County Recycling Markets. Contractors can also contact Dane County's Special Projects & Materials Manager at 608/266-4990, or local city, village, town recycling staff listed at site www.countyofdane.com/pwht/recycle/contacts.aspx. Statewide listings of recycling / reuse markets are available from UW Extension at www4.uwm.edu/shwec/wrmd/search.cfm.

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: _____

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

SECTION 01 91 00 COMMISSIONING

PART1 - GENERAL

1.01 SUMMARY

- A. Purpose: Define the responsibilities of the parties involved and the procedures related to the commissioning process.
- B. Related Sections
 - 1. 01 00 00 – Basic Requirements
 - 2. Division 23 – Heating, Ventilating, and Air Conditioning (HVAC)
 - 3. Division 26 – Electrical

1.02 REFERENCES

- A. ASHRAE Guideline 1.1-2007, "HVAC&R Technical Requirements for The Commissioning Process".
- B. ASHRAE Guideline 0-2005, "The Commissioning Process".
- C. NEBB – Procedural Standards for Building Systems Commissioning.

1.03 DEFINITIONS

- A. Acceptance Phase - phase of construction after startup and initial checkout when functional performance tests are performed.
- B. Commissioning Authority (CxA) - an independent entity, not otherwise associated with the A/E team members or the Contractor and reporting directly to the Owner. The CxA directs and coordinates the commissioning activities.
- C. Commissioning Plan (Cx Plan) - an overall plan, developed before or after bidding, that provides the structure, schedule and coordination planning for the commissioning process. The Cx Plan is included in the bid documents and is to be reviewed by all contractors before submitting their bid.
- D. Contract Documents - the documents binding on parties involved in the construction of this project (drawings, specifications, change orders, amendments, contracts, Cx Plan, etc.).
- E. Construction Checklist (CC) - a list of items to inspect and test equipment and components to verify proper installation of equipment. The CCs are provided by the CxA to the Sub.
- F. Construction Checklist Database - The Construction Checklist Database is a Web-based interfaced used to electronically collaborate and coordinate activities related to completing the Construction Checklists. The Construction Checklist Database is hosted by the CxA and is accessible by all Parties participating in the Cx process. Internet access at the project site is required to utilize all the features of the Construction Checklist Database. Smart Phones are not supported. Checklist database can alternatively be utilized in a traditional paper format.
- G. Datalogging - monitoring flows, currents, status, pressures, etc. of equipment using stand-alone dataloggers separate from the control system.
- H. Deferred System Performance Tests – SPT's that are performed later, after substantial completion, due to partial occupancy, equipment, seasonal requirements, design or other site conditions that prevent the tests from being performed earlier.

- I. Deficiency - a condition in the installation or function of a component, piece of equipment or system that is not in compliance with the Contract Documents (that is, does not perform properly or is not complying with the Owner's Project Requirements).
- J. Factory Testing - testing of equipment on-site or at the factory by factory personnel with an Owner's representative present.
- K. Indirect Indicators - indicators of a response or condition, such as a reading from a control system screen reporting a damper to be 100% closed.
- L. Manual Test - using hand-held instruments, immediate control system readouts or direct observation to verify performance (contrasted to analyzing monitored data taken over time to make the "observation").
- M. Monitoring - the recording of parameters (flow, current, status, pressure, etc.) of equipment operation using dataloggers or the trending capabilities of control systems.
- N. Over-written Value - writing over a sensor value in the control system to see the response of a system (e.g., changing the outside air temperature value from 75F to 50F to verify economizer operation). See also "Simulated Signal."
- O. Owner's Project Requirements (OPR) – A document that describes what the Owner and stakeholders want to achieve with this project and what expectations they have of the completed project.
- P. Sampling - reviewing or testing only a fraction of the total number of identical or near identical pieces of equipment.
- Q. Seasonal Performance Tests – SPT's that are deferred until the system(s) will experience conditions closer to their design conditions.
- R. Simulated Condition - condition that is created for the purpose of testing the response of a system (e.g., applying a hair blower to a space sensor to see the response in a VAV box).
- S. Simulated Signal - disconnecting a sensor and using a signal generator to send an amperage, resistance or pressure to the transducer and DDC system to simulate a sensor value.
- T. System Performance Test (SPT) - Dynamic testing of entire systems (rather than just components of the system) under full operation.
- U. Trending - monitoring using the building automation system.

1.04 DESCRIPTION

- A. General: Commissioning (Cx) is a systematic process of verifying that all building systems perform interactively to meet the Owner's Project Requirements (OPR). This is achieved by beginning in the planning phase with documenting the OPR and continuing through design, construction, acceptance, and the warranty period with verification of performance. The Cx process shall encompass and coordinate the traditionally separate functions of system documentation, equipment startup, control system calibration, testing and balancing, performance testing and training.

Cx during the construction phase is intended to achieve the following specific objectives according to the Contract Documents:

1. Verify that applicable equipment and systems are installed according to the manufacturer's recommendations and to industry accepted minimum standards and that they receive adequate operational checkout by installing contractors.
2. Verify and document proper performance of equipment and systems.
3. Verify that O&M documentation is complete.
4. Verify that the Owner's operating personnel are adequately trained.

- B. The Cx process does not take away from or reduce the responsibility of the system designers or installing contractors to provide a finished and fully functioning product.
- C. The commissioning authority (CxA) has no authority to change, modify or direct any work. The CxA can only provide comments and suggestions.
- D. Commissioning Plan. The Cx Plan provides guidance in the execution of the Cx process. The CxA will update the Cx Plan regularly as the project progresses. The Drawings and Specifications will take precedence over the Cx Plan

1.05 RESPONSIBILITIES

- A. General Contractor (GC) and Subcontractors (Subs)
 - 1. Construction and Acceptance Phase
 - a. Provide assistance to the Construction Manager CM in the coordination of the Cx work by the CxA, and with the CM and CxA ensure that Cx activities are being scheduled into the master schedule.
 - b. Provide an updated construction schedule to the CxA any time the schedule changes.
 - c. Include the Cx activities in the contract.
 - d. Furnish a copy of all submittals and shop drawings pertaining to the commissioned systems for review concurrently with the Architect and Engineers.
 - e. Furnish a copy of all construction meeting agendas and minutes to the CxA.
 - f. In each purchase order or subcontract written, include requirements for submittal data, O&M data, Cx tasks and training.
 - g. GC will ensure that all Subs execute their Cx responsibilities according to the Contract Documents and schedule.
 - h. A representative from the GC and each sub associated with the Cx process shall attend the Cx pre-construction meeting and the regular Cx meetings scheduled by the CxA to facilitate the Cx process.
 - i. Coordinate and execute the training of Owner personnel.
 - j. Prepare O&M manuals, according to the Contract Documents, including clarifying and updating the original sequences of operation to as-built conditions.
 - k. Prepare and submit draft forms, including but not limited to start-up procedures, Testing and Balancing (TAB) forms, calibration forms, etc. for review by the CxA before execution.
 - l. Submit test reports to the CxA of all tests performed on components and equipment to be commissioned that are not included as part of the Construction Checklist and SPT procedures.
 - m. Complete all construction checklist and functional performance test forms as required by the Cx process. Use of the Online Commissioning Database is optional. Internet access at the project site and a tablet is required to use the Online Commissioning Database. Smart Phones are not supported. Training on the use of the Online Commissioning Database will be provided by CxA.
 - n. Support the CxA with verification of the completion of construction checklist and functional performance tests as outlined in Part3.
 - o. Complete and inspect all installations. Certify that all components and systems are operating as intended per Contract Documents.
 - p. Remedy all deficiencies immediately as they are identified throughout construction.
 - q. Demonstrate functionality of all systems and equipment.
 - r. Maintain an updated set of record drawings (on a daily basis) on the construction site.
 - s. Provide support and instrumentation to verify TAB reports, start-up reports, calibration reports, and any other report pertinent to the commissioned equipment and systems.
 - t. Notify the CxA no less than 21 days before all testing, start-up, and training.

- u. Update the CxA on a weekly basis on the progress of the Cx activities.
 - v. Submit trend data in electronic format or allow access to trending data by internet connection as requested by the CxA.
 - w. Install access points by every sensor such that the sensor can be calibrated without removal (P/T plugs, plugged holes in ducts etc.).
2. Warranty Period
- a. Execute seasonal or deferred functional performance testing, witnessed by the CxA, according to the specifications.
 - b. Correct deficiencies and make necessary adjustments to O&M manuals and record drawings for applicable issues identified in any seasonal testing.
- B. Equipment Suppliers
- 1. Provide all requested submittal data, including detailed start-up procedures and specific responsibilities of the Owner to keep warranties in force.
 - 2. Assist in equipment testing per agreements with Subs.
 - 3. Include all special tools and instruments (only available from vendor, specific to a piece of equipment) required for testing equipment according to these Contract Documents in the base bid price to the Contractor, except for stand-alone datalogging equipment that may be used by the CxA.
 - 4. Provide information requested by CxA regarding equipment sequence of operation and testing procedures.
 - 5. Review test procedures for equipment installed by factory representatives.

1.06 SYSTEMS TO BE COMMISSIONED

- A. Heating and ventilation systems and associated controls, including the waste heat recovery system
- B. The electrical systems including electrical panels, transformers, motor control centers and electrical motors.
- C. Lighting and lighting controls

PART2 - PRODUCTS

2.01 TEST INSTRUMENTATION

- A. All instruments needed to verify sensor readings, component performance, and system performance will be provided by GC and Subs and be available to the CxA. These instruments will not be beyond what the contractors need to complete the work specified in these construction documents. Any data logging equipment required in addition to the BAS will be provided by the CxA.

PART3 - EXECUTION

3.01 COMMISSIONING TEAM

- A. The members of the commissioning team consist of the Commissioning Authority (CxA), the Owner's Project Manager (PM), the designated representative of the Owner's Construction Management firm (CM), the General Contractor (GC or Contractor), the architect and design engineers, the Mechanical Contractor, the Electrical Contractor, the TAB Contractor, the Controls Contractor, the Plumbing Contractor, and any other installing subcontractors or suppliers of equipment.
- B. Each Cx Team member shall designate one person who is responsible for coordinating the commissioning efforts with the CxA.

3.02 SCHEDULING AND MEETINGS

- A. Scheduling: The CxA will work with the other members of the Cx Team according to established protocols to schedule the Cx activities. The CxA will provide sufficient

notice to the Cx Team for scheduling Cx activities. The GC will integrate all Cx activities into the master schedule. All parties will address scheduling problems and make necessary notifications in a timely manner in order to expedite the Cx process.

- B. The CxA will provide the initial schedule of primary Cx events at the Cx pre-construction meeting. The Cx Plan provides a format for this schedule. As construction progresses more detailed schedules are developed by the CxA. The Cx Plan also provides a format for detailed schedules.
- C. Pre-Construction Meeting. Within 60 days of selection of the GC, the CxA will schedule, plan, and conduct a Cx pre-construction meeting with the entire Cx team in attendance. Meeting minutes will be distributed to all parties by the CxA. Information gathered from this meeting will allow the CxA to revise the Cx Plan which will also be distributed to all parties.
- D. Meetings: The Cx meetings will be scheduled approximately once a month during construction. These meetings will be scheduled directly before or after the regular construction meetings if practical. These meetings will cover coordination, deficiency resolution and planning issues with particular Subs. The CxA will plan these meetings and will minimize unnecessary time being spent by Subs

3.03 REPORTING

- A. The CxA will provide regular reports to the Owner as construction and Cx progresses. Standard forms are provided and referenced in the Cx Plan.
- B. The CxA will regularly communicate with all members of the Cx team, keeping them apprised of Cx progress and scheduling changes through memos, progress reports, etc.
- C. Testing or review approvals and non-conformance and deficiency reports are made regularly with the review and testing as described in later sections.

3.04 RECORD DRAWINGS

- A. The CxA will verify that the record drawings are updated throughout the construction. If a discrepancy is found between the record drawings and the installations, the CxA will notify the GC immediately but not reveal the details of the discrepancy. It is the GC and subcontractors responsibility to then inspect the installations and immediately and completely update the record drawings such that they accurately reflect the installation.

3.05 CONSTRUCTION COMMISSIONING PROCEDURES

- A. The following procedures apply to all equipment to be commissioned.
- B. General. Construction checklists are important to ensure that the equipment and systems are hooked up and operational. It ensures that system performance testing (in-depth system checkout) may proceed without unnecessary delays. Each piece of equipment receives full checkout. No sampling strategies are used. All construction checklists for a given system must be successfully completed prior to formal system performance testing of equipment or subsystems of the given system.
- C. Construction Checklists.
 - 1. The primary purpose of the construction checklists is to provide the individual workers with the key criteria for a successful installation. The secondary purpose is to track the progress of the delivery and installation.
 - 2. The CxA will develop construction checklists for all commissioned equipment and distribute these to the responsible contractor. The GC and Subs will review the construction checklists for each equipment type and provide comments to the CxA. The CxA will then print and distribute the construction checklist for each individual component.

3. Use of the Online Commissioning Database is optional.. Internet access at the project site and a tablet is required to use the Online Commissioning Database. Smart Phones are not supported. Training on the use of the Online Commissioning Database will be provided by CxA.
 4. The GC and Subs are responsible for all requirements in the specification, not only the requirements listed on the checklists.
 5. The checklists answer format will be to circle yes /no or provide a brief answer such as providing the model or serial numbers.
 6. These checklists are provided by the CxA to the GC. The GC determines which trade is responsible for executing and documenting each of the line item tasks and notes that trade on the form. Each form may have more than one trade responsible for its execution. A sample checklist for unit heater is provided at the end of this specification section.
 7. The construction checklists shall be completed as delivery is completed and the installation progresses.
 8. Only individuals who have direct knowledge and witnessed that a line item task on the construction checklist was actually performed shall initial or check that item off. It is not acceptable for supervisors without direct knowledge or who have not witnessed the line item task on the construction checklist to fill out these forms.
 9. Any negative response shall immediately be brought to the attention of the CxA. All negative replies shall be explained in detail on the construction checklist.
 10. The GC and Subs are responsible for recording the completion of the checklists. This recording shall be completed on a daily basis.
 11. Non-itemized installations such as wiring, ductwork, piping etc. will not have checklists to be completed, but the GC and Subs will be provided the key criteria for successful installation.
 12. The CxA will verify the construction checklist completion by a sampling of the delivered and installed equipment. The sampling process is described in the Cx Plan.
- D. Sensor Calibration. Calibration of all sensors shall be included as part of the construction checklists performed by the Contractors. Calibration information is provided in this specification section.
- E. Deficiencies, Non-Conformance and Approval in Checklists and Startup.
- a. The Subs shall clearly list any outstanding items of the construction checklist that were not completed successfully, at the bottom of the procedures form or on an attached sheet. The procedures form and any outstanding deficiencies are provided to the CxA within two days of task completion.
 - b. The CxA reviews the report and submits either a non-compliance report or an approval form to the Sub or CM. The CxA shall work with the Subs and vendors to correct deficiencies or uncompleted items. The CxA will involve the CM and others as necessary. The installing Subs or vendors shall correct all areas that are deficient or incomplete in the checklists and tests in a timely manner, and shall notify the CxA as soon as outstanding items have been corrected and include a Statement of Correction on the original non-compliance report. When satisfactorily completed, the CxA recommends approval of the completion of the checklists to the CM using a standard form.
 - c. Items left incomplete, which later cause deficiencies or delays during functional testing may result in backcharges to the responsible party.
- F. System Performance Tests (SPT). SPTs shall be performed to demonstrate that each system is operating according to the documented OPR and Contract Documents. System testing differs to the tests required in the Construction Checklist in that they facilitate bringing all the individual components together to verify that they operate collectively on a system level to provide the required design conditions.

1. Development of Test Procedures. The CxA shall prepare the SPT forms and procedures in accordance with the criteria defined in the Cx Plan. The GC and Subs shall assist the CxA in the preparation of these procedures by answering queries and forwarding site-specific information. A sample System Performance Test form is provided at the end of this specification section.
 2. Participation: The GC and the Subs are responsible for testing all systems to be commissioned such that they function as described in the contract documents. The CxA will verify the performance of the systems. The CxA will direct, witness and document the SPT verification and GC and Subs will execute the verification tests.
- G. Problem Solving. The CxA will recommend solutions to problems found, however the burden of responsibility to solve, correct and retest problems is with the GC, Subs and A/E.
- H. Seasonal Testing. During the warranty period, seasonal testing (tests delayed until weather conditions are closer to the system's design) shall be completed as part of this contract. The CxA shall coordinate this activity. Tests will be executed, documented and deficiencies corrected by the appropriate Subs, with facilities staff and the CxA witnessing. Any final adjustments to the O&M manuals and record documents due to the testing will be made.
- I. Unforeseen Deferred Tests. If any check or test cannot be completed due to the building structure, required occupancy condition or other deficiency, execution of checklists and functional testing may be delayed upon approval of the PM. These tests will be conducted in the same manner as the seasonal tests.

3.06 SENSOR AND ACTUATOR CALIBRATION

- A. Calibrate all field-installed temperature, relative humidity, carbon monoxide, carbon dioxide, and pressure sensors and gages, and all actuators (dampers and valves) on this piece of equipment shall be calibrated. Sensors installed in the unit at the factory with calibration certification provided need not be field calibrated.
- B. Calibrate using the methods described below; alternate methods may be used, if approved by Owner beforehand. See PART 2 for test instrument requirements. Record methods used on the relevant Prefunctional Checklist or other suitable forms, documenting initial, intermediate and final results.
- C. All Sensors:
1. Verify that sensor location is appropriate and away from potential causes of erratic operation.
 2. Verify that sensors with shielded cable are grounded only at one end.
 3. For sensor pairs that are used to determine a temperature or pressure difference, for temperature make sure they are reading within 0.2 degree F (0.1 degree C) of each other, and for pressure, within tolerance equal to 2 percent of the reading, of each other.
 4. Tolerances for critical applications may be tighter.
- D. Sensors Without Transmitters - Standard Application:
1. Make a reading with a calibrated test instrument within 6 inches (150 mm) of the site sensor.
 2. Verify that the sensor reading, via the permanent thermostat, gage or building automation system, is within the tolerances in the table below of the instrument-measured value.
 3. If not, install offset, calibrate or replace sensor.
- E. Sensors With Transmitters - Standard Application.
1. Disconnect sensor.

2. Connect a signal generator in place of sensor.
 3. Connect ammeter in series between transmitter and building automation system control panel.
 4. Using manufacturer's resistance-temperature data, simulate minimum desired temperature.
 5. Adjust transmitter potentiometer zero until 4 mA is read by the ammeter.
 6. Repeat for the maximum temperature matching 20 mA to the potentiometer span or maximum and verify at the building automation system.
 7. Record all values and recalibrate controller as necessary to conform with specified control ramps, reset schedules, proportional relationship, reset relationship and P/I reaction.
 8. Reconnect sensor.
 9. Make a reading with a calibrated test instrument within 6 inches (150 mm) of the site sensor.
 10. Verify that the sensor reading, via the permanent thermostat, gage or building automation system, is within the tolerances in the table below of the instrument-measured value.
 11. If not, replace sensor and repeat.
 12. For pressure sensors, perform a similar process with a suitable signal generator.
- F. Sensor Tolerances for Standard Applications: Plus/minus the following maximums:
1. Watthour, Voltage, Amperage: 1 percent of design.
 2. Pressure, Air, Water, Gas: 3 percent of design.
 3. Air Temperatures (Outside Air, Space Air, Duct Air): 0.4 degrees F (0.2 degree C).
 4. Relative Humidity: 4 percent of design.
 5. Barometric Pressure: 0.1 inch of Hg (340 Pa).
 6. Flow Rate, Air: 10 percent of design.
 7. Flow Rate, Water: 4 percent of design.
 8. Flow Rate, Steam: 3 percent of design.
 9. AHU Wet Bulb and Dew Point: 2.0 degrees F (1.1 degrees C).
 10. Hot Water Coil and Boiler Water Temperature: 1.5 degrees F (0.8 degrees C).
 11. Cooling Coil, Chilled and Condenser Water Temperatures: 0.4 degrees F (0.2 degree C).
 12. Combustion Flue Temperature: 5.0 degrees F (2.8 degrees C).
 13. Oxygen and CO2 Monitors: 0.1 percentage points.
 14. CO Monitor: 0.01 percentage points.
 15. Natural Gas and Oil Flow Rate: 1 percent of design.
- G. Critical Applications: For some applications more rigorous calibration techniques may be required for selected sensors. Describe any such methods used on an attached sheet.
- H. Valve/Damper Stroke Setup and Check:
1. For all valve/damper actuator positions checked, verify the actual position against the control system readout.
 2. Set pump/fan to normal operating mode.
 3. Command valve/damper closed; visually verify that valve/damper is closed and adjust output zero signal as required.
 4. Command valve/damper to open; verify position is full open and adjust output signal as required.
 5. Command valve/damper to a few intermediate positions.
 6. If actual valve/damper position does not reasonably correspond, replace actuator or add pilot positioner (for pneumatics).
- I. Isolation Valve or System Valve Leak Check: For valves not associated with coils.
1. With full pressure in the system, command valve closed.

2. Use an ultra-sonic flow meter to detect flow or leakage.

3.07 NON-CONFORMANCE

- A. All deficiencies or non-conformance issues shall be noted and reported by the GC to the CM on a standard non-compliance form.
- B. Corrections of minor deficiencies identified may be made during the tests at the discretion of the CxA. In such cases the deficiency and resolution will be documented on the procedure form.
- C. Every effort will be made to expedite the testing process and minimize unnecessary delays, while not compromising the integrity of the procedures. However, the CxA will not be pressured into overlooking deficient work or loosening acceptance criteria to satisfy scheduling or cost issues, unless there is an overriding reason to do so at the request of the CM and the Owner.
- D. As tests progress and a deficiency is identified, the CxA discusses the issue with the executing contractor.
 1. When there is no dispute on the deficiency and the Sub accepts responsibility to correct it:
 - a. The CxA documents the deficiency and the Sub's response and intentions and they go on to another test or sequence.
 - b. The CxA reschedules the test and the test is repeated.
 2. If there is a dispute about a deficiency, regarding whether it is a deficiency or who is responsible:
 - a. The deficiency shall be documented with the Sub's response and a copy given to the CM and to the Sub representative assumed to be responsible.
 - b. Resolutions are made at the lowest management level possible. Other parties are brought into the discussions as needed. Final interpretive authority is with the A/E. Final acceptance authority is with the Project Manager.
 - c. The CxA documents the resolution process.
 - d. Once the interpretation and resolution have been decided, the appropriate party corrects the deficiency, and notifies the CxA in writing. The CxA reschedules the test and the test is repeated until satisfactory performance is achieved.
 3. Cost of Retesting.
 - a. The cost incurred by the Subs to retest a construction checklist item or functional test, if they are responsible for the deficiency, shall be theirs. If they are not responsible, any cost recovery for retesting costs shall be negotiated with the GC.
 - b. For a deficiency identified, not related to any construction checklist or start-up fault, the following shall apply: The CxA and CM will direct the retesting of the equipment once at no "charge" to the GC for their time. However, the CxA's and CM's time for a second retest will be charged to the GC, who may choose to recover costs from the responsible Sub.
 - c. The time for the CxA and CM to direct any retesting required because a specific construction checklist or start-up test item, reported to have been successfully completed, but determined during functional testing to be faulty, will be backcharged to the GC, who may choose to recover costs from the party responsible for executing the faulty installation or test.
 - d. The Contractor shall respond in writing to the CxA and CM at least as often as Cx meetings are being scheduled concerning the status of each apparent outstanding discrepancy identified during Cx. Discussion shall cover explanations of any disagreements and proposals for their resolution.
 - e. Failure Due to Manufacturer Defect. If 10%, or three, whichever is greater, of identical pieces (size alone does not constitute a difference) of equipment fail to perform to the Contract Documents (mechanically or substantively) due to manufacturing defect, not allowing it to meet its submitted performance spec, all

identical units may be considered unacceptable by the CM or PM. In such case, the Contractor shall provide the Owner with the following:

- f. Within one week of notification from the CM or PM, the Contractor or manufacturer's representative shall examine all other identical units making a record of the findings. The findings shall be provided to the CM or PM within two weeks of the original notice.
 - g. Within two weeks of the original notification, the Contractor or manufacturer shall provide a signed and dated, written explanation of the problem, cause of failures, etc. and all proposed solutions which shall include full equipment submittals. The proposed solutions shall not significantly exceed the specification requirements of the original installation. The CM or PM will determine whether a replacement of all identical units or a repair is acceptable.
 - h. Two examples of the proposed solution will be installed by the Contractor and the CM will be allowed to test the installations for up to one week, upon which the CM or PM will decide whether to accept the solution.
 - i. Upon acceptance, the Contractor and/or manufacturer shall replace or repair all identical items, at their expense and extend the warranty accordingly, if the original equipment warranty had begun. The replacement/repair work shall proceed with reasonable speed beginning within one week from when parts can be obtained.
- E. Approval. The CxA notes each satisfactorily demonstrated function on the test form. Formal approval of the functional test is made later after review by the CxA and by the CM, if necessary. The CxA recommends acceptance of each test to the CM using a standard form. The CM gives final approval on each test using the same form, providing a signed copy to the CxA and the Contractor.

3.08 TRAINING

- A. The GC shall be responsible for training coordination and scheduling and ultimately for ensuring that training is completed. The GC shall ensure that the subs are aware of their training responsibilities as outlined in the contract documents. The CxA shall be responsible for reviewing and providing comments on the content and adequacy of the training of Owner personnel for the commissioned equipment.
- B. The O&M manual will be used as the "text book" for the training of the Owner personnel for the commissioned equipment. This will educate the maintenance staff about what information is available in the O&M manual. All other training material will be added to the O&M manual as a supplement.
- C. The commissioning authority (CxA) shall interview the facility manager and lead engineer to determine the special needs and areas where training will be most valuable. The Owner and CxA shall decide how rigorous the training should be for each piece of commissioned equipment. The CxA shall communicate the results to the Subs and vendors who have training responsibilities.
- D. Each Sub and vendor responsible for training will submit a written training plan to the CxA for review and approval prior to training. The plan will cover the following elements:
 - 1. Equipment (included in training).
 - 2. Intended audience
 - 3. Location of training
 - 4. Objectives
 - 5. Subjects covered (description, duration of discussion, special methods, etc.)
 - 6. Duration of training on each subject
 - 7. Instructor for each subject and qualifications
 - 8. Methods (classroom lecture, video, site walk-through, actual operational demonstrations, written handouts, etc.)

9. For the primary HVAC equipment, the Controls Contractor shall provide a short discussion of the control of the equipment during the mechanical or electrical training conducted by others.
10. The CxA develops criteria for determining that the training was satisfactorily completed, including attending some of the training, etc. The CxA recommends approval of the training to the CM using a standard form. The CM signs the approval form.
11. The amount of training time (active time in front of O&M staff, preparation time is excluded) provided shall be at a minimum that described in the specifications.
12. The CxA shall present a 1 hour presentation discussing the use of the blank system performance test forms for re-commissioning equipment.
13. The training sessions shall include classroom sessions and hands-on training detailing all normal and emergency modes of operation, manual and automatic operation, user interface instruction, maintenance issues, troubleshooting, spare parts, special tools etc.

E. Training sessions scheduling:

1. The first training session shall be scheduled before the equipment is hidden by ceiling tiles etc. This training session shall focus on the equipment location and system layout. In addition, the mechanical design engineer shall at the first training session present the overall system design concepts.
2. The second training session shall be conducted after the systems have been functionally verified. This training session shall focus on the operation of all equipment and systems including the building automation system. The mechanical and electrical design engineer shall at this second training session present the overall system design concept and the design concept of each equipment section. This presentation shall be 3 hours in length and include a review of all systems using the simplified system schematics (one-line drawings) including chilled water systems, condenser water or heat rejection systems, heating systems, fuel oil and gas supply systems, supply air systems, exhaust system, outside air strategies and plumbing systems.
3. The third training session shall be 2-6 months after substantial completion. This session shall focus on resolving any questions the maintenance staff has after operating the building for this period. The operating sequences will be discussed and any unclear O&M instruction explained. The third training session will focus on the building automation system.

3.09 SAMPLE DOCUMENTS

- A. The two documents after this section (Sample Construction Checklist and Sample System Performance Test) are included to demonstrate the level of effort and quality expected of the contractors. These documents will be revised as necessary as the project progresses.

END OF SECTION 01 91 00

DELIVERY CHECK

DATE _____

PRODUCT TAG: UH-1

PERFORMED BY: Mechanical Contractor

INITIALS _____

Fill in the Delivered product information. All discrepancies **MUST** be explained in "Notes" section below.

REF	ITEM	SUBMITTAL	DELIVERED
A	Manufacturer	Sterling	
B	Model #	HS-60	
C	Serial #		
D	Motor Hp/Voltage/Phase	(1/20)/115/1Ø	/ /

Notes (required for all no responses):

NOTES
050003001011



July 25, 2014

NO NOTES
050003001010

SAMPLE

PHYSICAL CHECK

DATE _____

PRODUCT TAG: UH-1

PERFORMED BY: Mechanical Contractor

INITIALS _____

Check the following items prior to mounting the unit heater.

Circle YES or NO for each question. Each NO response **MUST** be explained in the "Notes" section below.

REF	ITEM	RESPONSE	
A	The unit is physically undamaged	YES	NO
B	No signs of water damage	YES	NO
C	Wiring diagram and nameplate visible and matches unit configuration	YES	NO
D	Pipe connection plugs are in place and not damaged	YES	NO
E	Coils are secure and fins are not damaged	YES	NO
F	Installation and startup instructions included with unit	YES	NO
G	Unit is properly tagged	YES	NO

Notes (required for all no responses):

NOTES
050003001021



July 25, 2014

NO NOTES
050003001020

SAMPLE

INSTALLATION CHECK

DATE _____

PRODUCT TAG: UH-1

PERFORMED BY: Mechanical Contractor

INITIALS _____

Check the following items after the unit heater has been hung and before any duct, pipe or wiring connections have been made. Circle YES or NO for each question. Each NO response **MUST** be explained in the "Notes" section below.

REF	ITEM	RESPONSE	
		YES	NO
A	Unit identifier is correct and clearly visible	YES	NO
B	Unit nameplate and wiring diagram clearly visible and easy to read	YES	NO
C	Unit is properly mounted and supported	YES	NO
D	Service and maintenance clearances are adequate	YES	NO
E	Covering over pipe openings are secure and not breached	YES	NO

Notes (required for all no responses):

NOTES

050003001031



July 25, 2014

NO NOTES

050003001030

SAMPLE

HOT WATER PIPING CHECK

DATE _____

PRODUCT TAG: UH-1

PERFORMED BY: Mechanical Contractor

INITIALS _____

Check the following items after ducts and piping have been connected to the unit heater but before startup and controls tests are performed. Circle YES or NO for each question. Each NO response ***MUST*** be explained in the "Notes" section below.

REF	ITEM	RESPONSE	
A	Hot water return piped to top and hot water supply piped to bottom of coil	YES	NO
B	Piping installation allows for coil removal	YES	NO
C	Control valve, balancing valve, isolating valve, strainers and all other piping components are installed per Detail 3 on M503	YES	NO
D	Piping does not obstruct access and maintenance clearances	YES	NO
E	Manual air vent provided at high point of piping	YES	NO
F	Valves are tagged	YES	NO
G	All hot water piping is insulated	YES	NO

Notes (required for all no responses):

NOTES
050003001061



July 25, 2014

NO NOTES
050003001060

SAMPLE

ELECTRICAL CHECK

DATE _____

PRODUCT TAG: UH-1

PERFORMED BY: Electrical Contractor

INITIALS _____

Check the following items after ducts and piping have been connected and control and electrical wiring is completed. Circle YES or NO for each question. Each NO response **MUST** be explained in the "Notes" section below.

REF	ITEM	RESPONSE	
		YES	NO
A	Electrical and control wiring is installed per Specifications	YES	NO
B	All wire sizes are per Specifications	YES	NO
C	All electrical connections are grounded per Specifications	YES	NO
D	Disconnect switch is attached to or within proximity to unit heater	YES	NO

Notes (required for all no responses):

NOTES
050003001081



July 25, 2014

NO NOTES
050003001080

SAMPLE

MECHANICAL START-UP CHECK

DATE _____

PRODUCT TAG: UH-1

PERFORMED BY: Mechanical Contractor

INITIALS _____

Check the following items after piping has been connected and control and electrical wiring is completed. Circle YES or NO for each item. Each NO response **MUST** be explained in the "Notes" section below.

REF	ITEM	RESPONSE	
A	Unit operates without excessive noise or vibration	YES	NO
B	Fan rotates in the direction as indicated on the unit	YES	NO
C	Manufacturer's checklist has been completed	YES	NO

Notes (required for all no responses):

NOTES

050003001091



July 25, 2014

NO NOTES

050003001090

SAMPLE

CONTROLS CHECK

DATE _____

PRODUCT TAG: UH-1

PERFORMED BY: Controls Contractor

INITIALS _____

Check the following items after ducts and piping have been connected and control and electrical wiring is completed. Each NO response **MUST** be explained in the "Notes" section below.

REF	ITEM	RESPONSE	
		YES	NO
A	Unit Heater points are successfully linked to Building Automation System (BAS)	YES	NO
B	Graphical display representative of system configuration	YES	NO
C	Space temperature sensor calibrated and connected per Specifications	YES	NO
D	Heating control valves operating per Specifications	YES	NO
E	Heating control sequences function as per Specifications	YES	NO
F	Unoccupied control sequences function as per Specifications	YES	NO

Notes (required for all no responses):

NOTES

050003001101



July 25, 2014

NO NOTES

050003001100

SAMPLE

UNIT HEATERS



DATE _____

COMMISSIONING PARTICIPANTS:

	<u>Test Duty</u>	<u>Name</u>	<u>Company</u>
Commissioning Authority	Direct	_____	Sustainable Engineering Group
Control Contractor	Perform	_____	Automated Control Systems
Mechanical Contractor	Standby	_____	Year Mechanical
Plumbing Contractor	Standby	_____	Year Mechanical
Electrical Contractor	Standby	_____	Corbet Electric
TAB Contractor	Standby	_____	EB&T

Direct means that the Commissioning Authority will witness the tests and show the controls contractor which tests to execute.

Perform means that the contractor will be the one actually executing the test under the CxA directions

Standby means that the contractor is available to assist with operating equipment during the test if required.

The following system performance tests relate to the gas-fired unit heaters. The equipment to be tested includes the unit heaters and all related valves, piping, and sensors.

The contractors need to complete these tests on all equipment prior to verification by the CxA to ensure that the systems are functioning as required, and to ensure that the contractor is able to demonstrate the functionality of the systems as described in this document under the direction of the CxA without excessive time spent on determining how to perform the test procedures. The CxA will verify the performance on selected system(s) and modes. If the systems are not able to perform as required, retest will be required on the contractors' expense. **Verification of performance should not be considered a "troubleshooting" session, only a few minor corrections (implementation less than 15 min each occurrence, 1 hr accumulated) will be allowed during testing.**

1. SYSTEM PERFORMANCE TEST RESULTS:

After performing all the system performance tests included in this document the test results are rated as:

- Successful, No Comments
- Successful, Comments as Noted
- Deferred Seasonal Test Recommended
- Complete Retest Recommended
- Retest Recommended only on Noted Sections

Notes:

UNIT HEATERS



2. COMPLETED CONSTRUCTION CHECKLISTS

Confirm that the following construction checklists have been submitted and reviewed and that the equipment has been approved for system performance testing by checking the appropriate box.

Equipment	Tag ID	Delivery Check	Physical Check	Installation Check	Gas Piping Check	Ductwork Check	Electrical Check	Controls Check	Mechanical Startup Check
Unit Heater	UH-#	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	N/A	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Notes:

SAMPLE

UNIT HEATERS



3. INSTRUMENT LIST

The following is a list of required instrumentation to perform measurements and verification during this system performance test. It is the performing contractor's responsibility to provide this instrumentation. Included are measurement units and degree of accuracy; e.g. cfm, Amps, °F, "H2O, etc, and the acceptable calibration date range.

REF	INSTRUMENT	RANGE	ACCURACY	DATE OF CALIBRATION
A	Thermometer	0-150 °F	±0.5 °F	After Nov. 2009

4. VISUAL INSPECTION OF SYSTEM

Before starting the system performance test, perform a visual inspection of the building and major equipment related to the unit heater systems. Note any items that may be of importance when reviewing the test data.

Notes:

A series of horizontal lines for taking notes, overlaid with a large, diagonal red watermark that reads "SAMPLE".

SYSTEM PERFORMANCE TEST:
UNIT HEATERS

Dane Cty. – East Garage



5. CURRENT CONDITIONS

Record the following setpoint and scheduling information. All of these values will be returned to their pre-test value unless noted otherwise.

ITEM	PRE-TEST VALUE	END TEST VALUE	NOTES
UH-xx Space Setpoint			

6. DEVICE CALIBRATION CHECK

Check calibration of devices such as temperature sensors. Verify that the reading obtained from the sensor matches the actual physical condition.

Device or Actuator & Location	Procedure / State	BAS Reading	Physical Reading	Pass Y/N
UH-1 temperature sensor	Compare measured value to reading			
UH-2 temperature sensor	Compare measured value to reading			
UH-3 temperature sensor	Compare measured value to reading			
UH-4 temperature sensor	Compare measured value to reading			
UH-5 temperature sensor	Compare measured value to reading			
UH-6 temperature sensor	Compare measured value to reading			
UH-7 temperature sensor	Compare measured value to reading			
UH-8 temperature sensor	Compare measured value to reading			
UH-9 temperature sensor	Compare measured value to reading			
UH-10 temperature sensor	Compare measured value to reading			
UH-11 temperature sensor	Compare measured value to reading			
UH-12 temperature sensor	Compare measured value to reading			
UH-13 temperature sensor	Compare measured value to reading			
UH-15 temperature sensor	Compare measured value to reading			
UH-15 temperature sensor	Compare measured value to reading			
UH-16 temperature sensor	Compare measured value to reading			
UH-17 temperature sensor	Compare measured value to reading			
UH-18 temperature sensor	Compare measured value to reading			



UNIT HEATERS

Device or Actuator & Location	Procedure / State	BAS Reading	Physical Reading	Pass Y/N
UH-19 temperature sensor	Compare measured value to reading			
UH-20 temperature sensor	Compare measured value to reading			
UH-21 temperature sensor	Compare measured value to reading			
UH-22 temperature sensor	Compare measured value to reading			
UH-23 temperature sensor	Compare measured value to reading			
UH-24 temperature sensor	Compare measured value to reading			

SAMPLE



UNIT HEATERS

7. BAS DATA TRENDING

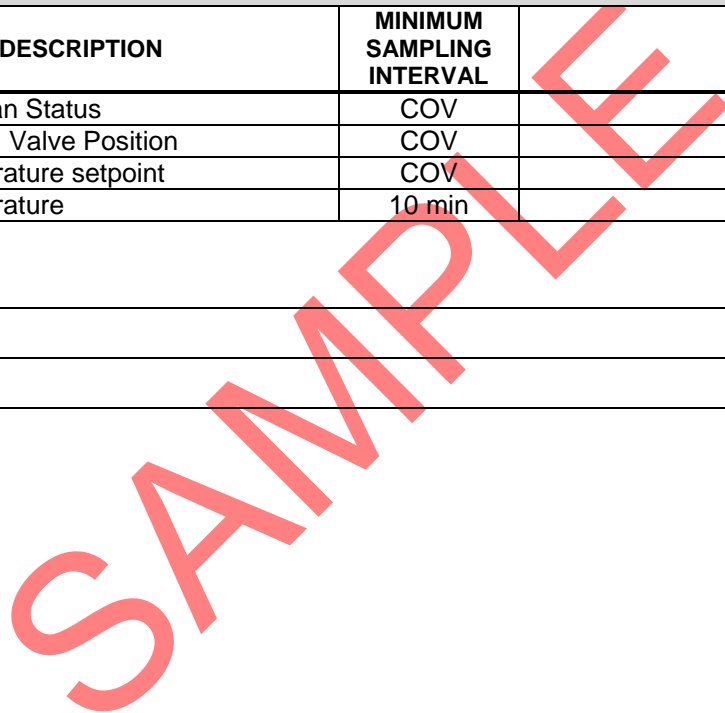
Prior to starting the system performance tests begin the collection of data as shown below using trend logs on the BAS. The purpose of collecting this data is to record the results of the tests and to verify the BAS performance, i.e. speed of response to step changes, no oscillations, etc. To do this we need a short sampling interval on all points that can change rapidly. A longer interval is acceptable for points that will not change quickly. For simplicity it may be easier to select the same sampling interval for all points (i.e. 1 min.). **Controls contractor must set up these trends before test and provide the data electronically no later than 1 week after test.** The trends should be set up for the following points:

Start Date: _____

Start Time: _____

BAS TRENDING			
POINT ID	DESCRIPTION	MINIMUM SAMPLING INTERVAL	Y/N
	UH Supply Fan Status	COV	
	Water Control Valve Position	COV	
	Space temperature setpoint	COV	
	Space temperature	10 min	

Notes:





UNIT HEATERS

8. GENERAL CONDITIONS OF TEST

The testing of the penthouse heating systems served by UH-1, UH-2, UH-3, and UH-4 shall verify that the systems operate as per the control sequences detailed in the project specifications. The tests shall demonstrate that the following functions are working correctly:

- Failure conditions (power failure, low temperature alarm)
- Off / On modes
- Heating mode

9. ALARM AND FAILURE TESTING PROCEDURES AND RECORD

8a. POWER FAILURE					
This test procedure is written for ambient conditions being such that heating mode can be achieved. This test may need to be completed at a later date when the ambient conditions are fit for the heating mode (54°F or less).					
STEP	ACTION	VERIFICATION	SUCCESS		COMMENT
			Yes	No	
1.	If necessary, raise the unit heater temperature setpoints so there is a call for heat. Cut power to Unit Heaters	Fan turns off			
		Control valve opens			
2.	Return power to Unit Heaters	Fan turns on			
		Control valve opens			

8b. LOW TEMPERATURE ALARM					
This test procedure is written for ambient conditions being such that heating mode can be achieved. This test may need to be completed at a later date when the ambient conditions are fit for the heating mode (54°F or less).					
STEP	ACTION	VERIFICATION	SUCCESS		COMMENT
			Yes	No	
1.	Verify low temperature alarm is set for 40°F.	BAS indicates low temperature alarm is 40°F.			
2.	Reset alarm setpoint above current space temperature.	Alarm occurs at BAS			
3.	Reset alarm setpoint to original value	Alarm clears at BAS			

UNIT HEATERS

10. SYSTEM TESTING PROCEDURES AND RECORD

9a. HEATING MODE					
This test may need to be completed at a later date when the ambient conditions are fit for the heating mode (54°F or less).					
STEP	ACTION	VERIFICATION	SUCCESS		COMMENT
			Yes	No	
1.	If necessary, raise the unit heater temperature setpoints so that the space temperature is 5°F lower than the space setpoint.	Unit heater fans turns on.			
		Hot water control valve opens			
		Fan has minimum run time of 10 minutes.			
		Space reaches setpoint			
		Fan turns off and control valve closes.			
2.	Reset the heating temperature setpoints back to specified values	Heaters return to normal operation or turn off if the heating temperature setpoints are satisfied.			
3.	Verify that the unit heaters can be scheduled to an occupied mode				
4.	Verify that unit heaters can temporarily overridden at space temp sensor to the occupied mode.				

SAMPLE

- END OF TEST -

SECTION 02 41 19

SELECTIVE DEMOLITION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Conditions of the Contract and portions of Division One of this Project Manual apply to this Section as though repeated herein.

1.02 WORK INCLUDED

- A. The work under this section shall consist of providing all work, materials, labor, equipment, and supervision necessary to provide for the demolition of such features as required in these specifications and on the drawings. Included are the following:
 1. Demolish pre-engineered metal building components, concrete, hollow metal frames, overhead doors and other items as indicated on drawings.
 2. Protect portions of building adjacent to or affected by selective demolition. Take appropriate measures to protect existing facilities operations against dust contamination. Materials shall be removed from the existing building without disruption to the Owner or facility operations.
 3. Remove and legally dispose of demolished materials off-site.
 4. Demolish and salvage for reuse those items noted on the drawings.
 5. Recycle as per requirements of Section 01 74 19.

1.03 SUBMITTALS

- A. For utilities or other services requiring removal or abandonment in-place, submit materials documenting completion of such work.
- B. Submit copies of records documenting recycling of demolition materials from the site.

1.04 DEFINITIONS

- A. "Remove": Remove and legally dispose of items, except those indicated to be reinstalled.
- B. "Remove and Reinstall": Remove items indicated; clean, service and otherwise prepare them for reuse; store and protect against damage. Reinstall in the same location or in locations indicated.
- C. "Existing to Remain": Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by the A/E, items may be removed to a suitable, protected storage location during selective demolition and then cleaned and reinstalled in their original locations.

1.05 QUALITY ASSURANCE

- A. Comply with governing codes and regulations.

1.06 RECORD DRAWINGS

- A. Maintain record drawings showing actual locations of utilities and other features encountered, and any deviations from the original design. Show actual limits of removal and demolition.

1.07 SAFETY

- A. Verify that all gas and electrical utilities have been abandoned or disconnected and associated hazards mitigated, prior to beginning any demolition.
- B. Take all necessary precautions while dismantling piping containing gas, gasoline, oil or other explosive or toxic fluids or gases. Purge lines and contain materials in accordance with all applicable regulations. Store such piping outdoors until fumes are removed.
- C. Maintain a clean and orderly site. Remove debris at end of each workday.
- D. If hazardous materials are not anticipated, but encountered, terminate operations and contact the Owner immediately. Follow all applicable local, state and federal regulations pertaining to hazardous materials.

1.08 PERMITS

- A. Unless otherwise noted, Contractor shall be responsible for obtaining and paying for all permits necessary to complete demolition work.
- B. If necessary, file and maintain Notification of Demolition and/or Renovation and Application for Permit Exemption (WDNR Form 4500-113) in accordance with the Wisconsin Administrative Code Chapter NR447.

1.09 DISCONNECTION OF SERVICES

- A. Prior to starting removal and/or demolition operations be responsible and coordinate disconnection with owner of all existing utilities, communication systems, alarm systems and other services.
- B. Disconnect all services in manner which insures continued operation in facilities not scheduled for demolition.
- C. Disconnect all services in manner which allows for future connection to that service.
- D. Disconnect services to equipment at unions, flanges, valves, or fittings wherever possible.

1.010 REMOVAL/SALVAGING OF ITEMS

- A. Carefully remove all items that are scheduled to be salvaged.
- B. Secure salvaged items to allow for future movement; provide pallets, skids and other devices as necessary. Secure all loose parts.
- C. Provide crates, padding, tarps and other measures necessary to protect salvaged items during storage. Store items in secure location, safe from vandalism, weather, dust and other adverse elements.
- D. Where salvaged items are indicated to be turned over to Owner, deliver to location on property where designated by Owner.
- E. Where indicated to be incorporated into new work, store the salvaged item in secure location until trade responsible for re-installation mobilizes his equipment and storage facilities to the site, or otherwise accepts responsibility for the salvaged item.
- F. Items of salvage value that are not to be returned to the Owner shall be removed from the structure. Storage or sale of such salvage items at project site is prohibited.

PART 2 - PRODUCTS

2.01 EQUIPMENT

- A. Use Contractor's normal equipment for demolition purposes and which meets all safety requirements imposed on such equipment.

PART 3 - EXECUTION

3.01 GENERAL

- A. Examine all areas of work, verify all existing conditions, and report any unsatisfactory conditions.

3.02 PROTECTION OF EXISTING WORK AND FACILITIES

- A. Verify the locations of, and protect, any building elements, utilities, and all other such facilities that are intended to remain or be salvaged.
- B. Make such explorations and probes as necessary to ascertain any required protection measures that shall be used before proceeding with demolition.
- C. Take all measures necessary to safeguard all existing work and facilities which are outside the limits of the work.
- D. Furnish and install temporary enclosures or other barriers as shown on the plans or as otherwise necessary to protect existing features.
- E. Protect adjacent interior areas from collection of dust and noxious fumes. Seal HVAC system ductwork and grilles to prevent contamination of building or mechanical systems.
- F. Provide protection for workers, public, adjacent construction and occupants of existing building(s).
- G. Report damage of any facilities or items scheduled for salvaging to the Owner.
- H. Repair or replace any damaged facilities that are not scheduled for demolition.
- I. Do not damage building elements and improvements indicated to remain.
- J. Do not close or obstruct walks, drives, other occupied or used spaces, or facilities without the written permission from the owner, A/E and the authorities having jurisdiction.
- K. Do not interrupt utilities serving occupied facilities without permission from the owner, A/E and authorities having jurisdiction. If necessary, provide temporary utilities.
- L. Cease operations if public safety or remaining structures are endangered. Perform temporary corrective measures until operations can be continued properly.
- M. If necessary, provide additional materials to protect existing building components that are to remain.
- N. Where necessary to prevent collapse of any construction, install temporary shores, struts or bracing. Do not commence demolition work until all temporary construction is complete.

- O. Take precautions to guard against movement, settlement or collapse of any surrounding construction designated to remain and be liable for any such movement, settlement or collapse.

3.03 DEMOLITION

- A. Remove all equipment, fixtures and other materials scheduled for salvage prior to beginning demolition operations.
- B. Abandon gas, electric and communication utilities in accordance with local utility company requirements, or applicable substantive requirements if considered private.
- C. Remove all sealant, fasteners and damaged or rotten blocking from existing construction to remain where demolition occurs.

3.04 TRANSPORTATION AND DISPOSAL OF DEMOLITION WASTE

- A. Transport and dispose all demolition waste in accordance with local, state, and federal guidelines.
 - 1. Recycle fluorescent lamps and other lamps containing heavy metals with a company engaged in the proper handling and recycling of these materials.
 - 2. Properly dispose of any lamp ballasts containing PCB's.
- B. Whenever possible, or otherwise required by the Contract Documents, recycle demolition waste.
- C. Demolition waste that cannot be recycled shall be disposed of at a landfill or dumpsite designed and approved to accept the given waste.
- D. Maintain records documenting recycling of demolition waste. Record description of material, date removed, quantity removed and recycling destination.
 - 1. Provide copies of records to A/E at completion of project.

3.05 SCHEDULE

- A. Items to be removed shall be as indicated on the Drawings.
 - 1. Items to be stored and reinstalled.
 - 2. Items to be removed from site by Contractor.
- B. Items to remain (if clarification required).

3.06 CLEANING

- A. All adjacent areas shall be broom cleaned and ready to receive new construction.
- B. Remove from the site all debris resulting from the Work of this Section.

END OF SECTION 02 41 19

SECTION 03 30 00

CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section specifies cast-in place concrete, including formwork, reinforcement, concrete materials, accessories, mixture design, placement procedures, and finishes.
- B. See Division 31 Section "Earth Moving" for drainage fill under slabs-on-grade.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Design Mixtures: For each concrete mixture.
- C. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.
- D. Field quality-control test reports.
- E. Material Certificates: For each of the following, signed by manufacturers:
 - 1. Cementitious materials.
 - 2. Admixtures.
 - 3. Form materials and form-release agents.
 - 4. Steel reinforcement and accessories.
 - 5. Fiber reinforcement.
 - 6. Curing compounds.
 - 7. Floor and slab treatments.

1.3 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
 - 1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."
- B. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:

1.4 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 the 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. Resident Project Representative
 - 6. Architect/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 the proposed mix design and placing can produce concrete quality required by this Section.
- E. Contractor shall notify Architect/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-FACING MATERIALS

- A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
- B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.

2.2 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.
- B. Plain-Steel Welded Wire Reinforcement: ASTM A 185, plain, fabricated from as-drawn steel wire into flat sheets.
- C. Deformed-Steel Welded Wire Reinforcement: ASTM A 497, flat sheet.
- D. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice."

1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.
2. For epoxy-coated reinforcement, use epoxy-coated or other dielectric-polymer-coated wire bar supports.

2.3 SLAB DOWELS IN TIPPING SLAB

- A. Dowels: 3/4" x 4 1/2" x 4 1/2" diamond plate dowels
- B. Diamond plate dowel pocket former
- C. Manufacturer:
 1. PNA Construction Technologies.
 2. Substitutions: As approved by Engineer

2.4 TIPPING SLAB 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" 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 Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:
 1. Portland Cement: ASTM C 150, Type I/II. Supplement with the following:
 - a. Fly Ash: ASTM C 618, Class C.
 - b. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.
 2. Normal-Weight Aggregates: ASTM C 33 Free of materials with deleterious reactivity to alkali in cement.
- B. Water: ASTM C 94/C 94M and potable.
- C. Air-Entraining Admixture: ASTM C 260.
- D. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
 1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
 2. Retarding Admixture: ASTM C 494/C 494M, Type B.
 3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
 4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.

5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

2.6 CURING MATERIALS

- A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
- B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.
- C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- D. Water: Potable.
- E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.
- F. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, nondissipating, certified by curing compound manufacturer to not interfere with bonding of floor covering.
- G. Clear, Waterborne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.

2.7 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber or ASTM D 1752, cork or self-expanding cork.

2.8 CONCRETE MIXTURES

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.

Concrete Mix Design Schedule							
Type of construction	28 day strength (psi) (ASTM C39)	Max Slump +/- 1" (inches) (ASTM C143) (D)	Maximum aggregate size (inch)	Percent of air entraining +/- 1-1/2%	Maximum water/cementitious material ratio	Minimum Cementitious Materials per cubic yard	Additional Comments
Footings	3000	4	1½"	--	--	--	(A)
Foundation and Exterior Exposed Walls	4000	3	1	4-1/2	--	--	(A)
Interior Exposed Walls	4000	3	1	--	--	--	(A)

Tipping Slab on Grade	6000	3	1½"		0.45		(B) (E) (F)
Other Interior Slab on Grade	4000	3	1	--	--	520	(B) (E)
Exterior Slab on Grade	4500	3	1	6	0.45	520	(B) (E)
Miscellaneous	4000	3	1	(C)	--	--	(A) (E)

Comments:

- A) Maximum replacement of cementitious materials by weight flyash 25%, slag 50%, Limit total replacement of cementitious materials to 50%
- B) Maximum replacement of cementitious materials by weight flyash 15%, slag 30%, Limit total replacement of cementitious materials to 30%,
- C) Provide 4-1/2% Air Entrainment At Exposed Conditions
- D) Slump may be increased when chemical admixtures are used, provided that the admixture treated concrete has the same or lower water-cement ratio and does not exhibit segregation potential or excessive bleeding.
- E) Concrete supplier and finisher shall coordinate approximate set times of proposed mix design under various weather conditions and adjust mix design as necessary to assure set time is acceptable to complete placing and finishing of slab in a timely manner.
- F) Steel Fiber Reinforcement: 55 lbs/cy of Bekaert Corporatoin – Dramix RC 80/60 BN or approved equal

2.9 FABRICATING REINFORCEMENT

- A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.10 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M and ASTM C 1116, and furnish batch ticket information.
 - 1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

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 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 of ACI 117.
- C. Chamfer exterior corners and edges of permanently exposed concrete.

3.2 EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

3.3 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.
 - 1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would reduce bond to concrete.
- C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.
 - 1. Weld reinforcing bars according to AWS D1.4, where indicated.
- D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
- E. Install welded wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

3.4 JOINTS

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
- C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:
 - 1. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.
- D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.

3.5 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.
- B. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.
 - 1. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
- C. Cold-Weather Placement: Comply with ACI 306.1.
- D. Hot-Weather Placement: Comply with ACI 301.

3.6 FINISHING FORMED SURFACES

- A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
 - 1. Apply to concrete surfaces not exposed to public view .
- B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
- C. Rubbed Finish: Apply the following to smooth-formed finished as-cast concrete where indicated:
 - 1. Smooth-Rubbed Finish: (This includes the inside face of the basement wall) Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.
- D. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.

3.7 FINISHING FLOORS AND SLABS

- A. General: Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
- B. Scratch Finish: While still plastic, texture concrete surface that has been screeded and bull-floated or darbied. Use stiff brushes, brooms, or rakes to produce a profile amplitude of 1/4 inch in 1 direction.

1. Apply scratch finish to surfaces indicated and to receive concrete floor toppings to receive mortar setting beds for bonded cementitious floor finishes
- C. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture.
- D. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
 1. Apply a trowel finish to surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.
 2. Finish and measure surface so gap at any point between concrete surface and an unleveled, freestanding, 10-foot- long straightedge resting on 2 high spots and placed anywhere on the surface does not exceed 1/4 inch
- E. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces where ceramic or quarry tile is to be installed by either thickset or thin-set method. While concrete is still plastic, slightly scarify surface with a fine broom.
 1. Comply with flatness and levelness tolerances for trowel finished floor surfaces.
- F. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, and ramps, and elsewhere as indicated.

3.8 CONCRETE PROTECTING AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.
- B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.
- C. Cure concrete according to ACI 308.1, by one or a combination of the following methods:
 1. Moisture Curing: Keep surfaces continuously moist for not less than seven days.
 2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
 3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

- a. After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound will not interfere with bonding of floor covering used on Project.
4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

3.9 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 for the tipping slab
 1. Overall
 - a. FF = 26
 - b. FL = 17
 2. Local Minimum
 - a. FF = 20
 - b. FL = 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 the 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.

3.10 CONCRETE SURFACE REPAIRS

- A. Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval.

3.11 FIELD QUALITY CONTROL

- A. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:
 1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd. but less than 25 cu. yd. plus one set for each additional 50 cu. yd. or fraction thereof.

- a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
2. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
3. Air Content: ASTM C 231, pressure method, for normal-weight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
4. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F and below and when 80 deg F and above, and one test for each composite sample.
5. Compressive-Strength Tests: ASTM C 39/C 39M; test one set of two laboratory-cured specimens at 7 days and one set of two specimens at 28 days.
 - a. Test one set of two field-cured specimens at 7 days and one set of two specimens at 28 days.
 - b. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.
6. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
7. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi
8. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
9. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42/C 42M or by other methods as directed by Architect.
10. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
11. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

END OF SECTION 03 30 00

SECTION 03 36 02

SPECIAL CONCRETE FLOOR FINISHES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

- A. Conditions of the Contract and portions of Division One of this Project Manual apply to this Section as though repeated herein.

1.02 SUMMARY

- A. This section includes the following.
 - 1. Applying Sealer and Hardener, and polishing concrete to specified finish level: floors/horizontal surfaces.

1.03 RELATED WORK

- A. Section 03 30 00, Cast-In-Place Concrete

1.04 REFERENCES

- A. American Society for Testing and Materials:
 - 1. ASTM-C779, Standard Test Method for Abrasion Resistance of Horizontal Concrete Surfaces
 - 2. ASTM G23-81, Ultraviolet Light & Water Spray
 - 3. ASTM C805, Impact Strength
- B. American Concrete Institute
 - 1. ACI 302. 1R-89, Guide for Concrete Floor and Slab Construction
- C. Other Test:
 - 1. Reflectivity

1.05 SUBMITTALS

- A. Submit in accordance with general conditions of this contract.
- B. Product data:
 - 1. Submit special concrete finishes manufacturer's specifications and test data.
 - 2. Submit special concrete finishes describing product to be provided, giving manufacturer's name and product name for the specified material proposed to be provided under this section.
 - 3. Submit special concrete finishes manufacturer's recommended installation procedures; which when approved by the Architect, will become the basis for accepting or rejecting actual installation procedures used on the work.
 - 4. Submit special concrete finishes technical data sheet giving descriptive data, curing time, and application requirements.
 - 5. Submit special concrete finishes manufacturer's Material Safety Data Sheet (MSDS) and other safety requirements.
 - 6. Follow all special concrete finishes published manufacturer's installation instructions.
- C. Test Reports:
 - 1. Provide certified test reports, prepared by an independent testing laboratory, confirming compliance with specified performance criteria.

1.06 QUALITY ASSURANCE

- A. Protection:
 - 1. No satisfactory chemical or cleaning procedure is available to remove petroleum stains from the concrete surface. Prevention is therefore essential.
 - a. All hydraulic powered equipment must be diapered to avoid staining of the concrete.
 - b. No trade will park vehicles on the inside slab. If necessary to complete their scope of work, drop cloths will be placed under vehicles at all times.
 - c. No pipe cutting machine will be used on the inside floor slab.
 - d. Steel will not be placed on interior slab to avoid rust staining.
 - e. Acids and acidic detergents will not come into contact with slab.
 - f. All trades informed that the slab must be protected at all times.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in original containers, with seal's unbroken, bearing manufacturer labels indicating brand name and directions for storage.
- B. Dispense special concrete finish material from factory numbered and sealed containers. Maintain record of container numbers.

1.08 PROJECT CONDITIONS

- A. Environmental limitations:
 - 1. Comply with manufacturers written instructions for substrate temperature and moisture content, ambient temperature and humidity, ventilation, and other conditions affecting topping performance.
 - a. Concrete Floor Flatness rating recommended at least 40, where possible.
 - b. Concrete Floor Levelness rating recommended at least 30, where possible.
 - c. Concrete must be cured a minimum of 45 days or as directed by the manufacturer before application of hardening/sealing system can begin.
 - d. Application of hardening/sealing shall take place 10 days prior to installation of equipment and substantial completion, thus providing a complete, uninhibited concrete slab for application.
- B. Close areas to traffic during floor application and after application, for time period recommended in writing by manufacturer.

1.09 ENVIRONMENTAL REQUIREMENTS

- A. Low-Emitting Materials, Field applied Paints and Coatings: Interior paints and coatings applied on-site must meet the limitations and restrictions concerning chemical components set by the following standards:
 - 1. "All Other Architectural Coatings, Primers and Undercoats: South Coast Air Quality Management District (SCAQMD) Rule #1113, Architectural Coatings", rules in effect on January 1, 2004.
- B. Low-Emitting Materials, Adhesives, and Sealants: Materials used on the interior of the building (defined as inside the weatherproofing system and applied on site) must not exceed the following requirements.
 - 1. Adhesives, Sealants and Sealant Primers: South Coast Air Quality Management (SCAQMD) Rule # 1168, requirements in effect on July 1, 2005, and rule amendment date January 7, 2005.

2. Aerosol Adhesives: Green Seal Standard for Commercial Adhesives GS-36, requirements in effect on October 19, 2000.

PART 2 - PRODUCTS

2.01 MATERIALS AND MANUFACTURERS

- A. CF-1 Concrete Sealer:
 1. Water based penetrating sealer specifically designed for industrial applications; V-Seal 101 DPS Concrete Sealer.
 - a. Finish: Satin finish
 2. Or approved equal.

2.02 RELATED MATERIALS

- A. Neutralizing Agent:
 1. Tri-sodium Phosphate
- B. Water:
 1. Potable

PART 3 - EXECUTION

3.01 SURFACE CONDITIONS:

- A. Examine substrate, with installer present, for conditions affecting performance of finish. Correct conditions detrimental to timely and proper work. Do not proceed until unsatisfactory conditions are corrected.
- B. Verify that base slab meet finish and surface profile requirements in Division 3 Section "Cast-In-Place Concrete," and Project Conditions above.
- C. Prior to application, verify that floor surfaces are free of construction laitance.

3.02 APPLICATION

- A. CF-1: Apply per manufacturer's instructions.

3.03 WORKMANSHIP AND CLEANING:

- A. Remove splatter from adjoining surfaces as needed.
- B. Repair damages to surface caused by cleaning operation.
- C. Remove debris from jobsite.
 1. Dispose of materials in separate, closed containers in accordance with local regulations.

3.04 PROTECTION:

- A. Protect finished work until fully cured in accordance with manufacturer's recommendations.

END OF SECTION 03 36 02

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SECTION 05 12 00

STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.01 SUMMARY

- A. This Section includes structural steel and grout.

1.02 PERFORMANCE REQUIREMENTS

- A. Connections: Provide details of simple shear connections required by the Contract Documents to be selected or completed by structural-steel fabricator to withstand loads indicated and comply with other information and restrictions indicated.
 - 1. Select and complete connections using details indicated and AISC's "Specification for Structural Steel Buildings (AISC 360-05)"

1.03 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show fabrication of structural-steel components.
- C. Welding certificates.
- D. Mill test reports.
- E. Source quality-control test reports.

1.04 QUALITY ASSURANCE

- A. Fabricator Qualifications: A qualified fabricator who participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category Sbd.
- B. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel.
- C. Comply with applicable provisions of AISC's "Code of Standard Practice for Steel Buildings and Bridges.
- D. Preinstallation Conference: Conduct conference at Project site.

- 1.05 DEFINITIONS. Architecturally Exposed Structural Steel: Steel designated as AESS in the contract documents.

PART 2 - PRODUCTS

2.01 STRUCTURAL-STEEL MATERIALS

- A. W-Shapes: ASTM A 992/A 992M Grade 50.
- B. Channels, Angles, M , S-Shapes: ASTM A 36/A 36M.
- C. Plate and Bar: ASTM A 36/A 36M.
- D. Cold-Formed Hollow Structural Sections: ASTM A 500, Grade B, structural tubing.
- E. Steel Pipe: ASTM A 53/A 53M, Type E or S, Grade B.
- F. Welding Electrodes: Comply with AWS requirements.

2.02 BOLTS, CONNECTORS, AND ANCHORS

- A. High-Strength Bolts, Nuts, and Washers: ASTM A 325, Type 1, heavy hex steel structural bolts; ASTM A 563 heavy hex carbon-steel nuts; and ASTM F 436 hardened carbon-steel washers. Plain finish unless noted otherwise.
- B. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F 1852, Type 1, round head steel structural bolts with splined ends; ASTM A 563 heavy hex carbon-steel nuts; and ASTM F 436 hardened carbon-steel washers. Plain finish unless noted otherwise.
- C. Shear Connectors: ASTM A 108, Grades 1015 through 1020, headed-stud type, cold-finished carbon steel; AWS D1.1, Type B.
- D. Unheaded Anchor Rods: ASTM F 1554, Grade 36.
 - 1. Configuration: As detailed .
 - 2. Finish: Plain unless noted otherwise.
- E. Headed Anchor Rods: ASTM F 1554, Grade 36, straight.
 - 1. Finish: Plain unless noted otherwise.
- F. Threaded Rods: ASTM A 36/A 36M.
 - 1. Finish: Plain unless noted otherwise.

2.03 PRIMER

- A. Primer: SSPC-Paint 25, Type II, iron oxide, zinc oxide, raw linseed oil, and alkyd.
- B. Primer: Fabricator's standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer.
- C. Galvanizing Repair Paint: ASTM A 780.

2.04 GROUT

- A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

2.05 FABRICATION

- A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate according to AISC's "Code of Standard Practice for Steel Buildings and Bridges" and AISC's AISC's "Specification for Structural Steel Buildings (AISC 360-05)
- B. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1 and manufacturer's written instructions.
- C. Architecturally exposed Structural Steel (AESS):
 - 1. Shop fabricate and assemble AESS to the maximum extent possible. Locate field joints at concealed locations if possible. Detail assemblies to minimize handling and to expedite erection.
 - 2. Fabricate and erect all structural steel items identified on the drawings as AESS Category 2 in accordance with the AISC Code of Standard Practice for Buildings and Bridges. Fabricate with exposed surfaces smooth, square and free of surface blemishes including pitting, rust, scale, seam marks, roller marks, rolled trade names and roughness. Remove blemishes by filling and grinding or by welding and grinding before cleaning, treating and shop priming. Fabricate with piece marks fully hidden in the completed structure or made with media that permits full removal after erection.
 - 3. Prepare AESS surfaces according to the following specifications and standards: SSPC-SP-6 "Commercial Blast Cleaning".

2.06 SHOP CONNECTIONS

- A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
 - 1. Joint Type: Snug tightened unless otherwise indicated.
- B. Weld Connections: Comply with AWS D1.1 for welding procedure specifications, tolerances, appearance, and quality of welds and for methods used in correcting welding work.

2.07 SHOP PRIMING

- A. Shop prime steel surfaces except the following:
 - 1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches.
 - 2. Surfaces to be field welded.
 - 3. Surfaces to be high-strength bolted with slip-critical connections.
 - 4. Surfaces to receive sprayed fire-resistive materials.
 - 5. Galvanized surfaces.
- B. Surface Preparation: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards:
 - 1. SSPC-SP 2, "Hand Tool Cleaning."
- C. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a dry film thickness of not

less than 1.5 mils. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

- D. Finished Paint System for Exposed Structural Steel: Structural steel shall be painted as follows: Apply on coat of steel primer in shop as specified above. Apply two coats of alkyd enamel paint to minimum dry film thickness of 1.5 mils for each coat. Paint shall be applied according to the manufacturer's recommendations. Paint shall be free of sags, runs, drips or other defects. Allow ample drying time before handling to prevent damage to coatings.
- E.

2.08 GALVANIZING

- A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel according to ASTM A 123/ A 123M.
 - 1. Fill vent holes and grind smooth after galvanizing.
 - 2. Galvanize pieces and assemblies indicated in drawings.

2.09 SOURCE QUALITY CONTROL

- A. Owner will engage an independent testing and inspecting agency to perform shop tests and inspections and prepare test reports. Comply with testing and inspection requirements of Part 3, Article "Field Quality Control."
- B. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.
- C. In addition to visual inspection, shop-welded shear connectors will be tested and inspected according to requirements in AWS D1.1 for stud welding.

PART 3 - EXECUTION

3.01 ERECTION

- A. Examination: Verify elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments, with steel erector present, for compliance with requirements.
 - 1. Proceed with installation only after unsatisfactory conditions have been corrected.
- B. Set structural steel accurately in locations and to elevations indicated and according to AISC's "Code of Standard Practice for Steel Buildings and Bridges" and AISC's "Specification for Structural Steel Buildings (AISC 360-05)"
- C. Base and Bearing Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting base and bearing plates. Clean bottom surface of base and bearing plates.
 - 1. Set base and bearing plates for structural members on wedges, shims, or setting nuts as required.
 - 2. Weld plate washers to top of base plate.
 - 3. Snug-tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of base or bearing plate before packing with grout.

4. Promptly pack grout solidly between bearing surfaces and base or bearing plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.
- D. Maintain erection tolerances of structural steel within AISC's "Code of Standard Practice for Steel Buildings and Bridges."

3.02 FIELD CONNECTIONS

- A. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
1. Joint Type: Snug tightened unless otherwise indicated.
 2. Weld Connections: Comply with AWS D1.1 for welding procedure specifications, tolerances, appearance, and quality of welds and for methods used in correcting welding work.
 3. Comply with AISC's "Code of Standard Practice for Steel Buildings and Bridges" and AISC's "Specification for Structural Steel Buildings (AISC 360-05)" for bearing, adequacy of temporary connections, alignment, and removal of paint on surfaces adjacent to field welds.

3.03 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to inspect field welds and high-strength bolted connections.
- B. Bolted Connections: Shop-bolted connections will be inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
- C. Welded Connections: Field welds will be visually inspected according to AWS D1.1.
1. In addition to visual inspection, field welds will be tested according to AWS D1.1 and the following inspection procedures, at testing agency's option:
 - a. Liquid Penetrant Inspection: ASTM E 165.
 - b. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
 - c. Ultrasonic Inspection: ASTM E 164.
 - d. Radiographic Inspection: ASTM E 94.
- D. In addition to visual inspection, test and inspect shop and field-welded shear connectors according to requirements in AWS D1.1 for stud welding and as follows:
1. Perform bend tests if visual inspections reveal either a less-than- continuous 360-degree flash or welding repairs to any shear connector.
- E. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.

END OF SECTION 051200

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SECTION 05 40 0

COLD-FORMED METAL FRAMING

PART 1 - GENERAL

- A. RELATED DOCUMENTS: Drawings and general provisions of the Contract, including General and Supplementary conditions and Division 1 General Requirements, apply to work of this section.
- B. SUMMARY
1. This Section includes the following:
 - a. Interior partition walls
 - b. Cold-Formed ceiling joists
- C. PERFORMANCE REQUIREMENTS
1. Structural Performance: Cold-formed metal framing is capable of withstanding design loads within limits and under conditions indicated.
 - a. Design Loads:
 - i. Ceiling Live Load = 40 psf
 - ii. Ceiling Collateral Dead Load = 7 psf
 - iii. Lateral load on Studs = 5 psf.
 - b. Deflection Limits: Framing systems are designed to withstand design loads without deflections greater than the following.
 - i. Ceiling Joists
 - 1) Total Load: $L/360$
 - 2) Walls: $L/360$
- D. QUALITY ASSURANCE
1. Delegated Design: Engage a qualified professional engineer to design cold-formed steel framing
 2. AISC Specifications and Standards: Comply with AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members" and its "Standard for Cold-Formed Steel Framing - General Provisions"

E. SUBMITTALS

1. Product Data: For each type of product and accessory indicated

F. SHOP DRAWINGS

1. Submit shop drawings for prefabricated panel assemblies, components, and installations to be on or off site fabricated
2. Include placing drawings for framing members showing size and gage designations, number, type, location and spacing. Indicate supplemental strapping, bracing, splices, accessories, type and location of welds, bolts and fastening devices and details required for proper installation.
3. Submit complete design calculations for all systems and design dead and live loads signed and sealed by the qualified professional engineer responsible for their preparation.
4. Include design for all connections.
5. Cold-Formed Steel Framing, General: Design according to AISI's "Standard for Cold-Formed Steel Framing - General Provisions."
 - a. Headers: Design according to AISI's "Standard for Cold-Formed Steel Framing - Header Design."

G. SUBMITTALS

1. Product Data: For each type of product and accessory indicated.
2. Welding certificates, if requested.

PART 2 - PRODUCTS

A. MATERIALS

1. Steel Sheet: ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of grade and coating weight as follows:
 - a. Minimum coating requirement for Structural Grade, Type H steel is G60 or equivalent.

B. BEARING WALL AND CEILING JOIST FRAMING

1. Steel Studs and Joists: Manufacturer's standard C-shaped steel studs of size noted on the Drawings. For member sizes not noted on Drawings provide member of web depths indicated on drawings, punched, with stiffened flanges, and as follows:

- a. Minimum Base-Metal Thickness: 18 Ga.
 - b. Flange Width: 1-5/8 inches.
2. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, and same minimum base-metal thickness as steel studs unless noted otherwise on the Drawings.

C. FRAMING ACCESSORIES

1. Fabricate steel-framing accessories from steel sheet, ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of same grade and coating weight used for framing members, unless otherwise indicated.
2. Steel Shapes and Clips: ASTM A 36/A 36M, zinc coated by hot-dip process according to ASTM A 123/A 123M.
3. Expansion Anchors: Fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 5 times design load, as determined by testing per ASTM E 488 conducted by a qualified independent testing agency.
4. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 10 times design load, as determined by testing per ASTM E 1190 conducted by a qualified independent testing agency.
5. Mechanical Fasteners: ASTM C 1513, corrosion-resistant-coated, self-drilling, self-tapping steel drill screws.
 - a. Head Type: Low-profile head beneath sheathing, manufacturer's standard elsewhere.

D. MISCELLANEOUS MATERIALS

1. Shims: Load bearing, high-density multimonomer plastic, nonleaching.

PART 3 - EXECUTION

A. INSTALLATION, GENERAL

1. Install cold-formed metal framing according to AISI's "Standard for Cold-Formed Steel Framing - General Provisions" and to manufacturer's written instructions unless more stringent requirements are indicated.
2. Install cold-formed metal framing and accessories plumb, square, and true to line, and with connections securely fastened.
3. Install framing members in one-piece lengths.

4. Install temporary bracing and supports to secure framing and support loads comparable in intensity to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.
5. Fasten hole reinforcing plate over web penetrations that exceed size of manufacturer's standard punched openings.
6. Erection Tolerances: Install cold-formed metal framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:
 - a. Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

B. BEARING WALL INSTALLATION

1. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure as indicated.
2. Fasten both flanges of studs to top and bottom track, unless otherwise indicated. Space studs as follows:
 - a. Stud Spacing: As indicated on Drawings. For non indicated spacing on the drawings the maximum stud spacing to be 16"
3. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar requirements.
4. As noted on the drawings isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.
5. Install horizontal bridging in wall studs, spaced in rows indicated on the Drawings but not more than 60 inches apart. Fasten at each stud intersection.
 - a. Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs.
 - b. Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and stud-track solid blocking of width and thickness to match studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.
 - c. Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.
6. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, fasteners, and stud girts, to provide a complete and stable curtain-wall-framing system.
7. Install temporary bracing for walls as required. Bracing shall remain in place until the structure is completely stabilized

8. At load bearing walls studs are to align with floor or roof joists. Install additional studs as required.

C. REPAIRS AND PROTECTION

1. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed metal framing with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.
2. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that cold-formed metal framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION 05 40 00

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SECTION 05 50 00

METAL FABRICATIONS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Conditions of the Contract and portions of Division One of this Project Manual apply to this Section as though repeated herein.

1.02 WORK INCLUDED

- A. Steel handrails and guardrails (Galvanized)
- B. Steel angles, tubes, channels, bar stock, plates and steel grating and plating for stairs (Galvanized).
- C. Steel plate at bunkers
- D. Steel closure plate
- E. Steel bollards
- F. All angles and miscellaneous metals to be set in concrete.
- G. Metal accessories.
 - 1. Including, but not limited to, anchors, bolts, screws, joist hangers, and fasteners.
- H. Misc. Metal Brackets, supports, etc. as shown on drawings.

1.03 RELATED WORK

- A. Cast-in-Place Concrete: Section 03 30 00.
- B. Structural Steel Framing: Section 05 12 00.
- C. Finished Carpentry: Section 06 20 00.
- D. Painting: Section 09 90 00.

1.04 REFERENCES

- A. Metal Fabrications shall be in strict accord with Wisconsin Commercial Building Code, Chapter 11 - "Accessibility".

1.05 SUBMITTALS

- A. Submit in accord with the General Conditions of the Contract.
 - 1. Shop drawings required for all items. Show all work to be fabricated with all construction details shown in appropriate scale, methods of attachments to other materials, finished dimensions, shop welds and grinding of welds, field assembly joints, etc.
 - 2. Coordinate work with other suppliers and subcontractors; obtain their approved shop drawing where necessary, or obtain any necessary additional detail information regarding mounting conditions or other aspects of related work.

1.06 QUALITY ASSURANCE

- A. Take field measurements prior to shop drawing preparation and fabrication.
- B. Comply with the provisions of the following except as otherwise indicated:
 - 1. AISC "Code of Standard Practice for Steel Buildings and Bridges".
 - 2. AISC "Specifications for the Design, Fabrication, and Erection of Structural Steel for Buildings", including the "Commentary" and Supplements thereto as issued.
 - 3. AISC "Specifications for Structural Joints using ASTM A 325 or A 490 Bolts" approved by the Research Council on Riveted and Bolted Structural Joints of the Engineering Foundation.
 - 4. AWS D1.1 "Structural Welding Code".
- C. Qualify welding process and welding operators in accordance with the AWS "Standard Qualification Procedure". Provide certification that welders to be employed in the work have satisfactorily passed AWS qualification tests within the previous twelve months. If recertification of welders is required, retesting will be the Contractor's responsibility.
- D. Structural Performances
 - 1. Treads and platforms shall be capable of withstanding a uniform load of 100 lbs. per sq. ft. or a concentrated load of 300 lbs. located to produce maximum stress conditions.
 - 2. Handrails and top rails shall be capable of withstanding concentrated loads of 200 lbs. applied at any point in any direction or a uniform load of 50 lbs/ft applied horizontally at the top rail, whichever produces the greatest stress.
- E. Preassemble items in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

1.07 DELIVERY, STORAGE AND HANDLING

- A. Package, handle, deliver and store at the job site in a manner that will avoid damage or deformation. Damaged material will be rejected.
- B. Items to be built into concrete, masonry, etc. shall be furnished by the respective contractor and the contractor shall build this into the work as the work progresses.

1.08 PROJECT CONDITIONS

- A. Verify dimensions in field for pre-cut or prefabricated items.
- B. Examine job conditions and adjoining construction which may affect the acceptability of the work.
- C. Coordinate installation of anchorages for metal fabrications. Furnish setting drawings, templates, and directions for installing embedments and other items that are to be embedded in concrete. Deliver such items to Project site in time for installation.

1.09 ENVIRONMENTAL REQUIREMENTS

- A. Low-Emitting Materials, Field applied Paints and Coatings: Interior paints and coatings applied on-site must meet the limitations and restrictions concerning chemical components set by the following standards:
 - 1. Topcoat Paints, Green Seal Standard GS-11, Paints: First Edition, May 20, 1993.
 - 2. Anti-Corrosive and Anti-Rust Paints: Green Seal Standard GS-03, Anti-Corrosive Paints", Second Edition, January 7, 1997. For applications on ferrous metal substrates.

3. "All Other Architectural Coatings, Primers and Undercoats: South Coast Air Quality Management District (SCAQMD) Rule #1113, Architectural Coatings", rules in effect on January 1, 2004.
- B. Low-Emitting Materials, Adhesives, and Sealants: Materials used on the interior of the building (defined as inside the weatherproofing system and applied on site) must not exceed the following requirements.
1. Adhesives, Sealants and Sealant Primers: South Coast Air Quality Management (SCAQMD) Rule # 1168, requirements in effect on July 1, 2005, and rule amendment date January 7, 2005.
 2. Aerosol Adhesives: Green Seal Standard for Commercial Adhesives GS-36, requirements in effect on October 19, 2000.

PART 2 - PRODUCTS

2.01 METAL FOR FABRICATIONS

- A. Cold-rolled carbon steel sheets: ASTM A336.
- B. Structural Steel Sheet: Hot rolled ASTM A570, or cold-rolled ASTM A611, of grade required for design loading, minimum of Grade C.
- C. Galvanized carbon steel sheets: ASTM A446, with G90 zinc coating.
- D. Welding materials: AWS D1.1; type required for materials being welded.
- E. Shop coat primer: FS-TT-P-32, for shop application and field touch-up.
- F. Touch-up primer for galvanized surfaces.
 1. Steel shapes and fasteners, in general, for exterior use and where built into exterior wall: zinc coated.
- G. Structural Steel: ASTM A36.
- H. Structural Steel Angles: ASTM A36, hot dipped galvanized.
- I. Steel Pipe: ASTM A53, Type S, Grade A, standard weight, schedule 40.
- J. Steel Bars and Bar Size Shapes: ASTM A 306, Grade 65, or ASTM A 36.
- K. Castings: Gray iron, ASTM A48-83 Class 35B; or Ductile iron ASTM A536-80 Grade 65-45-12.
- L. Steel Diamond Tread Plate: .0125-inch thickness

2.02 GALVANIZED STEEL

- A. All galvanized steel shall be hot-dipped galvanized.

2.03 ACCESSORIES

- A. Concrete Inserts: Threaded or wedge type, galvanized ferrous castings, either malleable iron ASTM A 47 or cast steel ASTM A 27. Provide bolts, washers and shims as require, hot-dipped galvanized, ASTM A 153.
- B. Fasteners: Including, but not limited to the following;

1. Provide zinc-coated fasteners for exterior use where built into exterior walls or where shown on drawings. Select fasteners for the type, grade and class required.
 - a. Provide hot-dipped galvanized coating for fasteners less than 1/2" diameter that are in contact with pressure-treated wood.
2. Bolts and Nuts: Regular hexhead type, ASTM A 307, Grade A or Type 304 stainless steel, ASTM A 320. High Strength bolts and nuts, ASTM A 325.
3. Lag Bolts: Type, FS FF-B-561.
4. Machine Screws: Cadmium plated steel, FS FF-S-92, Security Screw
5. Wood Screws: Carbon steel, FS FF-S-111.
6. Plain Washers: Round, carbon steel, FS FF-W-92.
7. Concrete Anchorage Devices: Wedge-type expansion bolts, FS FF-S-325, Group II, Type 4, Class I, zinc coated or stainless steel as shown on the drawings and installed in accordance with manufacturer's recommendations.
 - a. "Kwik-bolt", Hilti Corporation.
 - b. "Wej-it", Wej-it Corporation.
8. Masonry Sleeve Anchors: zinc coated or stainless as shown on the drawings.
 - a. Rawl "Lok/Bolt".
 - b. HILTI - Sleeve anchor.
9. Toggle Bolts: Spring-wing type, FS FF-B-558, Type I, Class I and Style 1 zinc coated or stainless steel as shown on the drawings.
10. Lock Washers: Helical spring type carbon steel, FS FF-W-84.
11. Countersunk Washer: Type 316 stainless steel and stainless steel wood screw at solid surface 'panel' ADA vanity enclosure assembly.

C. Electrodes for Welding: Comply with AWS code.

2.04 FABRICATION

- A. Weld permanent connections wherever possible; use continuous welds where exposed. Grind smooth all welds where exposed; straighten members after welding.
 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 2. Obtain fusion without undercut or overlap.
 3. Remove welding flux immediately.
 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- B. Do shop cutting, drilling, fitting wherever possible. Field measure before fabrication when necessary or required.
- C. Workmanship: Use materials of size and thickness indicated, or if not indicated, as required to produce strength and durability in finished product for use intended. Work to dimensions on shop drawings, using proven details of fabrication and support. Use type of materials indicated or specified for various components of work.
- D. Form exposed work true to line and level with accurate angles and surfaces and straight sharp edges. Ease exposed edges to a radius of approximately 1/32" unless otherwise indicated. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

- E. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners wherever possible. Use exposed fasteners of type indicated or, if not indicated, security (countersunk) screws or bolts.
- F. Remove burrs and ease edges to a radius of approximately 1/32 inch, unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

2.05 STEEL HANDRAIL AND GUARDRAIL

- A. Pipe railings shall be of standard weight mild steel pipe, 1-1/4 inch inside diameter, fabricated to true lines, joints welded and ground smooth. Provide wall mounting flanges and bolts of the proper type to suit conditions of installation and provide pipe sleeves for vertical members. Provide wall returns at ends of wall mounted handrails. Close ends of exposed pipes.
 - 1. Steel handrail and guardrails are to be galvanized.

2.06 GALVANIZED STEEL STAIR (ANGLES, TUBES, CHANNELS, BAR STOCK, PLATES, BAR GRATES AND FRAMING)

- A. Bar Grates basis of design: McNichols Bar Grating Stair Treads
 - 1. Or approved equal.
 - 2. Refer to plans for dimensional criteria.
 - 3. Steel Grates:
 - a. GW series by McNichols Co. (800) 237-3820. Ohio Grating Inc. SGCS Series (1/2" open) (800) 321-9800. Or approved equal.
- B. Other stair components as indicated on drawings.

2.07 STEEL BUNKERS

- A. Provide steel plate bunker as indicated on drawings, painted

2.08 STEEL CLOSURE PLATE

- A. Provide steel closure plate as indicated on drawing, painted.

2.09 STEEL BOLLARDS

- A. ASTM A53, Type S, Grade A, standard weight, schedule 40.
 - 1. Bollards: 8-inch and 12-inch diameter. Refer to drawings for more information.

2.010 STRUCTURAL PERFORMANCE

- A. Structural Performance of Stairs: Provide metal stairs or ladders capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
 - 1. Uniform Load: 100 lbf/sq. ft.
 - 2. Concentrated Load: 300 lbf applied on an area of 4 sq. in.
 - 3. Uniform and concentrated loads need not be assumed to act concurrently.
 - 4. Stair or Ladder Framing: Capable of withstanding stresses resulting from railing loads in addition to loads specified above.
 - 5. Limit deflection of treads, platforms, and framing members to L/240 or 1/4 inch, whichever is less.
- B. Structural Performance of Railings: Provide railings capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
 - 1. Handrails:

- a. Uniform load of 50 lbf/ ft applied in any direction.
 - b. Concentrated load of 200 lbf applied in any direction.
 - c. Uniform and concentrated loads need not be assumed to act concurrently.
2. Top Rails of Guards:
- a. Uniform load of 50 lbf/ ft. applied in any direction.
 - b. Concentrated load of 200 lbf applied in any direction.
 - c. Uniform and concentrated loads need not be assumed to act concurrently.
3. Infill of Guards:
- a. Concentrated load of 50 lbf applied horizontally on an area of 1 sq. ft.
 - b. Infill load and other loads need not be assumed to act concurrently.
- C. Connector plates, tees, brackets and other accessories at exterior wood framing and trim shall be stainless steel.

2.011 STEEL FINISHES

- A. Galvanizing: Hot-dip galvanize items as indicated to comply with applicable standard listed below:
- 1. ASTM A 123/A 123M, for galvanizing steel products.
 - 2. ASTM A 153/A 153M, for galvanizing steel hardware.
 - 3. Except for items indicated to be fabricated of stainless steel, exterior metal fabrication items shall be hot-dip galvanized.
- B. Preparation for Shop Painting: Clean steel items free of mill scale, rust and foreign matter, grease, oil, dust, and dirt in accordance with SSPC SP-2, SP-3, or SP-7.
- C. Shop Priming: Apply one shop coat of metal primer using manufacturer's standard primer, except stainless steel, galvanized steel, and other non-ferrous items.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Anchorage to masonry with expansion bolts, sleeves, toggle bolts or approved similar. Do not use wood plugs for anchorage.
- B. Bolts, screws, and similar fastenings for field connections shall be of the same material and finish as the parts being fastened.
- C. Immediately after erection, repaint field connections, weld burns, abraded surfaces. Scrape and wire brush loose and scaling paint to sound metal, follow with spot priming.
- D. Install manufactured units and specialty products in accordance with the manufacturer's instructions and approved shop drawings.
- E. Do not proceed with installation until conditions are satisfactory.
- F. Install in accordance with approved shop drawings.
- G. Perform field welding in accordance with AWS D1.1.
- H. Corrosion Protection: Coat concealed metal surfaces that will come into contact with grout, concrete, or dissimilar metals with a heavy coat of bituminous paint.

3.02 ADJUSTING AND CLEANING

- A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 - 1. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.
- B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.
- C. Protect stainless steel finishes from contamination by materials containing iron.

END OF SECTION 05 50 00

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SECTION 06 10 00
ROUGH CARPENTRY

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Conditions of the Contract and portions of Division One of this Project Manual apply to this Section as though repeated herein.

1.02 SCOPE

- A. Perform all Work required to complete the Rough Carpentry indicated by the Construction Documents, and furnish all items necessary for its proper installation.

1.03 WORK INCLUDED

- A. Wood Blocking.
- B. Plywood Wall Panels.

1.04 RELATED WORK

- A. Section 10 28 00, Toilet Bath and Laundry Accessories

1.05 SUBMITTALS

- A. Submit in accordance to the General Conditions of the contract.
- B. Material certificates for dimensional lumber specified to comply with minimum allowable unit stresses indicated on the documents. Indicate species and grade selected for each use, and design values approved by American Lumber Standards Committee.
- C. Schedule for completion of rough framing for coordination of templating for shop fabrication of architectural woodwork.
- D. Wood treatment data as follows, including chemical treatment manufacturer's warranty and instructions for handling, storing, installing, and finishing treated materials:
 - 1. For each type of preservative-treated wood product, include certification by treating plant stating type of preservative solution and pressure process used, net amount of preservative retained, and compliance with applicable standard.

1.06 REFERENCES

- A. American Institute of Timber (AITC)
 - 1. AITC, Timber Construction Manual
- B. American Forest and Paper Association (AFPA)
 - 1. AFPA, National Design Specification for Wood Construction.
 - 2. AFPA, Design Values for Wood Construction, NDS Supplement.
- C. American Plywood Association (APA)
 - 1. APA, Plywood Design Specification.

- D. American National Standards Institute (ANSI)
 - 1. ANSI A190.1, Structural Glued Laminated Wood.
 - 2. ANSI A208.1, Material Formed Wood Particle Board.
- E. American Society for Testing and Materials (ASTM)
 - 1. ASTM E84, Test for Surface Burning Characteristics of Building Materials.
- F. American Wood Preservers Association (AWPA)
 - 1. AWPA C-20, Structural Lumber - Fire Retardant Treatment by Pressure Processes.
- G. American Wood Preservers Bureau (AWPB)
 - 1. AWPB LP-2, Pressure Treatment with Water-Borne Preservatives.
- H. National Bureau of Standards (NBS)
 - 1. NBS PS 1, Voluntary Product Standard for Construction and Industrial Plywood.
 - 2. NBS PS 20, Voluntary Product Standard for Lumber.

1.07 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials to the site dry and store above ground on level wood blocking, cover from rain, allowing drainage of water from all parts. Handle with care to avoid damage.

1.08 COORDINATION

- A. Correlate location of all framing, furring, blocking, grounds and similar items with all trades.
- B. Verify all dimensions and shop drawing requirements prior to proceeding with work.
- C. Avoid delay of work of other trades dependent on or affected by carpentry work.

1.09 ENVIRONMENTAL REQUIREMENTS

- A. Low-Emitting Materials, Adhesives, and Sealants: Materials used on the interior of the building (defined as inside the weatherproofing system and applied on site) must not exceed the following requirements.
 - 1. Adhesives, Sealants and Sealant Primers: South Coast Air Quality Management (SCAQMD) Rule # 1168, requirements in effect on July 1, 2005, and rule amendment date January 7, 2005.
 - 2. Aerosol Adhesives: Green Seal Standard for Commercial Adhesives GS-36, requirements in effect on October 19, 2000.
- B. Low- Emitting Materials, Composite Wood & Agrifiber Products: Composite wood and agrifiber products used inside the weatherproofing system shall contain no added urea-formaldehyde resins.
 - 1. Laminating Adhesives used to fabricate on-site and shop applied composite wood and agrifiber assemblies shall contain no added urea-formaldehyde resins.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Wood for nailers, blocking, furring, sleepers and other miscellaneous boards: Construction grade, S4S, dried, 19 percent maximum moisture content. Pressure preservative treat items in contact with flashing, waterproofing, masonry, concrete or the ground.

- B. Plywood Wall Panels: Thickness as indicated on drawings, 7-ply, CDX APA Rated, un-sanded with a minimum 16/0 span rating. Refer to drawings for sizes.
- C. Preservative Treatment by Pressure Process: AWWA U1; Use Category UC2 for interior construction not in contact with the ground, Use Category UC3b for exterior construction not in contact with the ground, and Use Category UC4a for items in contact with the ground.
 - 1. Treat wood materials subject to insect attack. Moisture content after treatment shall be 19 percent for lumber and 15 percent for plywood.
 - 2. Preservative Chemicals: Water-borne, alkaline copper quaternary (ACQ) preservatives.
 - a. Acceptable to authorities having jurisdiction and containing no arsenic or chromium.
- D. Fire-retardant treated wood products shall be pressure-impregnate wood materials to comply with ASTM E84, Class A and with AWWA C-20 and C-27. Each piece shall bear UL label "FR-S" for 25 maximum flame spread. Moisture content after treatment shall be 19 percent for lumber and 15 percent for plywood.
 - 1. Treated materials shall be "Dricon" as manufactured by Koppers Company, Inc.
 - 2. Application: Treat all rough carpentry, unless otherwise indicated.
 - a. Concealed blocking.
 - b. Plywood backing panels.
- E. Rough hardware shall include all nails, spikes, screws, bolts and similar items of types and sizes sufficient to draw and rigidly secure members for which they are used. Fasteners shall be galvanized plated at exterior locations and at all treated wood applications.
- F. Adhesive shall be of proper design and characteristics to rigidly secure materials for which they are used. Adhesive shall be "Titebond VOC-Compliant Heavy Duty Construction Adhesive" conforming with ASTM C557, as manufactured by Franklin International; or approved equal.
 - 1. Provide construction adhesive with a VOC content of less than 70 g/l.
- G. Miscellaneous Materials
 - 1. Sill-Sealer Gaskets: Glass-fiber-resilient insulation, fabricated in strip form, for use as a sill sealer; 1-inch nominal thickness, compressible to 1/32 inch; selected from manufacturer's standard widths to suit width of sill members indicated.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Examine all adjoining work, verify all governing dimensions, and report any unsatisfactory conditions.
- B. Provide temporary enclosures, partitions, or stairs to properly protect and facilitate the work.

3.02 GENERAL INSTALLATION

- A. Install materials and systems in accordance with manufacturer's published instructions and requirements. Install materials with uniform appearance and in proper relation with adjacent construction.
- B. Cut and frame all lumber into the respective locations, true to line, grade, plumb and level. Form nailers, blockings and bucks to the shape and dimension indicated. Cut and frame all rough carpentry work required by the other sections.

- C. Use only sound, thoroughly seasoned materials of longest practical lengths and sizes to minimize jointing. Use materials free from warp which cannot be easily corrected by anchoring and attachment.
- D. Treat all wood nailers, sleepers, blocking, furring, other wood in contact with concrete, masonry adjacent to grade or exterior which shall be inaccessible in finished work.
- E. Provide blocking, bucks and framing for all trades as required.
 - 1. Blocking to be provided at the following locations:
 - a. All wall hung casework, cabinetry, countertops and shelving.
 - b. All wall hung/mounted equipment, including but not limited to flat screen monitors, brackets, autopsy/lab equipment, etc.
 - c. All wall hung writing surfaces
 - d. And as indicated on drawings.
- F. Include 2 inch nominal blocking in metal stud partitions required for backing of all accessories, cabinetry, and other surface or recessed items.
- G. Where finish trim is applied directly to framing members or blocking, such members shall be perfectly straight, clear and well seasoned. Warp or other poor characteristics not allowed.
- H. Provide solid surfaces at least 1 1/2 inches wide in both directions at all corners for securing finishes.

3.03 HARDWARE

- A. Secure permanently and in proper position all materials with the necessary fastenings to provide the strength and rigidity required to complete the work. Provide washers under bolt heads and nuts in contact with wood.
- B. Bolt nailers and blocking to steel, masonry or concrete members with bolts of proportionate strength of members attached, length required, spaced 2 feet 0 inches on center and 4 inches from each end, except as otherwise indicated. Unless otherwise indicated, anchor bolts shall be 3/8 inch diameter by length required or comparable power actuated fasteners.
- C. Nail plywood in accord with APA recommendations.

3.04 TEMPORARY ENCLOSURES

- A. The Subcontractor shall furnish, erect, keep in good repair and remove all necessary temporary guard rails, barricades, pedestrian walkways, temporary ladders, building enclosures and partitions (including temporary wood doors hung on temporary wood bucks at exterior door entrances, doors to allow emergency egress by building occupants) and all other necessary temporary enclosures as required as the work progresses.

3.05 CLEANING

- A. Remove from the site all debris resulting from the Work of this Section.

END OF SECTION 06 10 00

SECTION 06 41 16

PLASTIC LAMINATE CLAD CASEWORK

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Conditions of the Contract and portions of Division One of this Project Manual apply to this Section as though repeated herein.

1.02 WORK INCLUDED

- A. Work Surfaces (with brackets beneath)
- B. Hardware: Grommets and Brackets

1.03 RELATED WORK

- A. Rough Carpentry: Section 06 10 00
- B. Sealant: Section 07 92 00

1.04 REFERENCES

- A. Plastic Laminate: National Electrical Manufacturers Association (NEMA) Publication No. LD3-1991.
- B. Fiberboard Core: ANSI A208.2.

1.05 SUBMITTALS

- A. Submit in accordance with the General Conditions of the Contract.
 - 1. Product Data: Manufacturer's catalog information edited to indicate specific products and related accessories to be provided for this Project.
 - 2. Shop Drawings: Show layout of work surface, typical details of construction, and finish selections.
 - a. Locate rough-in for grommets required and show methods of compensating for minor variations in actual job conditions within specified tolerances.
 - b. Include details of fastening to all other work, countertop layout for each location, details of countertop construction including backsplash, endsplash, and edge details, plastic laminate selections previously made by Architect/Engineer and type of core substrate material.
 - c. Field measure for all countertops.
 - d. Indicate all hardware and keying schedule.

1.06 QUALITY ASSURANCE

- A. Quality Standards: Perform work in accordance with Architectural Woodwork Quality Standards (current edition), Guide Specification and Quality Control Program as set forth by the Architectural Woodwork Institute (AWI).
- B. ANSI/BHMA A156.9 – Cabinet Hardware.

1.07 DELIVERY, STORAGE AND HANDLING

- A. Deliver work surface items only when proper storage conditions will be available. Store work surface in protected area until ready for installation.
- B. Store in manner to allow free circulation of air around all items.
- C. Maintain temperature of casework storage areas between 50 to 75 degrees Fahrenheit.

PART 2 - PRODUCTS

2.01 CASEWORK

- A. AWI Section 400, Custom grade.

2.02 MANUFACTURERS

- A. The following casework manufacturers are acceptable as long as they meet or exceed this specification.

1. A.J. Pietsch Company, (414) 342-0531.
2. Carley Wood Associates, Inc. (608) 249-7444.
3. Central Wisconsin Woodworking, (715) 675-4491.
4. Creative Laminates, Inc., (800) 441-5885.
5. Diversified Woodcrafts Inc., (920) 842-2136.
6. Glenn Rieder, Inc., (414) 449-2888.
7. Hillcraft Ltd., (608) 221-3220.
8. Lange Brothers Woodwork Co, Inc., (414) 466-2226.
9. O'Keefe Incorporated, (715) 425-8981.
10. Stück Wood Works Inc., (414) 351-5595.
11. T. J. Hale Company, (262) 255-5555.
12. Techline, (608) 238-6868.
13. Wood Design Inc., (920) 563-4833.
14. Woodmill Products, Inc., (262) 754-4641.
15. Or approved equal.

- B. Hardware manufacturers.

1. Doug Mockett & Co. (800) 523-1269.
2. A&M Hardware (888) 647-0200
3. Or approved equal.

2.03 PLASTIC LAMINATE SURFACING

- A. Manufacturers: Wilsonart , Arpa, Formica, Lamin-Art, Nevamar, or approved equal.
- B. Exposed Exterior Surfaces (except countertops): NEMA GP28, 0.028 inch thick, standard vertical grade.
- C. Interior Surfaces/Backing Sheets: NEMA CL20, 0.020 inch thick, standard cabinet liner grade if applicable.
- D. Colors:
 1. Surface Plastic Laminate color to be selected from manufacturer's full range.

2.04 WORK SURFACE (COUNTERTOPS)

- A. Plastic Laminate: 1-1/2 inches thick 45-47 pound density particle board, NEMA GP50 finish top and edges, and NEMA CL20 backer sheet.
 1. Square front edge, back and side splashes. Provide cutouts for built-in fixtures.

2.05 HARDWARE

A. Steel Brackets

1. For upper shelving and work surfaces: Hafele, Hebgo bracket, approved equal by A&M Hardware or approved equal.
 - a. Color: To be selected by Architect from full line of powder coat finishes.
2. Hardware finish: 626 (US26D) Brushed Chrome.

B. Grommet

1. Doug Mocket round plastic grommet with removable cap, EDP Flip-Top® -2 -1/2" hole, or approved equal.
2. Color as selected by architect from Manufacturers full range.
3. Provide one grommet every 4-feet of work surface.

2.06 WORKMANSHIP

- A. Work surface parts shall be accurately machined utilizing hardwood dowels for premium quality grade joinery construction. Glue and mechanically fasten all joints for maximum rigidity.
- B. All work shall be square, plumb, true and self-supporting.

PART 3 - EXECUTION

3.01 DELIVERY

- A. Store and install in a ventilated building not exposed to extreme temperature and/or humidity.

3.02 INSTALLATION

- A. Installation shall be by the manufacturer's authorized representatives using factory trained personnel experienced in the installation of this type of equipment.
- B. Uncrate, set up, place, level, scribe and anchor all cabinets according to manufacturer's recommendations.
- C. Do all cutting, boring, patching required for the installation of work of other Sections.
- D. Provide all necessary fillers, panels, end panels, scribes required to make complete installation as detailed.
- E. Where work surface meets wall surfaces, set with uniform space not to exceed 1/8-inch. Seal all joints with silicone sealant to a slightly concave joint, using backer rod where required. Apply sealant in accord with Section 07 92 00.
- F. Work surfaces with surfaces having machine or tool marks will be rejected.
- G. All finishes must be smooth, uniform in color and match approved sample.
- H. Prior to final inspection, examine installation of the work of this Section. Repair or replace all defects found. Leave installation clean, undamaged and ready for use.

END OF SECTION 06 41 16

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SECTION 07 21 00

BUILDING INSULATION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Conditions of the Contract and portions of Division One of this Project Manual apply to this Section as though repeated herein.

1.02 WORK INCLUDED

- A. Batt Insulation.
- B. Vapor Retarder.
- C. Insulation Accessories.

1.03 RELATED WORK

- A. Section 09 29 00, Gypsum Board (Sound Attenuation)

1.04 SUBMITTALS

- A. General: Submit each item in this article according to the Conditions of the Contract and Division 1 Specification Sections.
 - 1. Manufacturer's Data: Submit manufacturer's data for each type of insulation required. Include data substantiating that the materials comply with specified requirements, including GreenGuard Certification.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Deliver material to the site in unopened packages, with identification labels intact.
- B. Protect insulations from physical damage and from becoming wet, soiled, or covered with ice or snow. Comply with manufacturer's recommendations for handling, storage and protection during installation.
- C. Protect plastic insulation against ignition at all times.
- D. Remove damaged materials from site.

1.06 ENVIRONMENTAL REQUIREMENTS

- A. Low-Emitting Materials, Adhesives, and Sealants: Materials used on the interior of the building (defined as inside the weatherproofing system and applied on site) must not exceed the following requirements.
 - 1. Adhesives, Sealants and Sealant Primers: South Coast Air Quality Management (SCAQMD) Rule # 1168, requirements in effect on July 1, 2005, and rule amendment date January 7, 2005.
 - 2. Aerosol Adhesives: Green Seal Standard for Commercial Adhesives GS-36, requirements in effect on October 19, 2000.

PART 2 - PRODUCTS

2.01 INSULATION TYPE 1: BATT INSULATION

- A. Batt Insulation:
 - 1. Unfaced Fiberglass batts per ASTM C665, Type I. Thickness as indicated on Drawings.
 - a. Provide batt insulation that is a GreenGuard Indoor Air Quality Certified, low-emitting product.
 - b. Manufacturers: CertainTeed, Guardian, Knauf, Owens Corning, or approved equal.
- B. Vapor Retarder:
 - 1. Class II, tested in accordance with ASTM E 96.
 - 2. 4 mil clear polyethylene.
- C. Vapor Retarder Tape: As recommended by vapor retarder manufacturer.

2.02 SPRAYED POLYURETHANE FOAM SEALANT

- A. Single-component polyurethane foam sealant for sealing cracks, gaps around openings and joints between other materials so as prevent air infiltration and water penetration. Provide products that have a VOC content of less than 250 g/l.
 - 1. Manufacturers:
 - a. OSI, Green Series, "Pro Foam II Minimally Expanding Sealant".
 - b. Dow, "Great Stuff Gaps and Cracks.
 - c. Soy Seal for Gaps & Cracks.
 - d. Or approved equal.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates and conditions under which insulation work is to be performed. Do not proceed with insulation work until unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Clean substrates of substances harmful to insulations or vapor barriers, including removal of projections, which might puncture vapor barriers.

3.03 INSTALLATION

- A. General
 - 1. Comply with manufacturer's instructions for particular conditions of installation in each case. If printed instructions are not available or do not apply to project conditions, consult manufacturer's technical representative for specific recommendations before proceeding.
 - 2. Extend insulation full thickness as shown over entire area to be insulated. Cut and fit tightly around obstructions, and fill voids with insulation. Remove projections which interfere with placement.
 - 3. Apply a single layer of insulation to required thickness, unless otherwise shown or required to make up total thickness.
 - 4. Supply and install manufacturer recommended construction tape over all joints in rigid insulation per manufacturer's instructions.
- B. Blanket Insulation

1. Install blanket with vapor retarder to warm side of wall.
 2. Use loose blanket insulation to tightly seal all cracks, openings, spaces causing drafts into heated spaces at furred ceiling, tops of walls, door rough openings, at deck and joist bearing on perimeter walls, etc.
 3. Use to close space around ducts where they pass through walls.
 4. Install ventilation baffles per manufacturer's instructions.
 5. Provide insulation supports at horizontal applications where friction fit is not adequate to hold insulation in proper position.
- C. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using the following materials:
1. Batt Insulation: Compact to approximately 40 percent of normal maximum volume equaling a density of approximately 2.5 lb/cu. ft.
 2. Spray Polyurethane Foam Sealant: Apply according to manufacturer's written instructions.
- 3.04 INSTALLATION OF VAPOR RETARDERS
- A. General: Extend vapor retarder to extremities of areas to be protected from vapor transmission. Secure in place with adhesives or other anchorage system as indicated. Extend vapor retarder to cover miscellaneous voids in insulated substrates, including those filled with loose-fiber insulation.
- B. Firmly attach vapor retarders to metal framing and solid substrates with vapor-retarder fasteners.
- C. Seal joints caused by pipes, conduits, electrical boxes, and similar items penetrating vapor retarders with vapor-retarder tape to create an airtight seal between penetrating objects and vapor retarder.
- D. Repair tears or punctures in vapor retarders immediately before concealment by other work. Cover with vapor-retarder tape or another layer of vapor retarder.
- E. Vapor retarder shall be installed in maximum material sizes so as eliminate intermediate horizontal joints and to achieve a minimum vertical joint spacing of 90-feet. The vertical joints shall have 12-inch overlaps and shall include two continuous runs of specified tape. The tape shall be used at the top and bottom seals.
- 3.05 PROTECTION
- A. Protect installed insulation and vapor barriers from harmful weather exposures and physical abuses, by non-delayed installation of concealing work or, where that is not possible, by temporary covering or enclosure.

END OF SECTION 07 21 00

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SECTION 07 84 00

FIRESTOPPING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Conditions of the Contract and portions of Division One of this Project Manual apply to this Section as though repeated herein.

1.02 SUMMARY

- A. Provide firestop systems consisting of a material, or combination of materials installed to retain the integrity of fire resistance rated construction by maintaining an effective barrier against the spread of flame, smoke and/or hot gases through penetrations, fire resistive joints, and perimeter openings in accordance with the requirements of the Building Code for this project.
- B. Firestop systems shall be used in locations including, but not limited to, the following:
 - 1. Penetrations through fire resistance rated floor and roof assemblies including both empty openings and openings containing penetrants.
 - 2. Penetrations through fire resistance rated wall assemblies including both empty openings and openings containing penetrants.
 - 3. Membrane penetrations in fire resistance rated wall assemblies where items penetrate on side of the barrier.
 - 4. Joints between fire resistance rated assemblies.
 - 5. Perimeter gaps between rated floors/roofs and an exterior wall assembly.
- C. Related Sections include, but are not limited to, the following:
 - 1. Division 22 and 23 – Mechanical; Pipe and Duct
 - 2. Division 26 – Electrical; Lighting, Power, Alarms, and Communications

1.03 REFERENCES

- A. American Society For Testing and Materials Standards (ASTM):
 - 1. ASTM E 84: Standard Test Method for Surface Burning Characteristics of Building Materials.
 - 2. ASTM E 814: Standard Test Method for Fire Tests of Through-Penetration Firestops.
 - 3. ASTM E 1966: Test Method for Resistance of Building Joint Systems.
 - 4. ASTM E 1399: Test Method for Cyclic Movement and Measuring Minimum and Maximum Joint Width.
 - 5. ASTM E 119: Methods of Fire Tests of Building Construction and Materials.
 - 6. ASTM E 2307: Standard Test Method for Determining Fire Resistance of Perimeter Fire Barriers Using Intermediate-Scale, Multi-Story Test Apparatus
 - 7. ASTM E 2174: Standard Practice for On-Site Inspection of Installed Fire Stops
 - 8. ASTM E 2393: Standard Practice for On-Site Inspection of Installed Fire Resistive Joint Systems and Perimeter Fire Barriers
- B. Underwriters Laboratories Inc. (UL):
 - 1. UL 723: Surface Burning Characteristics of Building Materials.
 - 2. UL 1479: Fire Tests of Through-Penetration Fire Stops.
 - 3. UL 2079: Tests for Fire Resistance of Building Joint Systems.
- C. UL Fire Resistance Directory -Volume 2:
 - 1. Through-Penetration Firestop Devices (XHJI)

2. Fire Resistive Ratings (BXUV)
3. Through-Penetration Firestop Systems (XHEZ)
4. Fill, Void, or Cavity Material (XHHW)

D. Omega Point Laboratories (OPL)

1. Directory of Listed Building Products, Materials & Assemblies – Volume II

1.04 DEFINITIONS

- A. Firestopping: The use of a material or combination of materials in a fire-rated structure (wall or floor) where it has been breached, so as to restore the integrity of the fire rating of that wall or floor.
- B. System: The use of a specific firestop material or combination of materials around a specific penetrant(s) or into a specific joint in conjunction with a specific wall and/or floor construction type.
- C. Barrier: Any bearing or non-bearing wall or floor that has an hourly fire and smoke rating.
- D. Through-penetration: Any penetration of a fire-rated wall or floor that completely breaches the barrier.
- E. Membrane-penetration: Any penetration in a fire-rated wall that breaches only one side of the barrier.
- F. Fire Resistive Joint: Any gap, joint, or opening, whether static or dynamic, between two fire-rated barriers including where the top of a wall meets a floor; wall edge to wall edge configurations; floor edge to floor edge configurations; floor edge to wall configurations.
- G. Perimeter Barrier: Any gap, joint, or opening, whether static or dynamic, between a fire-rated floor assembly and a non-rated exterior wall assembly.
- H. Engineering Judgment: A firestopping assembly proposed for conditions where a tested and listed firestopping system does not exist.

1.05 PERFORMANCE REQUIREMENTS

- A. Penetrations: Provide through-penetration firestop systems that are produced and installed to resist the spread of fire, passage of smoke and other hot gases according to requirements indicated, to restore the original fire-resistance rating of barrier penetrated.
 1. Provide and install complete penetration firestopping systems that have been tested and approved by nationally accepted testing agencies per ASTM E 814 or UL 1479 fire tests in a configuration that is representative of field conditions.
 2. F-Rated Systems: Provide through-penetration firestop systems with F-ratings indicated, as determined per ASTM E 814 or UL 1479, but not less than one (1) hour or the fire resistance rating of the barrier being penetrated.
 3. T-Rated Systems: Provide through-penetration firestop systems with T-ratings indicated, as well as F-ratings, as determined per ASTM E 814 or UL 1479, where required by the Building Code.
 4. For piping penetrations for plumbing and wet-pipe sprinkler systems, provide moisture-resistant through-penetration firestop systems.
 5. For penetrations involving insulated piping, provide through-penetration firestop systems not requiring removal of insulation.
- B. Fire Resistive Joints: Provide joint systems with fire resistance assembly ratings indicated, as determined by UL 2079 (ASTM E 1399 and E 1966), but not less than the fire resistance rating of

the construction in which the joint occurs. Firestopping assemblies must be capable of withstanding anticipated movements for the installed field conditions.

1. For firestopping assemblies exposed to view, traffic, moisture, and physical damage, provide products that after curing do not deteriorate when exposed to these conditions both during and after construction.
 2. For floor penetrations exposed to possible loading and traffic, provide firestop systems capable of supporting floor loads involved either by installing floor plates or by other means.
- C. Firestopping products shall have flame spread ratings less than 25 and smoke-developed ratings less than 450, as determined per ASTM E 84.
- D. Where there is no specific third party tested and classified firestop system available for an installed condition, the firestopping contractor shall obtain from the firestopping material manufacturer an Engineering Judgment (EJ) to be submitted to the Approving Authority and Authority Having Jurisdiction for approval prior to installation. The EJ shall follow International Firestop Council (IFC) guidelines.

1.06 SUBMITTALS

- A. Submit in accordance with general conditions of this contract.
- B. Product Data: For each type of firestopping product selected. Certify that firestopping materials are asbestos free and contain volatile organic compounds (VOCs) within limits of the local jurisdiction.
- C. Design Listings: Submit system design listings, including illustrations, from a qualified testing and inspecting agency that is applicable to each firestop configuration.
- D. Where there is no specific third party tested and classified firestop system available for a particular configuration, the firestopping contractor shall obtain from the firestopping material manufacturer an Engineering Judgment (EJ) for submittal.
- E. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Submit document from manufacturer wherein manufacturer recognizes the installer as qualified.

1.07 QUALITY ASSURANCE

- A. Provide firestopping system design listings from UL or OPL in accordance with the appropriate ASTM Standard(s) per article 1.5.
- B. Contractor Qualifications: An acceptable installer shall meet any two of the following requirements:
1. Licensed by State or Local Authority where applicable.
 2. Trained and approved by the firestop manufacturer.
 3. Shown to have successfully completed not less than 5 comparable scale projects.
- C. Single Source Limitations: Obtain firestop systems, for each kind of penetration and construction condition indicated from a single manufacturer, where possible.
- D. Materials from different firestop manufacturers shall not be installed in the same firestop system or opening.
- E. Firestopping material shall be asbestos and lead free and shall not incorporate nor require the use of hazardous solvents.
- F. Firestopping sealants must be flexible, allowing for normal pipe movement.

- G. Firestopping materials shall not crack or pull back from contact surfaces such that a void is created.
- H. Firestopping materials shall be moisture resistant, and may not dissolve in water after curing.
- I. Materials used shall be in accordance with the manufacturer's written installation instructions.
- J. Label each firestopping system installation with the following information:
 - 1. Firestopping product name
 - 2. System listing number
 - 3. Name and address of manufacturer
- K. Inspection of penetrations through fire rated floor and wall assemblies shall be in accordance with ASTM E 2174, Standard Practice for On-Site Inspection of Installed Fire Stops.
- L. Inspection of fire resistive joints and perimeter barriers shall be in accordance with ASTM E 2393, Standard Practice for On-Site Inspection of Installed Fire Resistive Joint Systems and Perimeter Fire Barriers

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Deliver firestopping products to Project site in original, unopened containers or packages with intact and legible manufacturer's labels identifying product and manufacturer, date of manufacture, lot number, UL or OPL classification marking, and mixing instructions for multi-component materials.
- B. Store and handle materials per manufacturer's instructions to prevent deterioration or damage due to moisture, temperature changes, contaminants, or other causes.
- C. All firestop materials shall be installed prior to expiration of shelf life.

1.09 PROJECT CONDITIONS

- A. Environmental Limitations: Install firestopping when ambient or substrate temperatures are within limits permitted by the manufacturer's written instructions. Do not install firestopping when substrates are wet due to rain, frost, condensation, or other causes.
- B. Ventilate per the manufacturer's written instructions on the product's Material Safety Data Sheet.
- C. Verify the condition of the substrates before starting work.
- D. Care should be taken to ensure that firestopping materials are installed so as not to contaminate adjacent surfaces.

1.10 COORDINATION

- A. Coordinate construction of openings and penetrating items to ensure that firestopping assemblies are installed according to specified requirements.
- B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate through-penetration firestop systems.
- C. Do not conceal firestopping installations until the Owner's inspection agency or Authorities Having Jurisdiction have examined each installation.
- D. Schedule firestopping after installation of penetrants but prior to concealing the openings.

1.11 ENVIRONMENTAL REQUIREMENTS

- A. Low-Emitting Materials, Adhesives, and Sealants: Materials used on the interior of the building (defined as inside the weatherproofing system and applied on site) must not exceed the following requirements.
 - 1. Adhesives, Sealants and Sealant Primers: South Coast Air Quality Management (SCAQMD) Rule # 1168, requirements in effect on July 1, 2005, and rule amendment date January 7, 2005.
 - 2. Aerosol Adhesives: Green Seal Standard for Commercial Adhesives GS-36, requirements in effect on October 19, 2000.

PART 2 - PRODUCTS

2.01 FIRESTOPPING, GENERAL

- A. Firestopping products specified in system design listings by UL or OPL may be used providing they conform to the construction type, penetrant type, annular space requirements, and fire rating involved in each separate assembly.
- B. Manufacturer of firestopping products shall have been successfully producing and supplying these products for a period of not less than three years and be able to show evidence of at least ten projects where similar products have been installed and accepted.
- C. Accessories: Provide components for each firestop system that are needed to install fill materials and to comply with "Performance Requirements" Article. Use only components specified by the firestopping manufacturer and approved by UL or OPL for the firestop systems indicated. Accessories include, but are not limited to the following items:
 - 1. Permanent forming/damming/backing materials, including the following:
 - a. Mineral wool insulation.
 - b. Foams or sealants used to prevent leakage of fill materials in liquid state.
 - c. Fire-rated form board.
 - d. Polyethylene/polyurethane backer rod.
 - e. Rigid polystyrene board.
 - f. Temporary forming materials.
 - g. Substrate primers.
 - h. Steel sleeves
- D. All firestopping products and systems shall be designed and installed so that the basic sealing system will allow the full restoration of the fire resistance properties of the barrier being penetrated with minimal repair if penetrants are subsequently removed.

2.02 MIXING

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

2.03 MANUFACTURERS

- A. Subject to compliance with the requirements, provide products by one of the following:
 - 1. Grace Construction Products, 62 Whittemore Ave, Cambridge MA 02140, (866) 333-3726.
 - 2. Hilti USA; 5400 S. 122nd E. Ave, Tulsa, OK 74146 (800) 445-8827

3. 3M Fire Protection; 3M Center, St. Paul, MN 55144 (888) 364-3577
4. Or Approved Equal.

2.04 MATERIALS

A. Intumescent Firestop Sealants and Caulks:

1. FlameSafe FS1900
2. Or Approved Equal

B. Elastomeric Water-Based Sealant:

1. FlameSafe FS1900, FS900
2. Or Approved Equal

C. Elastomeric Silicone Sealant:

1. FlameSafe Silicone
2. Or Approved Equal

D. Firestop Putty:

1. FlameSafe FSP1000 Putty & FSP1077 Putty Pads
2. Or Approved Equal

E. Firestop Devices:

1. FlameSafe FSWS Collar, FSIS Intumescent Sleeve, FlameSafe FSD Device
2. Or Approved Equal

F. Wrap Strips:

1. FlameSafe FSWS 100 Wrap Strip, FSWS 150 Wrap Strip
2. Or Approved Equal

G. Firestop Mortars:

1. FlameSafe FSM Mortar
2. Or Approved Equal

H. Firestop Bags/Pillows:

1. FlameSafe Bags, FlameSafe Pillows
2. Or Approved Equal

I. Elastomeric Coating:

1. FlameSafe FS3000
2. Or Approved Equal

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
- C. Verify that all pipes, conduits, cables, and/or other items which penetrate fire-rated construction have been permanently installed prior to installation of firestops.

3.02 PREPARATION

- A. Surface Cleaning: Clean out openings immediately before installing firestop systems to comply with written recommendations of firestopping manufacturer and the following requirements:
 - 1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of firestop systems.
 - 2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with firestop systems. Remove loose particles remaining from cleaning operation.
 - 3. Remove laitance and form-release agents from concrete.

3.03 PENETRATION FIRESTOP SYSTEMS

- A. General: Install through-penetration firestop systems to comply with "Performance Requirements" article in Part 1 and firestopping manufacturer's written installation instructions and published drawings for products and applications indicated.
- B. Installation of firestopping shall be performed by an applicator/installer qualified as described in article 1.7.
- C. Apply firestopping in accordance with UL or OPL listed system designs or manufacturer's EJ per the manufacturer's installation instructions.
- D. Install forming/damming/backing materials and other accessories required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire resistance ratings required.
- E. Install fill materials for firestop systems by proven techniques to produce the following results:
 - 1. Fill voids and cavities formed by openings, forming materials, accessories, and penetrating items as required to achieve fire-resistance ratings indicated.
 - 2. Apply materials so they fully contact and adhere to substrates formed by openings and penetrating items.
 - 3. For fill materials that will remain exposed after completing Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.04 JOINT FIRESTOP SYSTEMS

General: Install fire resistive joint firestop systems to comply with "Performance Requirements" article in Part 1 and firestopping manufacturer's written installation instructions and published drawings for products and applications indicated. System to meet UL2079-"Tests for Fire Resistance of Building Joint Systems.

- A. Installation of firestopping shall be performed by an applicator/installer qualified as described in article 1.7.
- B. Apply firestopping in accordance with UL or OPL listed system designs or manufacturer's Engineered Judgment per the manufacturer's installation instructions.
- C. Install joint forming/damming materials and other accessories required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths of installed firestopping material relative to joint widths that allow optimum movement capability and achieve fire resistance ratings required.
- D. Install fill materials for firestop systems by proven techniques to produce the following results:
 - 1. Fill joint as required to achieve fire-resistance ratings indicated.
 - 2. Apply materials so they fully contact and adhere to substrates forming the openings.
 - 3. Completely fill recesses provided for each joint configuration.

4. Tool non-sag firestop materials after their application and prior to the time skinning begins. Use tooling agents approved by the firestopping manufacturer.

3.05 PERIMETER BARRIER FIRESTOP SYSTEMS

- A. General: Install perimeter barrier firestop systems to comply with “Performance Requirements” article in Part 1 and firestopping manufacturer’s written installation instructions and published drawings for products and applications indicated.
- B. Installation of firestopping shall be performed by an applicator/installer qualified as described in article 1.7.
- C. Apply firestopping in accordance with UL or OPL listed system designs or manufacturer’s EJ per the manufacturer’s installation instructions.
- D. Install metal framing, curtain wall insulation, mechanical attachments, safing materials and firestop materials as applicable within the system design.

3.06 FIELD QUALITY CONTROL

- A. All penetrations shall maintain the fire rating of the assembly through which they pass by the use of UL, OPL, or Engineered Judgement firestopping systems.

3.07 CLEANING AND PROTECTION

- A. Clean off excess fill materials adjacent to openings as Work progresses by methods and with cleaning materials that are approved in writing by firestopping manufacturer(s) and that do not damage materials in which openings occur. Leave finished work in neat, clean condition with no evidence of spillovers or damage to adjacent surfaces.
- B. Provide final protection and maintain conditions during and after installation that ensure firestop systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated firestop systems immediately and install new materials to produce firestop systems complying with specified requirements.

END OF SECTION 07 84 00

SECTION 07 92 00

JOINT SEALANTS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Conditions of the Contract and portions of Division One of this Project Manual apply to this Section as though repeated herein.

1.02 WORK INCLUDED

- A. Miscellaneous Joints.
- B. Wall Joints (exterior).

1.03 RELATED WORK

- A. Section 08 11 13, Steel Doors and Frames.
- B. Section 09 29 00, Gypsum Board.

1.04 SUBMITTALS

- A. Product Data: For each joint-sealant product indicated.
- B. Samples for initial selection: Manufacturer's color charts.
- C. Samples for final selection: Custom color range of actual material for selection.
- D. Samples for exterior mockup selection: Custom color range of actual material installed in mockup for selection.
- E. Preconstruction Compatibility and Adhesion Test Reports: From sealant manufacturer, indicating the following:
 - 1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.
 - 2. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.
- F. Field-Adhesion Test Reports: For each sealant application tested.
- G. Warranties: Sample of special warranties.

1.05 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
- B. Source Limitations: Obtain each kind of joint sealant from single source from single manufacturer.
- C. Product Testing: Test joint sealants using a qualified testing agency.

1. Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.
2. Test according to SWRI's Sealant Validation Program for compliance with requirements specified by reference to ASTM C 920 for adhesion and cohesion under cyclic movement, adhesion-in-peel, and indentation hardness.

1.06 PROJECT CONDITIONS

- A. Examine the joint surfaces and backing, and their anchorage to the structure, and the conditions under which the joint sealer work is to be performed. Do not proceed with the joint sealer work until unsatisfactory conditions have been corrected.
- B. Do not proceed with installation of sealants under adverse weather conditions, or when temperatures are below or above manufacturer's recommended limitations for installation. Proceed with the work only when forecasted weather conditions are favorable for proper cure and development of high early bond strength. Wherever joint width is affected by ambient temperature variations, install sealants only when temperatures are in the lower third of manufacturer's recommended installation temperature range.

1.07 WARRANTY

- A. Special Installer's Warranty: Manufacturer's standard form in which Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
 1. Warranty Period: Two years from date of Substantial Completion.
- B. Special Manufacturer's Warranty: Manufacturer's standard form in which joint-sealant manufacturer agrees to furnish joint sealants to repair or replace those that do not comply with performance and other requirements specified in this Section within specified warranty period.
 1. Warranty Period: Five years from date of Substantial Completion.
- C. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:
 1. Movement of the structure caused by structural settlement or errors attributable to design or construction resulting in stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
 2. Disintegration of joint substrates from natural causes exceeding design specifications.
 3. Mechanical damage caused by individuals, tools, or other outside agents.
 4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

1.08 ENVIRONMENTAL REQUIREMENTS

- A. Low-Emitting Materials, Adhesives, and Sealants: Materials used on the interior of the building (defined as inside the weatherproofing system and applied on site) must not exceed the following requirements.
 1. Adhesives, Sealants and Sealant Primers: South Coast Air Quality Management (SCAQMD) Rule # 1168, requirements in effect on July 1, 2005, and rule amendment date January 7, 2005.
 2. Aerosol Adhesives: Green Seal Standard for Commercial Adhesives GS-36, requirements in effect on October 19, 2000.

PART 2 - PRODUCTS

2.01 MATERIALS, GENERAL

- A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.
- B. Stain-Test-Response Characteristics: Where sealants are specified to be non-staining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.
- C. Suitability for Contact with Food: Where sealants are indicated for joints that will come in repeated contact with food, provide products that comply with 21 CFR 177.2600.
- D. Colors of Exposed Joint Sealants: As selected by A/E from manufacturer's full range, or custom colors where indicated.

2.02 SILICONE JOINT SEALANTS

- A. Single-Component, Nonsag, Neutral-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 100/50, for Use NT.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Dow Corning Corporation; 790.
 - b. GE Advanced Materials - Silicones; SilPruf LM SCS2700.
 - c. May National Associates, Inc.; Bondaflex Sil 290.
 - d. Pecora Corporation; 301 NS.
 - e. Sika Corporation, Construction Products Division; SikaSil-C990.
 - f. Tremco Incorporated; Spectrem 1.
- B. Single-Component, Nonsag, Traffic-Grade, Neutral-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 100/50, for Use T.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Dow Corning Corporation; NS Parking Structure Sealant.
 - b. May National Associates, Inc.; Bondaflex Sil 728 NS.
 - c. Pecora Corporation; 311 NS.
 - d. Tremco Incorporated; Spectrem 800.
- C. Single-Component, Nonsag, Neutral-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 25, for Use NT.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Dow Corning Corporation; 799.
 - b. GE Advanced Materials - Silicones; UltraGlaze SSG4000 or UltraGlaze SSG4000AC.
 - c. May National Associates, Inc.; Bondaflex Sil 200 GPN or Bondaflex Sil 201 FC.
 - d. Polymeric Systems, Inc.; PSI-631.
 - e. Schnee-Morehead, Inc.; SM5731 Poly-Glaze Plus.
 - f. Tremco Incorporated; Proglaze SSG or Tremsil 600.
- D. Multicomponent, Nonsag, Neutral-Curing Silicone Joint Sealant: ASTM C 920, Type M, Grade NS, Class 50, for Use NT.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Tremco Incorporated; Spectrem 4TS.

- E. Mildew-Resistant, Single-Component, Nonsag, Neutral-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 25, for Use NT.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Pecora Corporation; 898.

2.03 LATEX JOINT SEALANTS

- A. Latex Joint Sealant: Acrylic latex or siliconized acrylic latex, ASTM C 834, Type OP, Grade NF.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. BASF Building Systems; Sonolac.
 - b. Bostik, Inc. Chem-Chal 600.
 - c. Pecora Corporation; AC-20+.
 - d. Tremco Incorporated; Tremflex 834.

2.04 PREFORMED JOINT SEALANTS

- A. A. Preformed Silicone Joint Sealants: Manufacturer's standard sealant consisting of precured low modulus silicone extrusion, in sizes to fit joint widths indicated, combined with a neutral-curing silicone sealant for bonding extrusions to substrates.

2.05 SEALANT ACCESSORIES

- A. Primer: When required, as recommended by the Sealant Manufacturer.
- B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.
- C. Masking Tape: Non-staining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.
- D. Joint Sealant Backing:
 - 1. General: Provide sealant backings of material that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
 - 2. Closed Cell Back-up (Backer Rod): ASTM C 1330, Type C.
 - a. Tremco "Closed Cell Backer Rod".
 - b. Sonneborn "Sonofam".
 - c. W.R. Meadows "Kool-Rod".
 - 3. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint. Provide self-adhesive tape where applicable.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 JOINT PREPARATION

- A. Clean joint surfaces immediately before installation of sealant. Remove dirt, insecure coatings, moisture and other substances which would interfere with bond of sealant. Etch concrete and masonry joint surfaces as recommended by sealant manufacturer. Roughen vitreous or glazed joint surfaces as recommended by sealant manufacturer.
- B. Prime or seal the joint surfaces wherever shown or recommended by the sealant manufacturer. Do not allow primer/sealer to spill or migrate onto adjoining surfaces.

3.03 SEALANT APPLICATION, GENERAL

- A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
- B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. Set joint filler units at proper depth or position in the joint to coordinate with other work, including the installation of bond breakers, backer rods and sealants.
 - 1. Do not leave voids or gaps between the ends of joint filler units.
 - 2. Do not stretch, twist, puncture, or tear sealant backings.
 - 3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.
- D. Install bond breaker tape wherever shown and wherever required by manufacturer's recommendations to ensure that elastomeric sealants will perform properly.
- E. Apply compound with a gun having proper size nozzle or with a knife, as required. Use sufficient pressure to fill all voids and joints solid. Remove excess sealant and leave surfaces smooth, neat and clean. Upon completion sealant shall have a smooth, even finish and all joints shall be weathertight. All work shall be in accordance with manufacturer's printed instructions.
- F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
 - 1. Remove excess sealant from surfaces adjacent to joints.
 - 2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
 - 3. Provide concave joint profile per Figure 8A in ASTM C 1193, unless otherwise indicated.
 - 4. Provide flush joint profile where indicated per Figure 8B in ASTM C 1193.
 - 5. Provide recessed joint configuration of recess depth and at locations indicated per Figure 8C in ASTM C 1193.
 - a. Use masking tape to protect surfaces adjacent to recessed tooled joints.
- G. Acoustical Sealant Installation: At sound-rated assemblies and elsewhere as indicated, seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at

perimeters and through penetrations. Comply with ASTM C 919 and with manufacturer's written recommendations. Refer to Section 09 29 00 for product.

- H. Do not allow sealants or compounds to overflow or spill onto adjoining surfaces, or to migrate into the voids of adjoining surfaces. Clean the adjoining surfaces by whatever means may be necessary to eliminate evidence of spillage.

3.04 FIELD QUALITY CONTROL

- A. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:
 - 1. Extent of Testing: Test completed and cured sealant joints as follows:
 - a. Perform 5 tests for the first 1000 feet of joint length for each kind of exterior sealant and joint substrate.
 - b. Perform 1 test for each 1000 feet of joint length thereafter or 1 test per each floor per elevation.
 - 2. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.
 - a. For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
 - 3. Inspect tested joints and report on the following:
 - a. Whether sealants filled joint cavities and are free of voids.
 - b. Whether sealant dimensions and configurations comply with specified requirements.
 - c. Whether sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. Compare these results to determine if adhesion passes sealant manufacturer's field-adhesion hand-pull test criteria.
 - 4. Record test results in a field-adhesion-test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant fill, sealant configuration, and sealant dimensions.
 - 5. Repair sealants pulled from test area by applying new sealants following same procedures used originally to seal joints. Ensure that original sealant surfaces are clean and that new sealant contacts original sealant.
- B. Evaluation of Field-Adhesion Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

3.05 PROTECTION

- A. Cure sealants in compliance with manufacturer's instructions and recommendations. Advise the Contractor of procedures required for the cure and protection of joint sealers during the construction period, so that they will be without deterioration or damage (other than normal wear and weathering) at the time of Substantial Completion.

3.06 JOINT-SEALANT COLOR SCHEDULE

1. Provide different sealant colors, as selected by A/E from manufacturer's full range of colors, at the following joint locations, and as specified in related Sections:
 - a. Exterior envelope (all conditions)
 - b. Door and window frames
 - c. GWB penetrations
 - d. GWB/Toilet room plumbing fixtures/plates

END OF SECTION 07 92 00

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SECTION 08 11 13

HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Conditions of the Contract and portions of Division One of this Project Manual apply to this Section as though repeated herein.

1.02 WORK INCLUDED

- A. Hollow Metal Doors.
- B. Hollow Metal Frames.

1.03 RELATED WORK

- A. Joint Sealants: Section 07 92 00.
- B. Door Hardware: Section 08 71 00.
- C. Glass and Glazing: Section 08 80 00.
- D. Painting: Section 09 90 00.
- E. Electrical: Division 26, for conduit in frames for door hardware.

1.04 REFERENCES

- A. Comply with Steel Door Institute "Recommended Specifications: Standard Steel Doors and Frames" (SDI-100) and as herein specified.
- B. Fire-Rated Doors: Comply with NFPA 80 "Standard for Fire Doors and Windows." and have been tested, listed, and labeled in accordance with ASTM E 152 "Standard Methods of Fire Tests of Door Assemblies" by a nationally recognized independent testing and inspection agency acceptable to authorities having jurisdiction.
- C. ANSI A250.3 Test Procedure and Acceptance Criteria for Factory Applied Finish Painted Steel Surfaces for Steel Doors and Frames
- D. ANSI A250.4 Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors and Hardware Reinforcings
- E. ANSI A250.5 Accelerated Physical Endurance Test Procedure for Steel Doors, Frames, and Frame Anchors
- F. ANSI A250.6 Hardware on Steel Doors (Reinforcement --Application)
- G. ANSI A250.8 Nomenclature for Standard Steel Doors and Steel Door Frames
- H. ANSI A250.10 Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames

- I. ANSI/DHI A115 Specifications for Hardware Preparations in Standard Steel Doors and Frames
 - J. ANSI/DHI A115.1G Installation Guide for Doors and Hardware
 - K. SDI-Steel Door Institute
 - L. ASTM E119 Methods for Fire Tests of Building Construction and Materials.
 - M. ASTM A240/A240M Standard Specification for Heat-Resisting Chromium and Chromium-Nickel Stainless Steel
 - N. ASTM A366 Standard Specification for Steel, Sheet, Carbon, Cold-Rolled, Commercial Quality
 - O. ASTM A568 Standard Specification for Steel, Sheet, Carbon, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements
 - P. ASTM A569 Standard Specification for Steel, Carbon (0.15 Maximum, Percent), Hot-Rolled Sheet and Strip Commercial Quality
 - Q. ASTM A591 Standard Specification for Steel Sheet, Electrolytic Zinc-Coated, for light Coating Mass Applications
 - R. ASTM A620 Standard Specification for Steel, Sheet, Carbon, Cold-Rolled, Drawing Quality, Special Killed
 - S. ASTM A653 Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvanealed) by the Hot-Dip Process
 - T. ASTM A924 Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
 - U. ASTM E2074-00 Methods of Fire Tests of Door Assemblies.
 - V. NFPA 80: Fire Doors and Windows.
 - W. NFPA-101-94: Life Safety Code.
 - X. NFPA 251: Fire Tests of Building Construction and Materials.
 - Y. NFPA 252: Fire Tests of Door Assemblies.
 - Z. UL 9: Fire Tests of Door Assemblies.
 - AA. UL 10B: Fire Tests of Door Assemblies.
 - BB. UL 263: Fire Tests of Building Construction and Materials.
 - CC. American Welding Society
- 1.05 SUBMITTALS
- A. Submit in accordance with the General Conditions of the Contract.
 - 1. Manufacturer's technical product data substantiating that products comply with requirements.

2. Shop Drawings for fabrication and installation of steel doors and frames. Include details of each frame type, elevations of door design types, conditions at openings, details of construction, location and installation requirements of finish hardware and reinforcements, and details of joints and connections. Show anchorage and accessory items.
 - a. Provide schedule of doors and frames using same reference numbers for details and openings as those on contract drawings.
 - b. Indicate coordination of glazing frames and stops with glass and glazing requirements.
3. Oversize Construction Certification: For assemblies required to be fire rated and exceeding limitations of labeled assemblies.
4. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each type of hollow metal door and frame assembly.

1.06 QUALITY ASSURANCE

- A. Source Limitations: Obtain hollow metal work from single source from single manufacturer.
- B. Fire-Rated Door Assemblies: Label, testing and installation of opening protectives shall be in accordance with Wisconsin Building Code Section 715.
 1. Oversize Fire-Rated Door Assemblies: For units exceeding sizes of tested assemblies, provide certification by a qualified testing agency that doors comply with standard construction requirements for tested and labeled fire-rated door assemblies except for size.
- C. Smoke-Control Door Assemblies: Comply with NFPA 105 or UL 1784.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver hollow metal work cartoned or crated to provide protection during transit and job storage.
 1. Provide additional protection to prevent damage to finish of factory-finished units.
- B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.
- C. Inspect hollow metal work upon delivery for damage. Minor damages may be repaired provided refinished items are equal in all respects to new work and acceptable to Construction Manager; otherwise, remove and replace damaged items as directed.
- D. Store doors and frames at building site under cover. Place units on minimum 4 inch high wood blocking. Avoid use of non-vented plastic or canvas shelters which could create a humidity chamber. If cardboard wrapper on door becomes wet, remove carton immediately. Provide 1/4 inch spaces between stacked doors to promote air circulation.

1.08 PROJECT CONDITIONS

- A. Examine the openings and conditions under which hollow metal work is to be installed. Do not proceed with the work until unsatisfactory conditions have been corrected.

PART 2 - PRODUCTS

2.01 MANUFACTURERS, HOLLOW METAL

- A. Amweld Building Products
- B. Ceco Door Products
- C. Curries Company
- D. Kewaunee Corporation
- E. Mesker Door, Inc.
- F. Steelcraft
- G. Or approved equal.

2.02 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.
- B. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.
- C. Frame Anchors: ASTM A 591/A 591M, Commercial Steel (CS), 40Z coating designation; mill phosphatized.
 - 1. For anchors built into exterior walls, steel sheet complying with ASTM A 1008/A 1008 or ASTM A 1011/A 1011M, hot-dip galvanized according to ASTM A 153/A 153M, Class B.
- D. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.
- E. Powder-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow metal frames of type indicated.
- F. Grout: ASTM C 476, except with a maximum slump of 4 inches, as measured according to ASTM C 143/C 143M.
- G. Mineral-Fiber Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool with 6- to 12-lb/cu. ft. density; with maximum flamespread and smoke-development indexes of 25 and 50, respectively; passing ASTM E 136 for combustion characteristics.
- H. Glazing: Comply with requirements in Division 08 Section "Glazing."
- I. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.
- J. Steel: Commercial quality, level, cold-rolled steel conforming to ASTM A366, free of scale and surface defects. Commercial quality hot rolled and pickled steel conforming to ASTM A569 may be used as option for interior frames. Standard hollow metal frame gauges are as follows (Bullet Resistant must meet specified resistance level):
 - 1. Interior Frames: 16-gage.
 - 2. Exterior Frames: 14-gage.
 - 3. Flush Doors: 16-gage (exterior), 18-gage (interior).
 - 4. Rough Bucks and Stiffeners: 12-gage.

5. Miscellaneous Trim: 16 gage.

2.03 FABRICATION, GENERAL

- A. Fabricate hollow metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.
- B. Tolerances: Fabricate hollow metal work to tolerances indicated in SDI 117.
- C. Fabricate concealed stiffeners, edge channels, and hardware reinforcement from either cold- or hot-rolled steel sheet.
- D. Fabricate doors to a maximum tolerance of 1/16 inch from a straight edge when laid on face of door in any direction, including diagonal.
- E. Provide proper Underwriters' Laboratory (UL) labels. Labeled doors shall have equal labeled frames.
- F. Clearances
 - 1. Edge clearances shall be provided as follows:
 - a. Between doors and frame, at head and jambs - 1/8 inch.
 - b. At door sills:
 - 1) Where no threshold is used - 3/8 minimum.
 - 2) Where threshold is used - 1/4 inch maximum between door & threshold.
- G. Hardware Preparation: Factory prepare hollow metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to the Door Hardware Schedule and templates furnished as specified in Division 08 Section "Door Hardware."
 - 1. Locate hardware as indicated, or if not indicated, according to ANSI/SDI A250.8.
 - 2. Reinforce doors and frames to receive nontemplated, mortised and surface-mounted door hardware.
 - 3. Comply with applicable requirements in ANSI/SDI A250.6 and ANSI/DHI A115 Series specifications for preparation of hollow metal work for hardware.
 - 4. Coordinate locations of conduit and wiring boxes for electrical connections with Division 26 Sections.
- H. Stops and Moldings: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with butted or mitered hairline joints.
 - 1. Single Glazed Lites: Provide fixed stops and moldings welded on secure side of hollow metal work. Multiple Glazed Lites: Provide fixed and removable stops and moldings so that each glazed lite is capable of being removed independently.
 - 2. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames.
 - 3. Provide loose stops and moldings on inside of hollow metal work. Coordinate rabbet width between fixed and removable stops with type of glazing and type installation indicated.

2.04 HOLLOW METAL FRAME FABRICATION

- A. Provide metal frames of the types and styles indicated on the drawings or schedules and complying with SDI for materials and construction requirements.
- B. Provide metal frames for doors, transoms, sidelights, borrowed lites, and other openings, as shown on drawings.

- C. Provide integral channel frames, sub frames and stiffeners to structure where indicated or required for fastening and stiffening frames.
- D. Provide steel spreader temporarily attached to feet of both jambs for welded frames.
- E. Completely clean all frames by degreasing process, followed by one coat rust inhibitive primer equal to withstand a salt spray test (5% solution) of 70 hours. Thoroughly prime all surfaces without runs, smears, or bare spots, and under and inside all removable stops.
- F. Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.
 - 1. Welded Frames: Weld flush face joints continuously; grind, fill, dress, and make smooth, flush, and invisible.
 - 2. Sidelight Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by butt welding.
 - 3. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
 - 4. Grout Guards: Weld guards to frame at back of hardware mortises in frames to be grouted.
 - 5. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.
 - 6. Jamb Anchors: Provide number and spacing of anchors as follows:
 - a. Masonry Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:
 - 1) Two anchors per jamb up to 60 inches high.
 - 2) Three anchors per jamb from 60 to 90 inches high.
 - 3) Four anchors per jamb from 90 to 120 inches high.
 - 4) Four anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof above 120 inches high.
 - b. Stud-Wall Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:
 - 1) Three anchors per jamb up to 60 inches high.
 - 2) Four anchors per jamb from 60 to 90 inches high.
 - 3) Five anchors per jamb from 90 to 96 inches high.
 - 4) Five anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof above 96 inches high.
 - 5) Two anchors per head for frames above 42 inches wide and mounted in metal-stud partitions.
 - c. Compression Type: Not less than two anchors in each jamb.
 - d. Postinstalled Expansion Type: Locate anchors not more than 6 inches from top and bottom of frame. Space anchors not more than 26 inches o.c.
 - 7. Door Silencers: Except on weather-stripped doors, drill stops to receive door silencers as follows. Keep holes clear during construction.
 - a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
 - b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.

2.05 HOLLOW METAL DOOR FABRICATION

- A. Top and bottom edges of all doors shall be closed with a continuous recessed steel channel not less than 16-gauge, full width spot welded to both faces.

- B. All doors to be flush with seamless edges i.e., provide continuous flush end closures, continuously welded in place and ground smooth.
- C. Hardware location per manufacturer recommended heights to meet ADA requirements.
- D. Completely clean all doors of impurities and pressure sand to a smooth surface and correct all irregularities with metallic putty sanded smooth. Provide one spray coat of primer, baked on. Thoroughly paint unexposed inside surfaces of exterior doors, fire doors, and other doors occurring in excessive moisture area.
- E. Exterior Doors: Provide weep-hole openings in bottom of exterior doors to permit moisture to escape. Seal joints in top edges of doors against water penetration.
- F. Glazed Lites: Factory cut openings in doors.
- G. Astragals: Provide overlapping astragal on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated. Extend minimum 3/4 inch beyond edge of door on which astragal is mounted.

2.06 STANDARD HOLLOW METAL DOORS

- A. General: Provide doors of design indicated, not less than thickness indicated; fabricated with smooth surfaces, without visible joints or seams on exposed faces unless otherwise indicated. Comply with ANSI/SDI A250.8.
 - 1. Design: As indicated.
 - 2. Core Construction: Manufacturer's standard kraft-paper honeycomb, polystyrene, polyurethane, polyisocyanurate, mineral-board, or vertical steel-stiffener core.
 - a. Fire Door Core: As required to provide fire-protection ratings indicated.
 - b. Thermal-Rated (Insulated) Doors: Where indicated, provide doors fabricated with thermal-resistance value (R-value) of not less than 6.0 deg F x h x sq. ft./Btu when tested according to ASTM C 1363.
 - 1) Locations: Exterior doors and doors that connect the main (office and Medical Examiner Suite) portion of the building to Garage, 150.
 - 3. Vertical Edges for Single-Acting Doors: Beveled edge.
 - a. Beveled Edge: 1/8 inch in 2 inches.
 - 4. Top and Bottom Edges: Closed with flush or inverted 0.042-inch- thick, end closures or channels of same material as face sheets.
 - 5. Tolerances: Comply with SDI 117, "Manufacturing Tolerances for Standard Steel Door and Frames."
- B. Exterior Doors: Face sheets fabricated from metallic-coated steel sheet. Provide doors complying with requirements indicated below by referencing ANSI/SDI A250.8 for level and model and ANSI/SDI A250.4 for physical performance level:
 - 1. Level 2 and Physical Performance Level B (Heavy Duty), Model 1 (Full Flush).
- C. Interior Doors: Face sheets fabricated from cold-rolled steel sheet. Provide doors complying with requirements indicated below by referencing ANSI/SDI A250.8 for level and model and ANSI/SDI A250.4 for physical performance level:
 - 1. Level 2 and Physical Performance Level B (Heavy Duty), Model 1 (Full Flush).
- D. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 with reinforcing plates from same material as door face sheets.

- E. Fabricate concealed stiffeners and hardware reinforcement from either cold- or hot-rolled steel sheet.

2.07 STANDARD HOLLOW METAL FRAMES

- A. General: Comply with ANSI/SDI A250.8 and with details indicated for type and profile.
- B. Exterior Frames: Fabricated from metallic-coated steel sheet.
 - 1. Fabricate frames with mitered or coped corners.
 - 2. Fabricate frames as face welded unless otherwise indicated.
 - 3. Frames for Level 2 Steel Doors: 0.053-inch- thick steel sheet.
- C. Interior Frames: Fabricated from cold-rolled steel sheet.
 - 1. Fabricate frames with mitered or coped corners.
 - 2. Fabricate frames as face welded unless otherwise indicated.
 - 3. Frames for Level 2 Steel Doors: 0.053-inch- thick steel sheet.
 - 4. Frames for Borrowed Lights: Same as adjacent door frame.
- D. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 with reinforcement plates from same material as frames.

2.08 FRAME ANCHORS

- A. Jamb Anchors:
 - 1. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, not less than 0.042 inch thick, with corrugated or perforated straps not less than 2 inches wide by 10 inches long; or wire anchors not less than 0.177 inch thick.
 - 2. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042 inch thick.
 - 3. Compression Type for Drywall Slip-on Frames: Adjustable compression anchors.
 - 4. Postinstalled Expansion Type for In-Place Concrete or Masonry: Minimum 3/8-inch diameter bolts with expansion shields or inserts. Provide pipe spacer from frame to wall, with throat reinforcement plate, welded to frame at each anchor location.
- B. Floor Anchors: Formed from same material as frames, not less than 0.042 inch thick, and as follows:
 - 1. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.
 - 2. Separate Topping Concrete Slabs: Adjustable-type anchors with extension clips, allowing not less than 2-inch height adjustment. Terminate bottom of frames at finish floor surface.

2.09 STOPS AND MOLDINGS

- A. Moldings for Glazed Lites in Doors: Minimum 0.032 inch thick, fabricated from same material as door face sheet in which they are installed.
- B. Fixed Frame Moldings: Formed integral with hollow metal frames, a minimum of 5/8 inch high unless otherwise indicated.
- C. Loose Stops for Glazed Lites in Frames: Minimum 0.032 inch thick, fabricated from same material as frames in which they are installed.

2.010 STEEL FINISHES

- A. Prime Finish: Apply manufacturer's standard primer immediately after cleaning and pretreating.
 - 1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with ANSI/SDI A250.10 acceptance criteria; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

2. Ensure primer is compatible with finish coats scheduled.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for embedded and built-in anchors to verify actual locations before frame installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.
- B. Prior to installation, adjust and securely brace welded hollow metal frames for squareness, alignment, twist, and plumbness to the following tolerances:
 1. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
 2. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
 3. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
 4. Plumbness: Plus or minus 1/16 inch, measured at jambs on a perpendicular line from head to floor.
- C. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

3.03 INSTALLATION

- A. General: Install hollow metal work plumb, rigid, properly aligned, and securely fastened in place; comply with Drawings and manufacturer's written instructions.
- B. Hollow Metal Frames: Install hollow metal frames of size and profile indicated. Comply with ANSI/SDI A250.11.
 1. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.
 - a. At fire-protection-rated openings, install frames according to NFPA 80.
 - b. Where frames are fabricated in sections because of shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
 - c. Install frames with removable glazing stops located on secure side of opening.
 - d. Install door silencers in frames before grouting.
 - e. Remove temporary braces necessary for installation only after frames have been properly set and secured.
 - f. Check plumbness, squareness, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.

- g. Field apply bituminous coating to backs of frames that are filled with grout containing antifreezing agents.
2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with postinstalled expansion anchors.
 - a. Floor anchors may be set with powder-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.
 3. Metal-Stud Partitions: Solidly pack mineral-fiber insulation behind frames.
 4. Concrete Walls: Solidly fill space between frames and concrete with grout. Take precautions, including bracing frames, to ensure that frames are not deformed or damaged by grout forces.
 5. In-Place Concrete or Masonry Construction: Secure frames in place with postinstalled expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
 6. Ceiling Struts: Extend struts vertically from top of frame at each jamb to overhead structural supports or substrates above frame unless frame is anchored to masonry or to other structural support at each jamb. Bend top of struts to provide flush contact for securing to supporting construction. Provide adjustable wedged or bolted anchorage to frame jamb members.
 7. Installation Tolerances: Adjust hollow metal door frames for squareness, alignment, twist, and plumb to the following tolerances:
 - a. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
 - b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
 - c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
 - d. Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.
- C. Hollow Metal Doors: Fit hollow metal doors accurately in frames, within clearances specified below. Shim as necessary.
1. Non-Fire-Rated Standard Steel Doors:
 - a. Jambs and Head: 1/8 inch plus or minus 1/16 inch.
 - b. Between Edges of Pairs of Doors: 1/8 inch plus or minus 1/16 inch.
 - c. Between Bottom of Door and Top of Threshold: Maximum 3/8 inch.
 - d. Between Bottom of Door and Top of Finish Floor (No Threshold): Maximum 3/4 inch.
 2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.
 3. Smoke-Control Doors: Install doors according to NFPA 105.
- D. Glazing: Comply with installation requirements in Division 08 Section "Glazing" and with hollow metal manufacturer's written instructions\.
1. Secure stops with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches o.c. and not more than 2 inches o.c. from each corner.
- E. Comply with provisions of SDI-105 "Recommended Erection Instructions for Steel Frames", unless otherwise indicated.
1. Except for frames located at cast-in-place concrete or masonry and at drywall installations, place frames prior to construction of enclosing walls and ceilings. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is completed, remove temporary braces and spreaders leaving surfaces smooth and undamaged.
 2. In masonry or cast-in-place concrete construction, locate 3 wall anchors per jamb at hinge and strike levels.
 3. At cast-in-place concrete or masonry construction, set frames and secure to adjacent construction with machine screws and masonry anchorage devices.

4. Install fire-rated frames in accordance with NFPA Std. No. 80.
 5. In metal stud partitions, install at least 3 wall anchors per jamb at hinge and strike levels. In open steel stud partitions, place studs in wall anchor notches and wire tie. In closed steel stud partitions, attach wall anchors to studs with self-tapping screws.
 6. Fill heads of fasteners with body putty, grind smooth and touch-up prime.
- F. Fit hollow metal doors accurately in frames, within clearances specified in SDI-100.
- G. Place fire-rated doors with clearances as specified in NFPA Standard No. 80.
- H. Install glazing in strict accordance with fire resistant glazing material manufacturer's specifications. Field cutting or tampering is not permissible.
- 3.04 ADJUSTING AND CLEANING
- A. Immediately after erection, sand smooth any rusted or damaged areas of prime coat and apply touch-up of compatible air-drying primer.
- B. Remove grout and other bonding material from hollow metal work immediately after installation.
- C. Check and readjust operating finish hardware items, leaving steel doors and frames undamaged and in complete and proper operating condition. Remove and replace defective work, including hollow metal work that is warped, bowed, or otherwise unacceptable.

END OF SECTION 08 11 13

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SECTION 08 31 13

ACCESS DOORS AND FRAMES

PART 1 - GENERAL

1.01 RELATED WORK

- A. Conditions of the Contract and portions of Division One of this Project Manual apply to this Section as though repeated herein.

1.02 SUMMARY

- A. This section includes the following:
 - 1. Access doors and frames.
- B. Related sections include the following:
 - 1. Division 23 Section "Duct Accessories" for duct access doors.

1.03 SUBMITTALS

- A. Submit in accord with the General Conditions of the Contract.
 - 1. Coordination Drawings: Reflected ceiling plans drawn to scale and coordinating penetrations and ceiling-mounted items with concealed framing, suspension systems, piping, ductwork, and other construction. Show the following
 - a. Method of attaching door frames to surrounding construction.
 - b. Ceiling-mounted items including access doors and frames, lighting fixtures, diffusers, grilles, and special trim.

1.04 QUALITY ASSURANCE

- A. Source Limitations: Obtain doors and frames through one source from a single manufacturer.
- B. Size Variations: Obtain Architect's acceptance of manufacturer's standard-size units, which may vary slightly from sizes indicated.

1.05 ENVIRONMENTAL REQUIREMENTS

- A. Low-Emitting Materials, Field applied Paints and Coatings: Interior paints and coatings applied on-site must meet the limitations and restrictions concerning chemical components set by the following standards:
 - 1. Anti-Corrosive and Anti-Rust Paints: Green Seal Standard GS-03, Anti-Corrosive Paints", Second Edition, January 7, 1997. For applications on ferrous metal substrates.
 - 2. "All Other Architectural Coatings, Primers and Undercoats: South Coast Air Quality Management District (SCAQMD) Rule #1113, Architectural Coatings", rules in effect on January 1, 2004.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Access Doors:
 - a. Bar-Co, Inc. Div.; Alfab, Inc.
 - b. Cesco Products.

- c. J. L. Industries, Inc.
- d. Karp Associates, Inc.
- e. Milcor Limited Partnership.

2.02 MATERIALS

- A. Hot-Rolled Steel Sheets: ASTM A 569/A 569M, Commercial Steel (CS), Type B; free of scale, pitting, and surface defects; pickled and oiled; with minimum thickness indicated representing specified nominal thickness according to ASTM A 568/A 568M.
- B. Cold-Rolled Steel Sheets: ASTM A 366/A 366M, Commercial Steel (CS), or ASTM A 620/A 620M, Drawing Steel (DS), Type B; stretcher-leveled standard of flatness; with minimum thickness indicated representing specified nominal thickness according to ASTM A 568/A 568M. Electrolytic zinc-coated steel sheet, complying with ASTM A 591/A 591M, Class C coating, may be substituted at fabricator's option.
- C. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B, with A60 zinc-iron-alloy (galvannealed); stretcher-leveled standard of flatness; with minimum thickness indicated representing specified thickness according to ASTM A 924/A 924M.
- D. Stainless Steel: Type No. 304 stainless steel with No. 4 satin polish.
- E. Drywall Beads: Edge trim formed from 0.0299-inch zinc-coated steel sheet formed to receive joint compound and in size to suit thickness of gypsum board.

2.03 PAINT

- A. Shop Primers: Provide primers that comply with Division 9 Section "Painting."
- B. Shop Primer for Ferrous Metal: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with performance requirements in FS TT-P-664; selected for good resistance to normal atmospheric corrosion, compatibility with finish paint systems indicated, and capability to provide a sound foundation for field-applied topcoats despite prolonged exposure.
- C. Shop Primer for Metallic-Coated Steel: Organic zinc-rich primer complying with SSPC-Paint 20 and compatible with topcoat.
- D. Galvanizing Repair Paint: High-zinc-dust-content paint for re-galvanizing welds in steel, complying with SSPC-Paint 20.

2.04 ACCESS DOORS AND FRAMES

- A. Flush Access Doors and Frames: Fabricated from metallic-coated steel sheet.
 - 1. Locations: Various locations and surfaces, assembly to be manufactured for specific applications.
 - 2. Sizes: 18" x 18" or as shown in drawings.
 - 3. Door: Sheet metal, gauged to door size, minimum 20 gauge metal set flush with surrounding finish surfaces.
 - 4. Frame: One-inch frame to be manufactured specifically for the surrounding material for flush installation, minimum 16 gauge metal flange.
 - a. Fire Rated doors to be place in fire rated assemblies or as noted on drawing.
 - 1) All fire rated doors to maintain at least a minimum of the hour rating of the assembly into which it is placed.
 - 2) Fire doors shall have automatic closure, be self latching, and contain interior latch release.
 - b. Other as needed.

5. Hinges:
 - a. Spring-loaded concealed pin type.
6. Latch:
 - a. Screwdriver-operated cam latch.
 - b. Key operated security lock.

2.05 FABRICATION

- A. General: Provide access door assemblies manufactured as integral units ready for installation.
- B. Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.
- C. Steel Doors and Frames: Grind exposed welds smooth and flush with adjacent surfaces. Furnish attachment devices and fasteners of type required to secure access panels to types of supports indicated.
- D. Latching Mechanisms: Furnish number required to hold doors in flush, smooth plane when closed.
- E. All access doors to be fabricated and properly installed in such a manner as to maintain the fire rating of the assembly into which it is placed.
- F. UL listed for use in fire rated partitions if required by the application.

2.06 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Finish metal fabrications after assembly.

2.07 METALLIC-COATED STEEL FINISHES

- A. Galvanizing of Steel Shapes and Plates: Hot-dip galvanize items indicated to comply with applicable standard listed below:
 1. ASTM A 123/A 123M, for galvanizing steel and iron products.
 2. ASTM A 153/A 153M, for galvanizing steel and iron hardware.
- B. Surface Preparation: Clean surfaces with nonpetroleum solvent so surfaces are free of oil and other contaminants. For galvanized surfaces, apply, after cleaning, a conversion coating suited to the organic coating to be applied over it. For metallic-coated surfaces, clean welds, mechanical connections, and abraded areas, and apply galvanizing repair paint specified below to comply with ASTM A 780.
 1. Galvanizing Repair Paint: High-zinc-dust-content paint for re-galvanizing welds in steel, complying with SSPC-Paint 20.
- C. Factory Priming for Field-Painted Finish: Apply shop primer immediately after cleaning and pre-treating.
- D. Stainless Steel: Type No. 304 stainless steel with No. 4 satin polish.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install according to manufacturer's instructions.
 - 1. Doors to be installed plumb/level/square as surfaces require.
 - 2. Maintain even gap between frame and door.
- B. Stainless steel access panels are to be installed for use in toilets, showers, similar wet areas and in any space in the Autopsy Suite proper.

3.02 ADJUSTING AND CLEANING

- A. Adjust doors and hardware after installation for proper operation.
- B. Remove and replace doors and frames that are warped, bowed, or otherwise damaged.
- C. Remove all packaging material upon completion.

END OF SECTION 08 31 13

SECTION 08 34 16

HANGAR DOORS (ALTERNATE BID #1)

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Conditions of the Contract and portions of Division One of this Project Manual apply to this Section as though repeated herein.

1.02 WORK INCLUDED

- A. Horizontal Sliding 4-Panel Hangar Doors.
 - 1. Door leaf structure, rails, electro-mechanical drive/brake control systems – fabrication, installation – operation, testing and inspection.
- B. Scope of Work: Work Included:
 - 1. Structural framework, including all brackets, bracing, and field fasteners.
 - 2. Rolling hardware, including bottom rollers and top guide rollers.
 - 3. Miscellaneous hardware, including bumpers, stops, pulls, locks and track cleaners.
 - 4. Flexible weathering for door head, jambs and sills.
 - 5. Electric power drives and accessories.
 - 6. Electric control, warning devices and emergency stop edges.
 - 7. Electric power feed.
 - 8. Bottom rails and tie angles, with anchor bolts.
 - 9. Personnel doors, frames, and hardware.
 - 10. Top guides.
 - 11. Interleaf connecting cable operator system.

1.03 RELATED WORK

- A. Section 13 34 19, Metal Building Systems

1.04 REFERENCES

- A. References: The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC S335	(1989) Structural Steel Buildings Allowable Stress Design and Plastic Design
AMERICAN IRON AND STEEL INSTITUTE (AISI)	
AISI SG-673	(1989: Errata 1990) Cold-Formed Steel Design Manual
AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)	
ASTM A 36/A 36M	(1994) Carbon Structural Steel
ASTM A 194/A 194M	(1996) Carbon and Alloy Steel Nuts for Bolts for High Pressure and High-Temperature Service
ASTM A 275/A275M	(1996) Magnetic Particle Inspection
ASTM A 307	(1994) Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength
ASTM A 325	(1997) Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
ASTM A 366/A 366M	(1991: R 1993) Steel, Sheet, Carbon, Cold-Rolled, Commercial Quality
ASTM A 563	(1996) Carbon and Alloy Steel Nuts
ASTM 569/A 569M	(1991; Rev. A, R 1993) Steel, Carbon (0.15 Maximum, Percent), Hot-Rolled Sheet and Strip Commercial Quality
ASTM A 653/A 653M	(1995) Steel Sheet, Zinx-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvanized) by the Hot-Dip Process
ASTM F 436	(1993) Hardened Steel Washers
ASTM C 920	(1994) Elastomeric Joint Sealants
ASTM E 84	(1995; Rev. A) Surface Burning Characteristics of Building Materials
AMERICAN WELDING SOCIETY, INC. (AWS)	
AWS D 14.1	(1985, R 1991) Welding of Industrial and Mill Cranes and Other Material Handling Equipment
NATIONAL ELECTRICAL MANUFACTUERERS ASSOCIATION (NEMA)	
NEMA ICS 1	(1993) Industrial Control and Systems
NEMA ICS 2	(1993) Industrial Control and Systems Controllers,

Contractors and Overload Relays, Rated Not More Than 2000
Volts AC or 750 Volts DC

NEMA ICS 6 (1993) Industrial Control and Systems Enclosures

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (1996) National Electrical Code

SOCIETY OF AUTOMOTIVE ENGINEERS

SAE J 995 (19979) Mechanical and material Requirements for
Steel Nuts

STEEL STRUCTURES PAINTING COUNCIL (SSPC)

SSPC SP 6 (1991) Commercial Blast Cleaning

SSPC Paint 25 (1991) Red Iron Oxide, Zinc Oxide, Raw Linseed
Oil and Alkyd Primer (Without Lead and Chromate Pigments)

UNDERWRITERS LABORATORIES INC. (UL)

UL 506 (1994; R 1994, Bul. 1994 and 1995) Specialty
Transformers

1.05 QUALITY ASSURANCE

A. Manufacturer's Qualifications

1. Only Hangar door manufacturers who have had at least 15 years' experience in the manufacture of Hangar doors and who are now regularly engaged in the design and manufacturing of the type of door specified and can submit evidence of ten (10) actual installations of comparable design, construction and size with proven durability will be qualified for work of this section.

B. Installer's Qualifications

1. The installation supervisor shall be an authorized representative of the door manufacturer. Mechanics shall be skilled and experienced in the erection of hangar doors of type and size required for this project.

1.06 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials which are not shop installed in containers, boxes, or crates bearing the manufacturer's name, brand, and model number. Store materials and equipment in locations with adequate ventilation, free from dust and water, and so as to permit access for inspection and handling. Handle with care to prevent damage. Remove damaged items that cannot be restored to like-new condition and provide new items.

1.07 SUBMITTALS

- A. Product Data: For door and accessories. Include details of construction relative to materials, dimensions of individual components, profiles, and finishes. Provide roughing-in diagrams, operating instructions, and maintenance information. Include the following:
 1. Setting drawings, templates, and installation instructions for built-in or embedded anchor devices.

2. Summary of forces and loads on walls and jambs.
 3. Motors: Show nameplate data and ratings; characteristics; mounting arrangements; size and location of winding termination lugs, conduit entry, and grounding lug; and coatings.
 4. Engineering design calculations for mechanical & door drive system.
- A. Shop Drawings: Showing details of Construction, installation, and operation; Size, shape and thickness of materials; joints and connections; reinforcing; hardware; mechanical devices; electrical devices; and design and detail data for work of other trades affected by hangar doors.
1. Wiring Diagrams: Detail wiring for power, signal, and control systems. Differentiate between manufacturer-installed and field-installed wiring and between components provided by door manufacturer and those provided by others.
 2. Diagrams and performance and characteristic curves of equipment and systems.
- B. Shop painting and finishing specifications.
- C. Manuals: Submit complete manuals containing instructions for proper operation and maintenance of the doors to the owner.
1. They shall contain complete:
 - a. Operating instructions
 - b. Maintenance & lubrication instructions
 - c. A suggested list of spare parts
 - d. A manufacturer's catalog for each component in or on the doors

1.08 GUARANTEE

- A. The equipment furnished under the specifications shall be guaranteed for a period of one year, from the date of acceptance thereof, either for beneficial use or final acceptance, whichever is earlier against defective materials and workmanship. Upon receipt of notice from the owner of failure of any part of the guaranteed equipment during the guarantee period, the affected part or parts shall be repaired or replaced by and at the expense of the contractor.

1.09 DESIGN REQUIREMENTS

- A. Door Design: The hangar doors shall be designed by the manufacturer in accordance with the criteria specified. Doors shall operate without binding, interference, or damage to weather stripping. Doors shall fit closely and be free from warping.
- B. Steel Design: AISC S335, AISI SG-673.
- C. Loading: Design doors as a system to withstand an external wind load in accordance with Uniform Building Code design wind loads indicated for the building. An internal wind load of not less than one-half of the external wind load shall be used. In both cases, the deflection shall not exceed the height of the door divided by 120. Fiber stresses due to combined dead load and wind load shall not exceed the recommended design stresses for the material used and type of loading sustained.
- D. Connection: Design connections at top and bottom guide rails to withstand an external and internal wind load of not less than 35 psf, or the design wind load for the building, whichever is greater, and a seismic load equal to 0.5 times the weight of the door.
- E. Cold-Formed Steel Members: Cold-formed steel primary framing members shall be not less than ¼ inch thick.

- F. Performance: Maximum leakage rate of installed shall not exceed 4 cfm per lineal foot of door leaf. Flow rates are at a pressure difference of 0.30 inch of water.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturer: Basis of Design: Aero-Door International, Multi-Panel Slider
- B. Or Approved Equal

2.02 HANGAR DOORS

- A. Structural Steel: AISC S335 and ASTM A 36/A 36M or ASTM A572 GRD50.
- B. Formed Steel: AISI SG-673.
- C. Sheet Steel: ASTM A 569/A 569M hot-rolled steel sheet, commercial quality, or ASTM A 366/A 366M cold-rolled steel sheet, stretcher grade, commercial quality.
- D. Galvanized Steel: ASTM A 569/A 653M, coating designation G 90 galvanized steel sheet, commercial quality.
- E. Exterior Covering: See architectural drawings and exterior metal wall specification(s).
- F. Interior Covering: Flat galvanized steel linear sheets, 16 gage or thicker as required by the door designer's analysis.
- G. Insulation: Provide insulation that:
 - 1. Contains no asbestos;
 - 2. Is permanently secured in place behind the exterior covering; and
 - 3. Has a flame spread rating of 75 or less and a smoke-developed rating of 100 or less when tested in accordance with ASTM E 84.
- H. Hardware: Provide hangar door hardware to accommodate actual dead loads plus wind loads specified. Provide top guide rollers, bottom wheels, interleaf cable operator, tractor pulls, track cleaners, and bottom rail/top guide bumpers as required for a complete and operational installation.
- I. Wheel Assemblies: Bottom wheels shall be of steel plate having a minimum tread diameter as required for the actual wheel loading where the height-to-width ratio of the door leaf exceeds three. The wheels assemblies shall be vertically adjustable. Construct wheel assemblies to permit removal of the wheel without removing the door leaf from its position on the rail.
 - 1. Treads: Machine wheel treads concentric with bearing seats. The clear distance between flanges shall not exceed the width of the rail by more than 1/8 inch at the tread nor more than 1/4 inch at the edge of the flange. Machine internal bearing seats accurately for a press fit. Heat treat wheels 18 inches or greater in diameter to obtain a rim hardness of 320 Brinell.
 - 2. Wheel bearings. Provide tapered rollers or spherical bearings, either internal or cartridge type, arranged so that both horizontal and vertical loads shall be transferred to the rail only through the bearing. Bearings shall be tightly sealed and equipped with high-pressure grease fittings.

- J. Bottom Rails shall be ASCE rails as defined in the AISC Manual of Steel Construction and shall be of the size and weight as shown on the drawings, unless heavier rails are required as a result of the Hangar Door Supplier's analysis. Length of rails, splices and guides shall provide for the maximum expected overrun in either the opening or closing operations.
- K. Door Stops: Provide stops embedded in concrete to stop each leaf at each door pocket as indicated on the structural drawings.
- L. Top Guide Rollers: Horizontal type with single or double steel rollers of a suitable diameter and thickness for satisfactory performance under the designated load conditions including live and dead loads, and rise and fall of the door truss. Provide permanently factory-lubricated and sealed ball or roller bearings. Include both horizontal and vertical rollers built into a frame which is connected in such a manner as to transmit the specified wind loads from the door to the hangar structure and to prevent disengagement of the door from the top of the guide.
- M. Provide bumpers connected to the upper guide rail to stop each leaf in the open and closed position. Provide neoprene bumpers to make proper contact with the main leaf structure. Bumpers shall be designed to withstand lateral impact loads without damage occurring to the hangar doors or to adjoining structures for the intended door design life of the normal operation or in case of the limit switch failure.
- N. Personnel Doors: The hangar door manufacturer shall provide structural frames and electrical interlock for personnel doors where indicated.
- O. Doors and Frames: Specified in Section 08110, "Steel Doors and Frames".
- P. Hardware for Personnel Doors: Specified in Section 08700, "Finish Hardware".
- Q. Electrical Interlock: Provide each personnel door with an electrical interlock switch to prevent motor operation of the leaf or group in which it is located when the personnel door is open. Provide an identified indicator light at each door leaf control station indicating when the personnel door is in the open position.
- R. Weather Stripping: Provide adjustable and readily replaceable material. Provide on vertical edges, sills and heads to afford a weathertight installation.
- S. Neoprene: Use flap-type, two-ply, cloth-inserted neoprene or extruded, double flap, single or dual opposed solid neoprene material on vertical edges and sills. The two-ply material shall have a minimum thickness of 1/8 inch and shall be retained continuously for its full length and secured with rust-resistant fasteners 12 inches o.c. Extruded weather stripping with heavy center section shall be attached at 12 inches o.c., but continuous bar may be omitted. Clearance between metal parts on vertical edges of leaves and between leaves and jambs which are to be weather-stripped shall be as indicated.
- T. Metallic: Form head weather stripping material between each leaf and the top guide system of not lighter than 16 gage galvanized sheet steel or flap-type, cloth-inserted neoprene, as indicated.
- U. Fasteners: Either zinc-coated or cadmium-plated steel.
- V. Sealant: Single-component or multicomponent elastomeric type conforming to ASTM C 920, Type S or M, Grade NS, Class 12.5, Use NT. Provide a sealant that has been tested on the types of substrate to which it will be applied.

- W. Primer: Red iron oxide, zinc oxide type, SSPC paint 25. Product shall conform to current air quality management district (AQMD) rules and regulations.
- X. Starters: Provide magnetic reversing starters in NEMA ICS 1, Type 12 enclosures equipped with access door-controlled, fused safety disconnect switches. Starters shall be factory wired with overload and undervoltage protection, mechanical and electrical interlocks, auxiliary contacts, relays and timing devices as required, control circuit transformers, and a numbered terminal strip. The control circuit transformer shall reduce the voltage in the control circuits to 115 volts or less, and shall conform to UL 506.
- Y. Electrical: Provide conduit, wire, flexible cables, boxes, devices, and accessories, and install trolley duct in accordance with applicable Division 16 specification sections. If permanent electrical power is not available when door installation is complete, provide temporary power as necessary for testing and adjusting the doors.

2.03 FABRICATION

- A. Doors
 1. Frames and Framing: Door leaves shall be of welded or bolted construction. Joints shall develop 100 percent of the strength of the framing members. Vertical members shall be continuous throughout the height of the door. When required, prepare splices to facilitate field assembly in accordance with standard practice. Frames and framing members shall be true to dimensions and square in all directions; no leaf shall be bowed, warped or out of line in the vertical or horizontal plane of the door opening by more than 1/8 inch in 20 feet. Provide diagonal bracing so that the completed leaf assembly will be braced to withstand shipping, assembly and operational loads. Exposed welds and welds which interfere with the installation of various parts such as cover sheets shall be ground smooth.
 2. Exterior Covering and Interior Liner Sheets: Where flat sheets are attached as either exterior covering or interior liner sheets, the clear unsupported area attached as either exterior covering or interior liner sheets, the clear unsupported area shall not exceed 25 square feet. Make edges of exterior sheets weather tight with sealant where corrugated wall cladding is employed, connections and pattern requirements similar to flat panel system. If and where corrugated wall cladding is indicated, connections and their pattern shall meet requirements for flat panels.
 3. Locking Devices: Do not provide locking devices on motor-operated hangar doors.
 4. Tractor Pulls: Provide tractor pulls so that leaves can be pulled by a tractor or similar equipment in the event of power failure
 5. Track Cleaners: Provide a device to clear the debris from the rail head and wheel flange grooves as the leaf is moved.
 6. Insulation: Secure insulation to doors with clips, studs or adhesives.
 7. Cable System: The minimum size for the cable which interconnects the leaves shall be 3/8 inch; the cables shall be improved plow steel with lubricated hemp centers or wire rope cores. Sheaves over which the cables shall operate shall have a pitch diameter of at least 18 cable diameters and shall have either ball- or roller- type bearings or graphite bronze bearings of a sufficient capacity for the operating loads. Grease fittings shall be provided for the sheave bearings unless permanently lubricated bearings are used.

2.04 OPERATION

- A. Group Operated Door System: Each group of leaves shall have a traction-driven operating unit located in the lead leaf of the group and driving one or more wheels of the lead leaf and with interconnecting cable system. All leaves in each group shall start to move at the same time and arrive at their fully-open or fully-closed positions simultaneously. All necessary cables, fittings, sheaves, housings, guards, pickups, brackets, anchors, and miscellaneous hardware shall be provided. Externally mounted rubber tire motor operators are absolutely not acceptable.
- B. Operating Units: Each operating unit shall move its lead leaf at a speed of approximately 60 feet per minute at a zero wind load conditions and to be operable up to and including a maximum wind load of 8 pounds per square foot. The operating units shall consist of either a separate motor and gear reducer or a gear head motor, high speed shaft brake, and necessary roller chains and sprockets. The systems shall be provided with overload protection for the drive units and a means for emergency tractor towing operation.
 - 1. Motors shall be single speed, squirrel-cage type of sufficient size to operate the leaves under zero wind load conditions at not more than 75 percent of their rated capacity.
 - 2. Gear reduction units shall allow a reversal of effort through the gears without damage to the units (e.g. should not be damage if door is pulled by the tractor).
 - 3. Operating mechanisms shall be covered on the interior side of the leaf by a hinged 16 gage flat steel cover.
- C. Braking System: Braking systems shall be designed to ensure stoppage of the leaves under normal, dry rail conditions within the safety edge over travel limit. The braking system shall be a magnetic, spring-set, solenoid-released brake. Provide a hand release to release the brake when it becomes necessary to move the leaf with an outside force. The hand release shall be an automatic reset type so that the brake will be operable during subsequent electrical operation of the door.
- D. Controls: Doors shall be controlled by constant pressure, mushroom head push buttons mounted on the door leaves. Removing pressure from the button shall stop the movement of the movement of the leaves. The control equipment shall conform to NEMA ICS 1 and 2. All interior push buttons shall be in heavy-duty, oil-tight enclosures conforming to NEMA ICS 6, Type 12 or Type 4, except that contractor enclosures shall be Type 3R.
- E. Push Buttons for Anchored Group Doors: Each group shall be controlled by a two-button push button station marked "OPEN" and "CLOSE" mounted near the leading edge of the lead leaf.
- F. The control equipment shall conform to NEMA ICS 1 and NEMA ICS 2. Interior push buttons shall be mushroom head type, mounted in heavy duty, oil-tight enclosures conforming to NEMA ICS 6, Type 13, except that enclosure for reversing starter with disconnect switch shall be Type 1 or Type 12. Push buttons shall be in watertight enclosures conforming to NEMA ICS 6, Type 4.
- G. Limit Switches: Provide limit switches to prevent overtravel and bumping. Safety edges shall not be used as limit switches. Provide for anchored group doors to stop the travel of each group in the fully open and fully closed positions. The limit switches shall be positive acting, snap action, lever arm type with actuating cams designed with sufficient overtravel to permit the group to come to a complete stop without overtravelling the limit switches. The limit switches shall be mounted on the leaves and the actuating cams mounted on the top guides overhead.
- H. Warning Devices: Provide a clearly audible signal on lead leaf of a group operated system. The warning device shall:
 - 1. Operate when the push button is actuated for movement of the door system in either direction;

2. Sound 5 seconds before the door moves, and while the door is moving; and consist of not less than a 6 inch diameter bell (min. 100 dB at 10 feet) or equivalent decibel-rated horn, loud enough to be heard in the hangar and on the apron.
- I. Emergency Operation: Hangar doors, shall be constructed and equipped so that they can be operated by on-site emergency power or manually by tractor pulls. Manual operation of hangar doors shall be designed to avoid damage to door leaves/electrical system.
 - J. Electrical Work: The door manufacturer shall provide the proper electrical equipment and controls built in accordance with the latest NEMA standards. Equipment, control circuits, and safety edge circuits shall conform to NFPA 70. Where located 18 inches or less above the floor, they shall be explosion-proof as defined in NFPA 70, Article 513. Manual or automatic control devices necessary for motor operation of the doors shall be provided, including push button stations, limit switches, combination fused disconnect switches and magnetic reversing starters, control circuit transformers, relays, timing devices, warning devices, and trolley ducts with collectors or trolleys.
 - K. Power and Grounding: Power shall be provided by junction boxes on end of the door leaves. Electrical for doors described above are 480 volts, three phase, three wire, 20 amperes, 60 hertz (each). Power shall be delivered to the rolling leaves by a trolley device carried along by lead door leaf in the door canopy. The trolley duct electrical characteristics shall be 480 volts, three phase, four pole, 60 amperes, with the fourth pole (rail) being for grounding purposes. Electrical work and equipment shall be grounded and bonded in conformance with UL 467.
 - L. Trolley Ducts: Provide runs of trolley duct as required for the door system indicated. Ducts shall have solid copper conductors in a protective steel or polyvinyl chloride housing. Locate ducts as shown on door manufacturer's drawings. Provide adequate clearances in the top guide system for the travel.
 1. Each run shall consist of the required number of sections of straight track, a section of dropout track, feed boxes, end caps, couplings, hangers and other accessories to make the system complete and workable.
 2. Furnish one self-supporting collector for each group-operated door, complete with spring-loaded brush contacts. Provide trolley pulling brackets and corrosion-protected chains attached from each side of the pulling bracket to each side of the support bracket for self-supporting collectors.

2.05 SAFETY EDGES

- A. Provide safety edges on leading edge of lead leaf from one inch above the floor to the top of the door leaf. For leaves 12 inches thick or less, provide a single run of safety edge. For leaves over 12 inches thick, provide a double run of safety edges spaced to provide the maximum degree of safety in stopping the leaves.
- B. Design: Provide safety edges to provide a minimum of 3 ½ inches of overtravel after actuation until solid resistance is met. Safety edges shall be pneumatic type. A minimum of one air pressure switch shall be provided for each 20 feet of vertical edge. The electrical service to the pressure switch shall not be more than 110 volts.
- C. Actuation of a safety edge shall lock out the motor control in the direction of travel until reset, but shall permit the door to be reversed away from the obstruction which tripped the safety edge. Safety edges shall be reset by moving doors away from the obstruction. The lower portion of the safety edges to a height of approximately 5 feet shall be independently removable for convenience in servicing or repair. The remainder of the edge may be in one piece up to a maximum of 20 feet.

PART 3 - EXECUTION

3.01 PROTECTIVE COATINGS

- A. Shop Painting
 - 1. All steel members and hardware shall be painted one (1) sprayed on coat of rust-inhibitive primer.
 - a. Finish door color to be selected by Architect from manufacturer's full range of colors.
 - 2. All steel shall be thoroughly cleaned prior to painting to remove all oil, rust and other foreign material.
 - 3. Machined surfaces and neoprene weathering shall not be painted.

3.02 ERECTION

- A. Assemble doors and accessories in accordance with approved shop drawings. Do not erect doors until the work of other trades in preparing the opening has been completed, the hangar roof is under full dead load, and the top guide and rail systems are within specified tolerances. After completing erection and before starting field painting, clean interior and exterior door surfaces. Clean abraded surfaces, field welds, and field bolts; and coat with priming paint. Field painting as specified in Section 09900, "Painting".

3.03 FIELD QUALITY CONTROL

- A. Manufacturer's Field Services: Provide an authorized representative of the door manufacturer to supervise erection of doors.
- B. Acceptance Test
 - 1. Contractor shall perform complete operating tests for all door leaves. Perform no less than three complete opening and closing cycles, all safety controls, emergency manual operational system, and such other tests as specified in the Contractor's approved door test procedure plan. Notify the Owner's Representative a minimum of seven (7) days prior to the beginning of door tests.
 - 2. Any defects disclosed by the tests shall be corrected, final adjustments of the doors and operating equipment shall be turned over to the Owner in a completely acceptable and proper operating condition. Tests of previously defective items repaired or replaced by the Contractor shall be accomplished at no additional cost to the owner.

END OF SECTION 08 34 16

SECTION 08 71 00

DOOR HARDWARE

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Conditions of the Contract and portions of Division One of this Project Manual apply to this Section as though repeated herein.

1.02 WORK INCLUDED

- A. Door Hardware.

1.03 RELATED SECTIONS

- A. Finish Carpentry: Section 06 20 00.
- B. Hollow Metal Doors and Frames (Including Tornado Resistant): Section 08 11 13.
- C. Metal Building Systems: Section 13 34 19
- D. Electrical: Division 26 and 28 Sections for electrical connections including conduit and wiring for automatic entrance door operators and access control devices.

1.04 REFERENCES

- A. Federal Specifications (FS)
 - 1. FF-H-106a Hardware, Builders'; Locks and Door Trim-Standard Finishes for Builders Hardware.
- B. National Fire Protection Association, Inc. (NFPA), Battery March Park, Quincy, MA 02269.
 - 1. NFPA 80 - Standard for fire doors and windows.
 - 2. NFPA 101 - Code for safety to life from fire in buildings and structures.
- C. Underwriter's Laboratories, Inc. (UL), 333 Pfingsten Road, Northbrook, IL 60062.
 - 1. Building Materials Directory.
- D. Hardware shall be in strict accord with Wisconsin Administrative Code Chapter Comm. 69 - "Barrier Free Design".

1.05 SUBMITTALS

- A. Submit in accordance with the General Conditions of the Contract.
 - 1. Five (5) copies of a detailed, vertical type hardware schedule for approval.
 - a. List and describe each opening separately. Include doors with identical hardware, except hand, in a single heading. Include door number, room designations, degree of swing, and hand.
 - b. List related details. Include dimensions, door and frame material, and other conditions affecting hardware.
 - c. List all hardware items. Include manufacturer's name, quantity, product name, catalog number, size, finish, attachments, and related details.
 - d. Resubmit four (4) copies of the corrected schedule when required.

- e. Determine keying requirements, as directed by the Owner's Representative and submit five (5) copies of a detailed keying schedule for approval; resubmit four copies (4) of the corrected schedule when required.
 - f. Prior to final payment, provide a record copy of hardware schedules, including all revisions and updates. All openings shall be listed to reflect final installed configuration only.
- 2. Samples of hardware items as may be required. Identify each sample and indicate the location of subsequent installation in the project.
 - 3. Provide a copy of the approved hardware schedule and all pertinent templates or template information to each fabricator of material factory-prepared for the installation of hardware.

1.06 QUALITY ASSURANCE

- A. Manufacturers and product numbers listed herein establish a standard of quality. Similar items by other manufacturers may be accepted by prior written approval by the architect in accord with the General Conditions of the Contract. Except where specified in the hardware schedule, furnish products of only one manufacturer for each type of hardware.
- B. Supplier: Hardware Supplier: The hardware supplier shall be a corporate member in good standing of The Door and Hardware Institute (DHI), employing at least one Architectural Hardware Consultant (AHC) who is currently participating in DHI's continuing education program (CEP).
- C. Items of hardware not definitely specified herein but necessary for completion of the Work shall be provided. Such items shall be of type and quality suitable to the service required and comparable to the adjacent hardware. Where size and shape of members is such as to prevent the use of types specified, hardware shall be furnished of suitable types having as nearly as practicable the same operation and quality as the type specified. Sizes shall be adequate for the service required. Include such nuances as strike type, strike lip, raised barrel hinges, mounting brackets, fasteners, shims, and coordination between conflicting products. All doors shall be provided with a stop.

1.07 REGULATORY REQUIREMENTS

- A. Furnish UL listed hardware for all UL labeled openings in conformance with requirements for the class of opening scheduled.

1.08 DELIVERY, STORAGE AND HANDLING

- A. Deliver hardware to the job site in the manufacturer's original containers marked to correspond with the approved hardware schedule for installation location.
- B. Store hardware in dry surroundings and protect against loss and damage.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Refer to the Hardware Schedule at the end of this Section.

2.02 ACCESSORIES

- A. Furnish all necessary hardware accessories such as wood or machine screws, bolts, nuts, anchors, toggle bolts, and other fasteners, each of the type, size, material and finish for its intended purpose and each according to the material to which the hardware is being applied.
- B. Keying system will be determined by the Owner's Representative.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install hardware in accordance with manufacturer's recommendations and instructions.
- B. Install hardware on UL labeled openings in accordance with manufacturer's requirements to maintain the fire rating.
- C. Mortise and cut to close tolerance and conceal evidence of cutting in the finished work.
- D. Remove, cover or protect hardware after fitting until paint or other finish is applied. Permanently install hardware after finishing operations are complete.
- E. Install closers on the room side of corridor doors, stair side of stairways, and interior side of exterior doors.
- F. Deliver one complete set of installation and adjustment instructions, and tools with the hardware.
- G. Coordinate security system electrical requirements at doors indicated to have such system.
- H. Coordinate all Owner Furnished Contractor Installed hardware.
- I. Furnish and install temporary keyed-alike cores as required by Architect and Public Works Project Manager to secure the building or portions of the building.

3.02 ADJUSTING

- A. At final completion, adjust and test all hardware for function and performance and leave in good operating condition.

3.03 CLEANING

- A. Clean all hardware to restore the original finish.

3.04 PROTECTION

- A. Protect the finished installation until acceptance of the project.

3.05 HARDWARE SCHEDULE

- | | | |
|---------------------|---------------------|-----|
| A. Manufacturers | | |
| 1. Hinges | Hager Hinge Co. | HAG |
| a. Approved Equals: | Stanley
McKinney | |
| 2. Lockset | Corbin Russwin | COR |

- a. Or Approved Equal.
- | | | | |
|----|----------------------|--------------------|-----|
| 3. | Cylinders | Schlage | SCH |
| | a. | Or Approved Equal. | |
| 4. | Door Closers | LCN | LCN |
| | a. | Or Approved Equal. | |
| 5. | Kickplate | Rockwood Mfg. Co | ROC |
| 6. | Door Position Switch | GE | GE |
| 7. | Exit devices | Von Duprin | VON |
| | a. | Or Approved Equal. | |

B. Hardware Sets:

SET 01

3 EA	HINGES	BB1199 (4.5"x4.5") NRP	630	HAG
1 EA	PASSAGE SET	ML2010 x NSM	630	COR
1 EA	CLOSER	4040 XP	689	LCN
1 EA	WALL STOP	WS407	630	IVE

SET 02

3 EA	HINGES	BB1199 (4.5"x4.5") NRP	630	HAG
1 EA	PASSAGE SET	ML2010 x NSM	630	COR
1 EA	CLOSER	4040 XP CUSH	689	LCN

SET 03

3 EA	HINGES	BB1199 (4.5"x4.5") NRP	630	HAG
1 EA	PRIVACY SET	ML2030 x NSM	630	COR
1 EA	CLOSER	4040 XP H	689	LCN
1 EA	WALL STOP	WS407	630	IVE

SET 04

3 EA	HINGES	BB1199 (4.5"x4.5") NRP	630	HAG
1 EA	STOREROOM LOCK	ML2057 x NSM – LC	630	COR
1 EA	CYLINDER	20-001 – C KEYWAY	626	SCH
1 EA	CLOSER	4040 XP	689	LCN
1 EA	OVERHEAD STOP	410	630	GLY

SET 05

3 EA	HINGES	BB1199 (4.5"x4.5") NRP	630	HAG
1 EA	STOREROOM LOCK	ML2057 x NSM – LC	630	COR
1 EA	CYLINDER	20-001 – C KEYWAY	626	SCH
1 EA	CLOSER	4040 XP CUSH	689	LCN

SET 06

3 EA	HINGES	BB1199 (4.5"x4.5") NRP	630	HAG
1 EA	OFFICE LOCK	ML2051 x NSM – LC	630	COR
1 EA	CLOSER	4040 XP H	689	LCN
1 EA	CYLINDER	20-001 – C KEYWAY	626	SCH
1 EA	OVERHEAD STOP	100	630	GLY
1 EA	THRESHOLD	950N	AL	NGP
1 SET	SEALS	170 P	AL	NGP

SET 07

3	EA	HINGES	BB1199 (4.5"x4.5") NRP	630	HAG
1	EA	OFFICE LOCK	ML2051 x NSM – LC	630	COR
1	EA	CYLINDER	20-001 – C KEYWAY	626	SCH
1	EA	CLOSER	4040 XP H	689	LCN
1	EA	OVERHEAD STOP	410	630	GLY

END OF SECTION 08 71 00

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SECTION 08 80 00

GLAZING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Conditions of the Contract and portions of Division One of this Project Manual apply to this Section as though repeated herein.

1.02 WORK INCLUDED

- A. Glass in Hollow Metal Frames
- B. Glass in Doors
- C. Mirror Glass

1.03 RELATED WORK

- A. Hollow Metal Doors and Frames: Section 08 11 13.
- B. Mirrors in Toilet Room: Section 10 28 00.

1.04 REFERENCES

- A. Reference Specification: "Glazing Manual", by Flat Glass Marketing Association.
- B. Materials: Conform in all respects to the "Safety Standard for Architectural Glazing Materials", 16CFR 1201, issued by the Consumer Product Safety Commission.
- C. AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)
 - 1. Aluminum Storefront and Entrance Manual.
 - 2. Structural Sealant Glazing Systems (A Design Guide) Aluminum CW Series No. 13.
- D. AMA WSG.1 Window Selection Guide.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications for Insulating-Glass Units with Sputter-Coated, Low-E Coatings: A qualified insulating-glass manufacturer who is approved and certified by coated-glass manufacturer.
- B. Installer Qualifications: A qualified installer who employs glass installers for this Project who are certified under the National Glass Association's Certified Glass Installer Program.
- C. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below, unless more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.
 - 1. GANA Publications: GANA's "Laminated Glazing Reference Manual" and GANA's "Glazing Manual."
 - 2. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."

- D. Safety Glazing Labeling: Where safety glazing labeling is indicated, permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.
- E. Fire-Protection-Rated Glazing Labeling: Permanently mark fire-protection-rated glazing with certification label of a testing agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name, test standard, whether glazing is for use in fire doors or other openings, whether or not glazing passes hose-stream test, whether or not glazing has a temperature rise rating of 450 deg F, and the fire-resistance rating in minutes.
- F. All materials used for this project shall be from the same batch run and manufacturer.
- G. Water Penetration Resistance, nor uncontrolled water leakage; tested as per ASTM E331
- H. Thermal Transmittance Resistance: Maximum "U" factor in accordance with Wisconsin Enrolled Commercial Code; as tested by AAMA 1503.1
- I. Condensation Resistance; Condensation Resistance Factor (CRF) to be minimum 56/frame and 50/glass, with 30 percent inside relative humidity, and 68 degree F temperature.; as tested by AAMA 1530.1.
- J. Sound Transmission Resistance; Sound Transmission Class (STC) for typical application to be a minimum of 32; AS tested by ASTM E4134.
- K. Fenestration must comply with minimum testing performance requirements for an AAMA/NWWDA 101/1.S.2 HC-40 rating. The recognized standard for performance ratings of windows is AAMA/NWWDA 101/1.S.2.
- L. All performance testing must be conducted by an independent, impartial, third party, AAMA certified testing laboratory.
- M. Polyurethane thermal barriers shall be tested as per AAMA TIR A8-90 and AAMA Draft #13 of AAMA's Dry Shrinkage & Composite Performance Thermal Cycling Procedure for validation testing at differential temperatures. At the conclusion of the tests, the shrinkage shall be equal to or less than the prescribed 0.10%.
- N. Use of poured and de-bridged polyurethane thermal beak assemblies will require window manufacturer's prior adoption and continued use of the procedures and quality control features outlined in AAMA's Quality Assurance processing guide For Poured and De-bridged Polyurethane Thermal Barriers.

1.06 PERFORMANCE REQUIREMENTS

- A. General: Installed glazing systems shall withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.

1.07 MIRROR WARRANTY

- A. Special Warranty: Manufacturer's standard form in which mirror manufacturer agrees to replace mirrors that deteriorate within specified warranty period. Deterioration of mirrors is defined as defects developed from normal use that are not attributed to mirror breakage or to maintaining

and cleaning mirrors contrary to manufacturer's written instructions. Defects include discoloration, black spots, and clouding of the silver film.

1. Warranty Period: Five years.

1.08 INSULATED GLASS WARRANTY

A. Provide insulating glass manufacturer's written guarantee as per Sections 08 41 13.

1.09 SUBMITTALS

A. Submit in accordance with the General Conditions of the Contract

1. Manufacturer's product data.

a. Provide data for visible light transmittance, reflectance, U-value, shading coefficient, solar heat gain coefficient and light to solar gain.

2. Two samples of each type glass specified.

1.010 DELIVERY, STORAGE AND HANDLING

A. Package, handle, deliver and store to avoid damage. Scratched glass will be rejected.

1.011 PROJECT CONDITIONS

A. Do not proceed with installation of liquid sealants under adverse weather conditions, or when temperatures are below or above manufacturer's recommended limitations for installation.

1.012 ENVIRONMENTAL REQUIREMENTS

A. Low-Emitting Materials, Adhesives, and Sealants: Materials used on the interior of the building (defined as inside the weatherproofing system and applied on site) must not exceed the following requirements.

1. Adhesives, Sealants and Sealant Primers: South Coast Air Quality Management (SCAQMD) Rule # 1168, requirements in effect on July 1, 2005, and rule amendment date January 7, 2005.

2. Aerosol Adhesives: Green Seal Standard for Commercial Adhesives GS-36, requirements in effect on October 19, 2000.

PART 2 - PRODUCTS

2.01 GLASS PRODUCTS, GENERAL

A. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass lites in thicknesses as needed to comply with requirements indicated.

B. Strength: Where float glass is indicated, provide annealed float glass, Kind HS heat-treated float glass, or Kind FT heat-treated float glass as needed to comply with "Performance Requirements" Article. Where heat-strengthened glass is indicated, provide Kind HS heat-treated float glass or Kind FT heat-treated float glass as needed to comply with "Performance Requirements" Article. Where fully tempered glass is indicated, provide Kind FT heat-treated float glass.

1. Provide safety glazing labeling.

C. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:

1. For monolithic-glass lites, properties are based on units with lites of thickness indicated.
2. For laminated-glass lites, properties are based on products of construction indicated.
3. For insulating-glass units, properties are based on units of thickness indicated for overall unit and for each lite.
4. U-Factors: Center-of-glazing values, according to NFRC 100 and based on LBL's WINDOW 5.2 computer program, expressed as Btu/sq. ft. x h x deg F.
5. Solar Heat-Gain Coefficient and Visible Transmittance: Center-of-glazing values, according to NFRC 200 and based on LBL's WINDOW 5.2 computer program.
6. Visible Reflectance: Center-of-glazing values, according to NFRC 300.

2.02 GLASS PRODUCTS

- A. Float Glass: ASTM C 1036, Type I, Quality-Q3, Class 1 (clear) unless otherwise indicated.
- B. Heat-Treated Float Glass: ASTM C 1048; Type I; Quality-Q3; Class I (clear) unless otherwise indicated; of kind and condition indicated.
 1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated and free of tong marks.
 2. For uncoated glass, comply with requirements for Condition A.
 3. For coated vision glass, comply with requirements for Condition C (other coated glass).
 4. Comply with requirements for safety glass in the International Building Code.
- C. Uncoated Tinted Float Glass: Class 2, complying with other requirements specified.

2.03 SILVERED FLAT GLASS MIRRORS

- A. Glass Mirrors, General: ASTM C 1503; manufactured using copper-free, low-lead mirror coating process.
- B. Tempered Clear Glass: Mirror Glazing Quality, for blemish requirements; and comply with ASTM C 1048 for Kind FT, Condition A, tempered float glass before silver coating is applied.
- C. Edge Sealer: Coating compatible with glass coating and approved by mirror manufacturer for use in protecting against silver deterioration at mirrored glass edges.
- D. Mirror Edge Treatment: Flat polished.
 1. Seal edges of mirrors with edge sealer after edge treatment to prevent chemical or atmospheric penetration of glass coating.

2.04 INSULATING GLASS

- A. Glass Type GL-13: Low-e-coated, insulated glass, Viracon VE1-85:
 1. Overall Unit Thickness: 1 inch.
 2. Thickness of Each Glass Lite: 6.0 mm.
 3. Outdoor Lite: Clear fully tempered float glass.
 - a. Coating: VE-85 on #2 surface
 4. Interspace Content: Air ½"
 5. Indoor Lite: Clear tempered float glass.
 6. Visible Light Transmittance: 76 percent minimum.
 7. Solar Transmittance: 47%
 8. UV Transmittance: 26%
 9. Exterior Reflectance: 12%

10. Interior Reflectance: 13%
11. Solar Reflectance: 21%
12. Winter Nighttime U-Factor: 0.31 maximum.
13. Summer Daytime U-Factor: 0.29 maximum.
14. Shading Coefficient: 0.63
15. Relative Heat Gain: 129
16. Solar Heat Gain Coefficient: 0.54 maximum.
17. LSG: 1.41
18. Provide safety glazing labeling.
19. Glass: Clear float.

- B. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified according to ASTM E 2190, and complying with other requirements specified.
1. Sealing System: Dual seal, with manufacturer's standard primary and secondary.
 2. Spacer: Manufacturer's standard spacer material and construction.
 3. Desiccant: Molecular sieve or silica gel, or blend of both.
 4. Dehydrated Interspace Content: Air.
 5. Thickness: 1 inch typical.

2.05 GLASS TYPE SCHEDULE

- A. Glass Products indicated below are based on proprietary products of Viracon, PPGs and Bendheim. Products from any of the above listed manufacturers that meet the design criteria of the glass specified below are acceptable.
1. GLT 2: Tempered glass mirror.
 - a. Thickness: 4.0mm.
 2. GLT 4: Tempered, clear float glass.
 - a. Thickness: 1/4".
 3. GLT 13: Refer to above.

2.06 GLAZING ACCESSORIES

- A. Glazing Sealant: One-part silicone similar to Pecora 860, Sonneborn Omniplus or Tremco Spectrum 2.
1. Comparable means both quality and color options.
- B. Setting Blocks: 70-90 Shore "A" durometer, sized to accommodate size of glass used, compatible with glazing sealant.
- C. Spacers: Compatible with sealant used.
- D. Primer, Sealers, Cleaners for Fire-Rated Glazing: As recommended by fire-rated glazing manufacturer.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Check that glazing channels are free of burrs, irregularities, and debris.
- B. Check that glass is free of edge damage or face imperfections.

- C. Do not proceed with installation until conditions are satisfactory.

3.02 PREPARATION

- A. Field Measurement
 - 1. Measure size of frame to receive glass.
 - 2. Compute actual glass size, allowing for edge clearances.
- B. Preparation of Surfaces
 - 1. Remove protective coatings from surfaces to be glazed.
 - 2. Clean glass and glazing surfaces to remove dust, oil and contaminants.

3.03 INSTALLATION

- A. Install glass in accordance with glass manufacturer's recommended instructions.
- B. Provide weathertight installation.
- C. Fire-rated glazing insulated glazing units shall be glazed into the appropriate fire-rated framing with an approved glazing compound (polysulfide sealant or closed cell PVC tape) as supplied by the installer.
- D. General: Install mirrors to comply with mirror manufacturer's written instructions and with referenced GANA publications. Mount mirrors accurately in place in a manner that avoids distorting reflected images.
 - 1. Provide a minimum air space of 1/8 inch between back of mirrors and mounting surface for air circulation between back of mirrors and face of mounting surface.

3.04 CLEANING

- A. Remove excess glazing compound from installed glass.
- B. Remove labels from glass surface as soon as installed.
- C. Wash and polish both faces of glass.
- D. Remove debris from work site.

3.05 PROTECTION

- A. Attach crossed streamers away from glass face.
- B. Do not apply markers to glass surface.
- C. Replace damaged glass.

END OF SECTION 08 80 00

SECTION 09 29 00

GYPSUM BOARD

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Conditions of the Contract and portions of Division One of this Project Manual apply to this Section as though repeated herein.

1.02 WORK INCLUDED

- A. Gypsum Board and Gypsum Board Assemblies (Metal Studs)
- B. Acoustical Batt Insulation.
- C. Trim and Accessories.
- D. Vapor Barrier at Interior Partitions.

1.03 RELATED WORK

- A. Section 06 10 00, Rough Carpentry
- B. Section 09 90 00, Painting

1.04 REFERENCES

- A. Referenced Specifications: The more stringent requirement of this section or referenced specification applies.
 - 1. "Using Gypsum Board for Walls and Ceilings", The Gypsum Association - GA-201-85.
 - 2. "Recommended Specifications for the Application and Finishing Gypsum Boards", The Gypsum Association - GA-216.
- B. Fire Rated Assemblies: Provide materials and installations identical with applicable assemblies which have been tested and listed by recognized authorities, including UL, or tested in accordance with ASTM E119 for type of construction shown.

1.05 SUBMITTALS

- A. Submit in accordance with the General Conditions of the Contract.
 - 1. Manufacturer's product data including acoustic sealant.
 - 2. Texture finish sample.

1.06 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials to the project site with manufacturer's labels intact and legible.
- B. Handle materials with care to prevent damage.
- C. Deliver fire-rated material bearing testing agency label and required fire classification numbers.
- D. Storage
 - 1. Store materials inside under cover, stack flat, off floor.

2. Stack wallboard so that long lengths are not over short lengths.
3. Avoid overloading floor system.
4. Store adhesives in dry area, provide protection against freezing at all times.

1.07 PROJECT CONDITIONS

- A. During cold weather, maintain temperature range between 55 degrees F. to 70 degrees F. for 24 hours before, during, and after gypsum board and joint treatment applications.
- B. Ventilation
 1. Provide ventilation during and following adhesive and joint treatment applications.
 2. Use temporary air circulators in enclosed areas lacking natural ventilation.
 3. Protect installed materials from drafts during hot, dry weather.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Georgia Pacific.
- B. LaFarge.
- C. National Gypsum Company.
- D. United States Gypsum Company.
- E. Dietrich Industries.
- F. Chicago Metallic.
- G. Certainteed Gypsum
- H. American Gypsum
- I. Reef Industries
- J. Fry Reglet Architectural Metals
- K. Or approved equal.

2.02 MATERIALS

- A. Gypsum Board: ASTM C 36, long edges tapered; in lengths as long as practical to keep number of end joints to absolute minimum.
 1. Regular Gypsum Board.
 2. Abuse-resistant Gypsum Board: USG Fiberock AR.
 3. Water Resistant Wallboard: 5/8-inch thick.
 4. Fire Code Board: Type "X" or Fire code "C".
 5. Embedded Glass Reinforced Gypsum Sheathing. 1/4" or as shown on drawings.
 - a. Certainteed "ProRoc 14" Flex" or approved equal.
 6. Or approved equal.
- B. Metal Studs/Resilient Furring Channels.
 1. Unless indicated otherwise, use 25-gage for partitions up to 12'-0" high, use 20-gage for partitions over 12'-0" high.

2. Unless indicated otherwise, use 20-gage studs at door jambs, head.
3. Track gauge shall be same gauge as nested studs.
4. All exterior non-structural metal framing, including but not limited to Z furring and studs shall be 16 ga. Galvanized.

C. Suspension System

1. Chicago Metallic 640 system.
 - a. Hanger Wire: 8-gage, annealed.
 - b. Carrying Channels: 1-1/2 inch cold rolled steel.
 - c. Screws: USG 1-inch type S.
 - d. Furring Channels: USG metal furring channel, attached with USG furring channel clips.
2. Chicago Metallic 650 System, complying with UL Design No. D502.
 - a. Hanger clips: 18 gauge galvanized steel.
 - b. Hanger wire: No. 12 SWG galvanized steel.
 - c. Carrying Channels: 16 gauge 1 1/2 inch cold rolled.
 - d. Furring Cross Channel: 16 gauge 7/8 inch where required.
 - e. Wall Molding: 26 gauge steel channel 1 11/16 inch deep with 15/16 inch flanges.
3. Or approved equal.

D. Accessories

1. Metal Trim: USG No. 200-A or approved equal.
2. L-shaped Metal Trim USG No. 801-B.
3. Metal Reveal Molding: Fry Reglet DRM-625-75.
4. Metal Reveal Molding: Fry Reglet DRM-625-200.
5. Metal 'Z' Reveal Molding, 1/4" wide: Fry Reglet DRMZ-625-25.
6. Metal "Z" Reveal Molding, 1/2" deep X 1/2" wide: Fry Reglet DRMZ-50-50
7. Metal 'Z' Reveal Molding 5/8" wide X 1/2" deep Fry-Reglet DRMZ- 625-50.
8. Metal 'Z' Reveal Molding, 1" wide: Fry Reglet DRMZ-100-100.
9. Metal "Z" Reveal Molding 2" wide: Fry Reglet DRMZ-625-200
10. Expansion Joints: USG No. 093.
11. Drywall Screws for Metal Framing: 1" Type S-12 or Type S bugle head.
12. Outside Corner Reinforcement: USG No. 104, 1-1/8" x 1-1/8" corner bead.
13. Acoustical Sealant: Equal to Tremco "Tremflex 834" or Pecora "Acoustic and Insulation Sealant", low VOC formulation.
 - a. VOC content less than 50 g/l.
14. Sound Attenuation Blanket: U.S. Gypsum Thermafiber, 3" for an STC of 49
15. Or approved equals.

E. Drywall Finishing Accessories

1. Joint Compounds: Ready mixed type, or approved equal.
2. Joint Reinforcement: USG Perf-A-Tape, or approved equal.

F. Texture Finish Materials

1. Ceilings: USG Spray Fine Sand Texture Finish, or approved equal.
2. Walls (Painted Only): "Orange Peel".

G. Vapor Barrier at Interior Partitions:

1. Multiple polyethylene layers with aluminum foil core.
2. UV Stable.
3. Cold Crack Resistant.
4. Chemical Resistant.
5. Class B, Tested to ASTM E-1745-97
 - a. Reef Industries, Inc. "Griffolyn" "Vaporguard"

- b. Or approved equal.
6. Vapor Barrier Tape: As recommended by vapor barrier manufacturer.

PART 3 - EXECUTION

3.01 METAL STUDS

- A. Attach metal runners at floor and at ceiling or structural elements above with suitable fasteners located 2 inches from each end, spaced 16 inches on center.
- B. Position studs vertically, engaging floor and ceiling runners. Splice studs with 8-inch nested lap, one positive attachment per stud flange. Place studs in direct contact with all door frame jambs, abutting partitions, partition corners, existing construction elements.
- C. Anchor studs adjacent to door frames, partition intersections, and corners to ceiling and floor runner flanges with USG metal lock fastener tool.
- D. Provide double studs at jambs and head of each door frame. Securely anchor studs to jamb and head anchor clips at metal door frames by bolt or screw attachment. Over metal frames, place a cut-to-length section of runner horizontally with web-flange bent at each end; secure with one positive attachment per flange. Position a cut-to length stud (extend to ceiling runner) at vertical board joints over door frame header. Place an additional track-to-track stud 6 inches from double jamb studs on both sides of framed openings.
- E. At curved surfaces, space studs and framing members 8 inches on center maximum.

3.02 INSTALLATION OF VAPOR BARRIER

- A. General: Extend vapor barrier to extremities of areas to be protected from vapor transmission. Secure in place with adhesives or other anchorage system as indicated. Extend vapor barrier to cover miscellaneous voids in insulated substrates, including those filled with loose-fiber insulation.
- B. Firmly attach vapor barrier to metal framing and solid substrates with vapor- barrier fasteners.
- C. Seal joints caused by pipes, conduits, electrical boxes, and similar items penetrating vapor barrier with vapor- barrier tape to create an airtight seal between penetrating objects and vapor barrier.
- D. Repair tears or punctures in vapor barrier immediately before concealment by other work. Cover with vapor- barrier tape or another layer of vapor barrier.
- E. Vapor barrier shall be installed in maximum material sizes so as eliminate intermediate horizontal joints and to achieve a minimum vertical joint spacing of 90-feet. The vertical joints shall have 12-inch overlaps and shall include two continuous runs of specified tape. The tape shall be used at the top and bottom seals.

3.03 GYPSUM BOARD

- A. Follow Gypsum Association's recommendations for installation procedures.
- B. Cut wallboards by scoring and breaking or sawing; scribe neatly at wall projections.
- C. Apply first to ceilings then to walls.
- D. Maintain a 5/8" space between floor and bottom edge of gypsum board.

- E. Locate wallboard joints at openings so that no end joint aligns with edge of opening.
- F. Set fasteners with heads slightly below surface of wallboard. Avoid breaking face paper.
- G. Provide water resistant wallboard at rooms/areas with high humidity.

3.04 CEILING SUSPENSION SYSTEM

- A. Suspend carrying channels with 8-gage hanger wires spaced 48 inches on center, within 6 inches of ends.
- B. Install carrying channels 48 inches on center and within 6 inches of walls. Provide 1 inch clearance between channel ends and abutting walls, partitions.
- C. At splices, interlock flanges, overlap ends 12 inches, and secure with 16-gage double standard tie wire at each end.
- D. Erect furring channels at right angles to carrying channels, spaced 24 inches on center and within 6 inches of walls. Provide 1-inch clearance between channel ends and abutting walls, partitions.
- E. Secure to carrying channels with clips, or, saddle tie with 16-gage double standard tie wire. At splices nest channels at least 8 inches, securely wire tie at each end.
- F. Install additional cross reinforcing to restore lateral stability of suspension system at openings that interrupt carrying or furring channels.
- G. Apply wallboard of maximum practical length with long dimension at right angles to furring channels. Position and stagger end joints over channel web. Fit ends and edges closely, but not forced together.
- H. Fasten board to channels with 1-inch Type S screws spaced 12 inches on center in field of board, along abutting ends, edges.
- I. Comply with UL Design No. D502 requirements at fire rated assembly.

3.05 EXPANSION JOINTS

- A. At Ceilings: 50'-0" on center each way maximum.
- B. At Walls: 30'-0" on center maximum.
- C. Provide continuous from each door jamb to top of partition.
- D. Provide at intersections with exposed masonry construction.

3.06 SINGLE LAYER/ERECTION

- A. Position all ends, edges over framing members, except when edge joints are at right angles to framing members, or when end joints are back-blocked. Apply wallboard horizontally or vertically on walls to minimize the number of joints.
- B. Attach wallboard to metal framing supports by power driven screws. For vertical application space screws 12 inches on center in field of board, 8 inches on center staggered along vertical abutting

edges. For horizontal application space screws 12 inches on center in field, along abutting end joints.

3.07 MULTI-LAYER WALLBOARD ERECTION

- A. Base Layer: Erected as specified for "Single Layer Erection".
- B. Joints in face layer to fall at least 10 inches from parallel joints in base layer.
- C. Apply face layers with adhesive in accordance with wallboard manufacturer's printed instructions. Provide sufficient number and spacing of fasteners to hold top layer tight with bottom layer until adhesive dries.

3.08 JOINT TREATMENT APPLICATION

- A. Mix joint compound in accordance with manufacturer's recommendations.
- B. Apply compound in thin uniform layer to all joints, angles to be reinforced. Apply reinforcing tape centered over joint, seated into compound. Follow immediately with thin skim coat or embed tape. Fold and embed tape in interior angles to provide true angle.
- C. When embedding coat is thoroughly dry, apply second coat of compound, filling board taper flush with surface. Cover tape, feather out slightly beyond tape.
- D. On joints with no taper, cover tape, feather out at least 10 inches on either side of tape.
- E. When second coat is thoroughly dry, spread finish coat evenly over and extend slightly beyond second coat. Feather to a smooth, uniform finish.
- F. Over taped edges, do not allow finish coat to protrude beyond plane of surface. Apply finish coat to cover tape, taping compound at taped angles to provide true angle. When necessary, sand between coats and follow with final coat to provide level 4 smooth surface ready for decoration except in locations noted in section 09 26 13 Gypsum Veneer Plastering.
- G. Do not abrade adjacent face-paper surfaces.

3.09 FINISHING FASTENERS

- A. Apply compound to fastener depressions. Follow with minimum of two additional coats leaving depressions level with surface.
- B. Do not abrade adjacent face-paper surfaces.

3.010 FINISHING BEAD AND TRIM

- A. Mechanically fasten outside corner reinforcement per manufacturer's instructions.
- B. Apply first coat to beads, trim. Properly feather out from ground to plane of surface. Embed flanges of corner reinforcement with compound.
- C. When embedding coat is thoroughly dry, apply second coat in same manner as first-coat, extending compound slightly beyond onto face of board.

D. When second coat is thoroughly dry, apply finish coat extending compound slightly beyond second coat, properly feathering from ground to plane of surface. Sand finish coat as necessary to provide a level 4 flat smooth surface, ready for decoration.

E. Do not abrade adjacent face-paper surfaces.

3.011 ACOUSTIC SEALANT

A. Apply sealant at intersections of wallboard and adjacent materials to form a complete seal to air and noise.

3.012 TEXTURE FINISH

A. Apply texture finish in accord with manufacturer's printed instructions.

B. Provide uniform texture over entire surface.

3.013 ADJUST AND CLEAN

A. Ridging

1. Sand ridges to reinforcing tape without cutting through tape.
2. Fill concave areas on both sides of ridge with topping compound.
3. After fill is dry, blend in topping compound over repaired area.

B. Fill cracks with compound and finish smooth and flush.

END OF SECTION 09 29 00

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SECTION 09 51 00

ACOUSTICAL CEILINGS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Conditions of the Contract and portions of Division One of this Project Manual apply to this Section as though repeated herein.

1.02 WORK INCLUDED

- A. Acoustical Board.
- B. Suspension Systems.

1.03 RELATED WORK

- A. Fire Suppression (Sprinkler Devices): Division 21.
- B. Mechanical (Air Supply and Return Devices): Division 23.
- C. Electrical (Light Fixtures): Division 26.

1.04 SUBMITTALS

- A. Submit in accord with the General Conditions of the Contract.
 - 1. Manufacturer's product specifications and installation instructions for each acoustical ceiling material and suspension system required, including certified laboratory test reports.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials in original, unopened, protective packaging, with manufacturer's labels indicating brand name, pattern, size and thickness as applicable, legible and intact.
- B. Store materials in original protective packaging to prevent soiling, physical damage or wetting.
- C. Store cartons open at each end to stabilize moisture content and temperature.

1.06 PROJECT CONDITIONS

- A. Do not install interior acoustical ceilings until space is enclosed and weatherproof. Complete installation of damp materials before beginning work.
- B. Maintain humidity of 65 - 75 percent in areas where acoustical materials are to be installed 24 hours before, during, and after installation.
- C. Maintain a uniform temperature in the range of 55 to 70 degrees F. prior to and during installation of materials.

1.07 EXTRA MATERIALS

- A. Deliver extra materials equal to a minimum of 2% of each type of acoustical material supplied.

- B. All cartons shall be new, unopened, packaged with protective covering for storage, and identified with appropriate labels.

1.08 ENVIRONMENTAL REQUIREMENTS

- A. Low-Emitting Materials, Adhesives, and Sealants: Materials used on the interior of the building (defined as inside the weatherproofing system and applied on site) must not exceed the following requirements.
 - 1. Adhesives, Sealants and Sealant Primers: South Coast Air Quality Management (SCAQMD) Rule # 1168, requirements in effect on July 1, 2005, and rule amendment date January 7, 2005.
 - 2. Aerosol Adhesives: Green Seal Standard for Commercial Adhesives GS-36, requirements in effect on October 19, 2000.
- B. Low-Emitting Materials, Composite Wood & Agrifiber Products: Composite wood and agrifiber products used inside the weatherproofing system shall contain no added urea-formaldehyde resins.
 - 1. Laminating Adhesives used to fabricate on-site and shop applied composite wood and agrifiber assemblies shall contain no added urea-formaldehyde resins.

PART 2 - PRODUCTS

2.01 CEILING TILE

- A. ACT-1:
 - 1. CertainTeed "Vinylrock", vinyl faced gypsum panel.

2.02 CEILING GRID

- A. Suspension System 1 Used with ACT-3: Faced Gypsum Board only.
 - 1. Product Basis of Design: USG DONN DX/DXL, 15/16"
 - a. Components: All main beams and cross tees shall be commercial quality hot dipped galvanized per ASTM A 653. Main beams and cross tees are double web steel construction with type exposed flange design. Exposed surfaces chemically cleansed, capping pre-finished galvanized steel in baked polyester paint. Main beams and cross tees shall have rotary stitching.
 - b. Structural Classification: ASTM C 635 Heavy Duty.
 - c. Color: White and match the actual color of the selected ceiling tile, unless noted otherwise.
 - 2. Or similar that meets the Basis of Design specification by:
 - a. Chicago Metallic.
 - b. National Rolling Mills.
 - c. Armstrong.
 - d. Or approved equal.
- B. Armstrong Axiom: Transition Trims
 - 1. Components:
 - a. Trim Channel: Aluminum
 - b. Corner Options:
 - c. Bottom Drywall Trim (for 5/8" drywall):
 - d. Alignment Clip:
 - e. T-Bar Connection Clip:
 - f. Splice Plate.

PART 3 - . EXECUTION

3.01 EXAMINATION

- A. Examine surfaces scheduled to receive suspended or directly attached acoustical units for unevenness, irregularities, and dampness that would affect quality and execution of work. Do not proceed with work until unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Do not begin installation until sufficient materials to complete a room are received.
- B. Install materials in accordance with manufacturer's printed instructions, governing regulations, fire resistance rating requirements, and industry standards applicable to work.
 - 1. Install wind clips at all areas subject to movement due to wind or rapid pressure changes or as shown on drawings.
- C. Measure each ceiling area and establish layout of acoustical units to balance border widths at opposite edges of each ceiling. Avoid use of less-than-half width units at borders, and comply with reflected ceiling plans wherever possible.
 - 1. Or as shown in on drawings.
- D. Symmetrically locate grid layout in each space. Coordinate work with other trades so that lighting fixtures, grilles, and other ceiling fixtures work with grid layout.
- E. Do not use universal splices or other splices which would obstruct passage of recessed lighting fixtures through grid openings or limit fixture relocation upon flanges of ceiling grids.
- F. Support suspension system from structure above, not from ductwork, metal deck, equipment or piping.
- G. Space hangers not more than 6 inches from ends and not more than 4 feet on center.
- H. Install edge moldings at the perimeter of each acoustical ceiling area and at locations where edge of units would otherwise be exposed.
 - 1. Secure moldings to building construction by fastening with screw anchors into the substrate, through holes drilled in vertical leg. Space holes not more than 3 inches from each end and not more than 16 inches on center along each molding.
 - 2. Level moldings with ceiling suspension system, to a level tolerance of 1/8 inch in 12 feet.
 - 3. Miter corners of moldings accurately to provide hairline joints, securely connected to prevent dislocation. Cope exposed flanges of intersecting suspension system members, so that flange faces will be flush.
 - 4. Furnish additional tees for supporting grilles, diffusers and light fixtures. Refer to the reflected ceiling, HVAC and electrical plans for locations.
 - 5. Provide tegular edge at walls, other abutting vertical surfaces, at all tegular tile board types.
 - 6. Field paint cut edges to surface color and sheen.
- I. Arrange acoustical units and orient directionally-patterned units, if any, in manner shown on reflected ceiling plans.
- J. Install wood plank suspension system and panels in compliance with ASTM C636, with the authorities having jurisdiction, and in accordance with the manufacturer's shop drawings and installation instructions.

3.03 CLEANING

- A. Clean exposed surfaces of acoustical ceilings, trim, edge moldings, and suspension members to comply with manufacturer's instructions for cleaning and touch-up of minor finish damage.
- B. Remove work which cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

3.04 PROTECTION

- A. Provide required protection for the acoustical ceilings, including temperature, humidity limitations and dust control so that the work will be without damage and deterioration at the time of acceptance by the Owner.

END OF SECTION 09 51 00

SECTION 09 65 00

RESILIENT FLOORING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Applicable provisions of Division 1 shall govern all work under this section.

1.02 WORK INCLUDED

- A. Resilient Wall Base.

1.03 RELATED WORK

- A. Section 09 29 00 Gypsum Board

1.04 SUBMITTALS

- A. Submit in accordance with the General Conditions of the Contract.
 - 1. Manufacturer's technical data for each type of resilient base, adhesive and accessory.
 - a. Data indicating adhesive meets VOC requirements.
 - 2. Manufacturer's standard color charts in form of actual sections of resilient base, including accessories, showing full range of colors and patterns available, for each type of resilient base required.

1.05 QUALITY ASSURANCE

- A. Provide each type of resilient base and accessories from a single manufacturer, including recommended primers, adhesives, and sealants.
- B. Installers Qualifications: Installer experienced (minimum of 2 years) to perform work of this section who has specialized in the installation of work similar to that required for this project and who is acceptable to the product manufacturer.
- C. Materials: For each type of material required for the work of this Section, provide primary materials which are the products of one manufacturer. Provide secondary materials which are acceptable to the manufacturer of the primary materials.
 - 1. Comply with applicable regulations regarding VOC (volatile organic compound) content of adhesives.

1.06 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials to project site in manufacturer's original, unopened containers with labels indicating brand names, colors and patterns, and quality designations legible and intact.
- B. Store and protect materials in accordance with manufacturer's recommendations.

1.07 PROJECT CONDITIONS

- A. Maintain minimum temperature of 68 degrees F, plus or minus 5 degrees F and maximum temperature of 90 degrees F in spaces to receive resilient base for at least 48 hours prior to

installation, during installation, and for not less than 48 hours after installation. Subsequently, maintain minimum temperature of 55 degrees F in areas where work is completed.

- B. Store resilient flooring materials in spaces where they will be installed for at least 48 hours before beginning installation.
- C. Install resilient base and accessories after other finishing operations, including painting, have been completed.

1.08 EXTRA MATERIALS

- A. Furnish full size units equal to 2 percent of quantity of resilient base installed as extra materials. Properly label and package extra materials. Deliver to Owner's designated storage area.

1.09 SUSTAINABLE DESIGN REQUIREMENTS

- A. Recycled content: Provide products manufactured from recycled content as specified.
 - 1. Resilient Wall Base, Rubber: 20% pre-consumer.
- B. Low-Emitting Materials, Adhesives, and Sealants: Materials used on the interior of the building (defined as inside the weatherproofing system and applied on site) must not exceed the following requirements.
 - 1. Adhesives, Sealants and Sealant Primers: South Coast Air Quality Management (SCAQMD) Rule # 1168, requirements in effect on July 1, 2005, and rule amendment date January 7, 2005.
 - 2. Aerosol Adhesives: Green Seal Standard for Commercial Adhesives GS-36, requirements in effect on October 19, 2000.

PART 2 - PRODUCTS

2.01 RESILIENT WALL BASE

- A. RB-1:
 - 1. Material, Rubber 5/8" Butt Toe Base, 4" High
 - a. Color: As selected by Architect from manufacturer's full line.
- B. Manufacturers: Provide products from one of the following only if equal and approved by A/E:
 - 1. Armstrong.
 - 2. Flexco.
 - 3. Freudenberg Building Systems, Nora.
 - 4. Johnsonite.
 - 5. Roppe.

2.02 ACCESSORIES

- A. Adhesive for Wall Base: W.W. Henry "595 Cove Base Adhesive", zero-VOCs; W.F. Taylor "2035 Cove Base Adhesive" or "2040 Premium Cove Base Adhesive", GreenGuard certified; PL Adhesives & Sealants "Cove Base Adhesive"; Bostik Findley, Durabond "D-740 Multipurpose Wall Adhesive".
 - 1. Low-VOC type: VOC content less than 100 g/l.
 - a. Or approved equal.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrate surfaces to determine that all substrates are dry, clean, smooth, level and structurally sound.

- B. Do not allow resilient wall base work to proceed until substrate surfaces are satisfactory. Indicate adverse conditions of any type by letter.

3.02 PREPARATION

- A. Remove all debris, sand and other materials which would result in lack of adhesion.

3.03 WALL BASE INSTALLATION

- A. Apply wall base to walls, columns, pilasters, casework and other permanent fixtures in rooms or areas where base is required.
- B. Install base in lengths as long as practicable, with preformed corner units, or fabricated from base materials with mitered or coped inside corners. Cut no shorter than full wall length.
- C. Tightly bond base to substrate throughout length of each piece, with continuous contact at horizontal and vertical surfaces.
 - 1. On masonry surfaces, or other similar irregular substrates, fill voids along top edge of resilient wall base with manufacturer's recommended adhesive filler material.
 - 2. Adhesive shall cover a minimum of 90 percent of ribbed back of base.
 - 3. Leave 1/4 inch uncovered space at top edge of base to prevent oozing.
 - 4. Roll base firmly, roll back toward starting point.

3.04 CLEANING

- A. Perform following operations immediately upon completion of resilient wall base.
 - 1. Clean surfaces only after adhesive has fully cured, no sooner than 72 hours after installation.
 - 2. Thoroughly clean wall base, being careful to remove black marks and excessive soil, according to manufacturer's instructions using products approved by manufacturer. Remove any excess adhesive or other surfaces blemishes, using appropriate cleaner recommended by resilient base manufacturers.

3.05 PROTECTION

- A. Protect wall base against damage during construction period to comply with resilient base manufacturer's directions.

END OF SECTION

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SECTION 09 90 00

PAINTING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Conditions of the Contract and portions of Division One of this Project Manual apply to this Section as though repeated herein.

1.02 WORK INCLUDED

- A. Painting and finishing of interior and exterior exposed items and surfaces on the Project not painted as per Section 0-9 96 00, High Performance Coatings.
- B. Refinishing of existing surfaces as indicated on Drawings, including removal of paint and finishes, preparation, painting and finishing.
- C. Field painting of exposed bare and covered pipes and ducts and hangers, conduits, uni-strut, and primed metal surfaces including but not limited to, hollow metal work, bollards and equipment installed under mechanical and electrical work.
- D. "Paint" as used herein means all coating systems materials including primers, emulsions, enamels, stains, sealers and fillers, and other applied material whether used as prime, intermediate or finish coats.
- E. Except where natural finish of material is specifically noted as a surface not to be painted, paint exposed surfaces. Where items or surfaces are not specifically mentioned, paint the same as similar adjacent materials or areas.
- F. Following categories are not included as part of field-applied finish work.
 - 1. Pre-Finished Items: Unless otherwise indicated, do not include painting when factory-finishing or installer-finishing is specified.
 - 2. Concealed Surfaces: Unless otherwise indicated, painting is not required on surfaces in concealed areas and generally inaccessible areas.
 - 3. Finished Metal Surfaces.
 - 4. Operating Parts.

1.03 RELATED WORK

- A. Section 03 36 02, Special Concrete Floor Finishes for sealing of exposed concrete floors.
- B. Section 09 96 00, High Performance Coatings: Exterior Substrates: Concrete vertical surfaces, steel, galvanized metal; Interior Substrates: Concrete, vertical surfaces, steel, galvanized metal.
- C. Shop Priming: Unless otherwise specified, shop priming of ferrous metal items is included under various sections for structural steel, metal fabrications, hollow metal work and similar items.
- D. Examine the Contract Documents and be familiar with all their provisions regarding painting. All surfaces that are left unfinished by the requirements of other Sections shall be painted or finished as part of this Section.

1.04 SUBMITTALS

- A. Submit in accordance with the General Conditions of the Contract:
1. Paint: Submit a list of specified products with corresponding name of manufacturer, identifying name and number of proposed products along with manufacturer's written instructions for use of each product.
 2. If manufacturer to be used is different from that of color chips furnished, prepare and submit two approximately 6 inch square, properly labeled samples of each color and sheen required on properly prepared paint-out cards or hardboard.
 3. Stain: Two, 6 inch square properly labeled samples of each color and sheen required on actual wood for project.
 4. Prepare and repaint an area of each designated interior surface to requirements specified herein, with specified paint or coating showing selected color, gloss/sheen, texture and workmanship to MPI Repainting Manual standards for review and approval by Owner and A/E. When approved, interior surface shall become acceptable standard of finish quality and workmanship for similar on-site repainting work.

1.05 QUALITY ASSURANCE

- A. MPI Standards:
1. Products: Complying with MPI standards indicated and listed in "MPI Approved Products List."
 2. Preparation and Workmanship: Comply with requirements in "MPI Architectural Painting Specification Manual" for products and paint systems indicated.
 - a. For areas to be renovated, comply with requirements in "MPI Maintenance Repainting Manual".

1.06 DELIVERY, STORAGE AND HANDLING

- A. Do not deliver materials to site until having received all written approvals of submitted information and samples.
- B. Deliver materials to job site in original, new and unopened packages and containers bearing manufacturer's name and label.
- C. Store materials not in actual use in tightly covered containers.
- D. Take all precautions to ensure that workers and work areas are adequately protected from fire hazards and health hazards resulting from handling, mixing and application of paints.
- E. Remove rags and waste from storage areas daily.

1.07 PROJECT CONDITIONS

- A. Apply water-base paints only when temperatures of surfaces to be painted and surrounding air temperatures are between 50 and 95 degrees F.
- B. Apply solvent-thinned paints only when temperature of surfaces to be painted and surrounding air temperatures are between 45 degrees F. and 95 degrees F.

- C. Do not apply paint when relative humidity exceeds 85%; at temperatures less than 5 degrees F. above the dew point; or to damp or wet surfaces.

1.08 SEQUENCING AND SCHEDULING

- A. Schedule cleaning and painting so that contaminants from cleaning process will not fall onto newly-painted surfaces.

1.09 EXTRA MATERIALS

- A. Furnish extra materials described below that are from same production run (batch mix) as materials applied and that are packaged for storage and identified with labels describing contents.

- 1. Quantity: Furnish an additional 5 percent, but not less than 1 gal. of each material and color applied.

1.010 ENVIRONMENTAL REQUIREMENTS

- A. Low-Emitting Materials, Field applied Paints and Coatings: Interior paints and coatings applied on-site must meet the limitations and restrictions concerning chemical components set by the following standards:
 - 1. Topcoat Paints, Green Seal Standard GS-11, Paints: First Edition, May 20, 1993.
 - 2. Anti-Corrosive and Anti-Rust Paints: Green Seal Standard GS-03, Anti-Corrosive Paints", Second Edition, January 7, 1997. For applications on ferrous metal substrates.
 - 3. "All Other Architectural Coatings, Primers and Undercoats: South Coast Air Quality Management District (SCAQMD) Rule #1113, Architectural Coatings", rules in effect on January 1, 2004.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Provide products from the following manufacturers:
 - 1. AFM Safecoat
 - 2. Benjamin Moore & Co.
 - 3. Cabot
 - 4. ICI/Dulux.
 - 5. Mythic Paint, Southern Diversified Products
 - 6. PPG Architectural Finishes, Inc.
 - 7. Rymar, LLC
 - 8. Sherwin-Williams Company
 - 9. Sikkens
 - 10. Target Coatings

11. Diamond Vogel Paint

2.02 MATERIALS

- A. Use the materials of the same manufacturer for each system.
- B. Sherwin-Williams systems are called out in the system schedules to establish quality and dry mil thickness of finished installation for all systems. A different manufacturer may be used for color selection. Any manufacturer noted above may be used as long as quality and color requirements are met.
 - 1. Proprietary names used to designate colors or materials are not intended to imply that products of named manufacturers are required to exclusion of equivalent products of other manufacturers.
- C. Provide best quality grade of various types of coatings as regularly manufactured by acceptable paint materials manufacturers.
- D. Material Compatibility:
 - 1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
 - 2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.
- E. Chemical Components of Field-Applied Interior Paints and Coatings: Provide products that comply with the following limits for VOC content, exclusive of colorants added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24) and the following chemical restrictions; these requirements do not apply to primers or finishes that are applied in a fabrication or finishing shop:
 - 1. Primer or Undercoat: VOC content of not more than 100 g/L (150 g/L with colorant added at point-of-sale).
 - 2. Flat Paints and Coatings: VOC content of not more than 50 g/L (100 g/L with colorant added at point-of-sale).
 - 3. Non-flat Paints and Coatings: VOC content of not more than 100 g/L (150 g/L with colorant added at point-of-sale).
 - 4. Floor Paint: VOC content of not more than 100 g/L (150 g/L with colorant added at point-of-sale).
 - 5. Aromatic Compounds: Paints and coatings shall not contain more than 1.0 percent by weight of total aromatic compounds (hydrocarbon compounds containing one or more benzene rings).
 - 6. Restricted Components: Paints and coatings shall not contain any of the following:
 - a. Acrolein.
 - b. Acrylonitrile.
 - c. Antimony.
 - d. Benzene.
 - e. Butyl benzyl phthalate.
 - f. Cadmium.
 - g. Di (2-ethylhexyl) phthalate.
 - h. Di-n-butyl phthalate.
 - i. Di-n-octyl phthalate.

- j. 1,2-dichlorobenzene.
- k. Diethyl phthalate.
- l. Dimethyl phthalate.
- m. Ethylbenzene.
- n. Formaldehyde.
- o. Hexavalent chromium.
- p. Isophorone.
- q. Lead.
- r. Mercury.
- s. Methyl ethyl ketone.
- t. Methyl isobutyl ketone.
- u. Methylene chloride.
- v. Naphthalene.
- w. Toluene (methylbenzene).
- x. 1,1,1-trichloroethane.
- y. Vinyl chloride.

F. Color Pigments: Pure, non-fading, applicable types to suit substrates and service indicated.

2.03 PRIMERS/SEALERS

A. Interior Latex Primer/Sealer: MPI #50.

2.04 METAL PRIMERS

A. Rust-Inhibitive Primer (Water Based): MPI #107.

2.05 LATEX PAINTS

A. Institutional Low-Odor/VOC Latex (Flat): MPI #143 (Gloss Level 1).

B. Institutional Low-Odor/VOC Latex (Low Sheen): MPI #144 (Gloss Level 2).

C. Institutional Low-Odor/VOC Latex (Eggshell): MPI #145 (Gloss Level 3).

D. Institutional Low-Odor/VOC Latex (Semigloss): MPI #147 (Gloss Level 5).

2.06 EQUIPMENT

A. Provide all brushes, rollers, ladders, scaffolding, and other equipment of any kind to properly execute each type of work.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of work.

B. Maximum Moisture Content of Substrates:

1. Gypsum Board: 12 percent.
2. Concrete: Must be cured a minimum of 45 days.

- C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
- D. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.
 - 1. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.

3.02 PREPARATION

- A. Perform preparation and cleaning procedures in accord with paint manufacturer's instructions and as specified for each particular substrate condition.
 - 1. Remove hardware, hardware accessories, machined surfaces, plates, lighting fixtures, and similar items in place and not to be finish-painted, or provide surface-applied protection prior to surface preparation and painting operations.
 - a. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
 - b. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
 - 2. Follow manufacturer's instructions for use of stripping solutions to avoid raising grain of wood.
 - 3. Do not dip fabricated units (doors, etc.) in stripping solution to avoid saturating wood or damaging glued connections.
 - 4. Clean surfaces to be painted before applying paint or surface treatments. Remove oil and grease prior to mechanical cleaning.
 - 5. Remove dirt, rust, scale, moisture, scuffed surfaces, or conditions otherwise detrimental to formation of a durable paint film.
- B. New wood: Prepare substrate and apply finish according to manufacturer's recommendations. Apply to smooth clean surfaces only.
- C. Gypsum Board: Fill minor irregularities with patching material and sand to smooth level surfaces taking care not to raise nap of paper.
- D. Existing Ferrous Metal
 - 1. Spot remove failed, damaged or rough existing paint to bare metal by means of stripping as indicated above. If existing metal surface is not smooth, sand or wire brush.
 - a. Sand edges of existing paint to a feather edge.
 - 2. Remove dirt and grease with mineral spirits or solvent recommended by paint manufacturer and clean cloths.
- E. Ferrous Metal
 - 1. Remove dirt and grease with mineral spirits or solvent recommended by paint manufacturer and clean cloths.
 - 2. Where not galvanized, shop coat of primer will exist on surface. If prime coat is not smooth, sand to bare metal and re-prime.

3.03 APPLICATION

- A. Provide adequate forced ventilation of enclosed areas for curing of installed materials, to disperse humidity, and to prevent hazardous accumulations of dust, fumes, vapors or gases.

- B. Do no interior work until building is properly enclosed.
- C. Do work under adequate illumination and dust-free conditions.
- D. Apply paints according to manufacturer's written instructions.
 - 1. Use applicators and techniques suited for paint and substrate indicated.
 - 2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
 - 3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
- E. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.
- F. Materials
 - 1. Do not open containers until required for use.
 - 2. Stir materials thoroughly and keep at uniform consistency during application.
- G. Coats
 - 1. Number specified is minimum.
 - 2. Touch up suction spots between coats.
 - 3. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
 - 4. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
 - 5. Refinish surfaces affected by refitting work.

3.04 COLOR SEPARATION

- A. An average of one or two wall colors will be used per room. Ceilings generally will be a different color than walls. Finished closets will usually be same as adjoining rooms.
- B. Job painted metal items such as diffusers, grilles and registers will generally be same color as adjacent surface.

3.05 CLEANING

- A. During the progress of this work, remove from the site all discarded paint materials, rubbish, cans and rags at the end of each work day.
- B. Upon completion of painting work, clean window glass and other paint-spattered surfaces. Remove spattered paint by proper methods of washing and scraping, using care not to scratch or otherwise damage finished surfaces.

3.06 PROTECTION

- A. Protect work of other trades, whether to be painted or not, against damage by painting and finishing work. Correct damage by cleaning, repairing or replacing.
- B. Provide "wet paint" signs to protect newly-painted finishes. Remove temporary protective wrappings, after completion of painting operations.

- C. At the completion of work of other trades, touch-up and restore all damaged or defaced painted surfaces.

3.07 SCHEDULE OF INTERIOR WORK

- A. In addition to obvious surfaces, the following do not require painting or finishing.
 - 1. Do not include painting when factory-finishing or installer-finishing is specified for such items as (but not limited to) acoustic materials, finished mechanical and electrical equipment including light fixtures and distribution cabinets.
 - 2. Painting is not required on surfaces such as walls or ceilings in concealed areas and generally inaccessible areas, furred areas, utility tunnels, pipe spaces, duct shafts and elevator shafts.
 - 3. Metal surfaces of anodized aluminum, stainless steel, chromium plate, copper, bronze and similar finished materials will not require finish painting, unless otherwise indicated.
 - 4. Moving parts of operating units, mechanical and electrical parts, such as valve and damper operators, linkages, sinkages, sensing devices, motor and fan shafts will not require finish painting, unless otherwise indicated.
 - 5. Do not paint over any code-required labels, such as Underwriter's Laboratories and Factory Mutual, or any equipment identification, performance rating, name or nomenclature plate.
 - 6. N/A indicates system not applicable to this Project.
- B. Walls and Ceilings
 - 1. Paint all rooms. Paint patched walls from 90 degree corner or vertical expansion joint cover in corridors, and patched ceilings complete.
 - 2. Do not apply next coat until previous is thoroughly dry.
 - 3. Provide final coat which is solid and even in color, free from runs, laps, sags, brush marks, air bubbles and excessive roller stipple and worked into crevices, joints and similar areas.
- C. Electrical Panel Box Covers and Doors
 - 1. Remove, paint and reinstall after paint is dry.
- D. Other Unfinished and Primed Surfaces
 - 1. Provide specified finish on exposed surfaces. This includes prime coated mechanical units, piping, pipe covering, conduit, and interior duct surfaces visible behind grilles.
- E. Interior Paint Schedule

System	Material	Type/Sheen	Number and Type of Coating
IPS-7	Gypsum Board	Latex/Eggshell Zero-VOC	One coat "Harmony Interior Latex Primer"; Two coats "Harmony Interior Latex Eggshell"
IPS-8	Concrete	Latex/Eggshell Zero-VOC	One coat "Harmony Interior Latex Primer"; Two coats "Harmony Interior Latex Eggshell"
IPS-13	Ferrous Metal (Unprimed)	Latex/Semi-gloss	One coat "Pro-Cryl Universal Primer"; Two coats "ProClassic Waterborne"
IPS-14	Ferrous Metal (Primed)	Latex/Semi-gloss	One coat "Pro-Cryl Universal Primer"; Two coats "ProClassic Waterborne"
IPS-15	Copper/Aluminum (finished rooms only)	Latex/Flat	One coat "DTM Acrylic Primer; Finish"; Two coats "ProMar 200 Interior Latex Flat"
IPS-16	Galvanized Metal (finished rooms only)	Latex/Flat	One coat "DTM Acrylic Primer Finish"; Two coats "ProMar 200 Interior Latex Flat"

3.08 SCHEDULE OF EXTERIOR WORK

A. General

1. Paint or finish other new, unfinished and primed surfaces noted on drawings.
2. Provide aggregate in quantity as recommended by manufacturer and mix according to manufacturer's written instructions.

B. Exterior Paint Schedule

System	Material	Type/Sheen	Number and Type of Coating
EPS-1	Ferrous Metal (hollow metal, exposed plates, angles, bolts, etc.)	Latex /Semi-Gloss	One coat "Kem-Kromik Universal" primer; Two coats "DTM Acrylic"
EPS-2	Galvanized Metal (hollow metal, equipment housings, steel, etc.)	Latex /Semi-Gloss	One coat "Pro-Cryl Univeral" primer; Two coats "DTM Acrylic"

3.09 PAINT COLOR SCHEDULE

- A. PT-1: GWB
- B. PT-2: Interior Metal and HM Frames and Doors
- C. PT-3: Exterior HM Door and Frame
- D. PT-4: Bollards

END OF SECTION

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SECTION 09 96 00

HIGH PERFORMANCE COATINGS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Conditions of the Contract and portions of Division One of this Project Manual apply to this Section as though repeated herein.

1.02 WORK INCLUDED

- A. This Section includes surface preparation and application of high-performance coating systems on the following substrates:
 - 1. Exterior Substrates:
 - a. Concrete vertical surfaces.
 - b. Steel.
 - c. Galvanized metal.
 - 2. Interior Substrates:
 - a. Concrete, vertical surfaces.
 - b. Steel.
 - c. Galvanized metal.

1.03 RELATED WORK

- A. Section 03 30 00, Cast-in-Place Concrete.
- B. Section 03 36 02, Special Concrete Floor Finishes for sealing of exposed concrete floors.
- C. Section 09 90 00, Painting for general field painting and colors.

1.04 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

1.05 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples for Initial Selection: For each type of finish-coat product indicated.
- C. Samples for Verification: For each type of coating system and in each color and gloss of finish coat indicated.
 - 1. Submit Samples on rigid backing, 8 inches square.
 - 2. Step coats on Samples to show each coat required for system.
 - 3. Label each coat of each Sample.
 - 4. Label each Sample for location and application area.

- D. Product List: For each product indicated. Cross-reference products to coating system and locations of application areas. Use same designations indicated on Drawings and in schedules.

1.06 QUALITY ASSURANCE

- A. MPI Standards:
 - 1. Products: Complying with MPI standards indicated and listed in "MPI Approved Products List."
 - 2. Preparation and Workmanship: Comply with requirements in "MPI Architectural Painting Specification Manual" for products and paint systems indicated.
 - a. For areas to be renovated, comply with requirements in "MPI Maintenance Repainting Manual".
- B. Mockups: Apply benchmark samples of each coating system indicated to verify preliminary selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Architect will select one surface to represent surfaces and conditions for application of each type of coating and substrate.
 - a. Wall and Ceiling Surfaces: Provide samples of at least 100 sq. ft.
 - b. Other Items: Architect will designate items or areas required.
 - 2. Apply benchmark samples after permanent lighting and other environmental services have been activated.
 - 3. Final approval of color selections will be based on benchmark samples.
 - a. If preliminary color selections are not approved, apply additional benchmark samples of additional colors selected by Architect at no added cost to Owner.

1.07 DELIVERY, STORAGE AND HANDLING

- A. Do not deliver materials to site until having received all written approvals of submitted information and samples.
- B. Deliver materials to job site in original, new and unopened packages and containers bearing manufacturer's name and label.
- C. Store materials not in actual use in tightly covered containers in well vented areas with ambient temperatures continuously maintained at not less than 45 deg. F.
- D. Take all precautions to ensure that workers and work areas are adequately protected from fire hazards and health hazards resulting from handling, mixing and application of paints.
- E. Remove rags and waste from storage areas daily.

1.08 PROJECT CONDITIONS

- A. Apply water-base paints only when temperatures of surfaces to be painted and surrounding air temperatures are between 50 and 95 degrees F.
- B. Apply solvent-thinned paints only when temperature of surfaces to be painted and surrounding air temperatures are between 45 degrees F. and 95 degrees F.
- C. Do not apply paint when relative humidity exceeds 85%; at temperatures less than 5 degrees F. above the dew point; or to damp or wet surfaces.

1.09 SEQUENCING AND SCHEDULING

- A. Schedule cleaning and painting so that contaminants from cleaning process will not fall onto newly-painted surfaces.

1.010 EXTRA MATERIALS

- A. Furnish extra materials described below that are from same production run (batch mix) as materials applied and that are packaged for storage and identified with labels describing contents.
 - 1. Quantity: Furnish an additional 5 percent, but not less than 1 gal. of each material and color applied.

1.011 ENVIRONMENTAL REQUIREMENTS

- A. Low-Emitting Materials, Field applied Paints and Coatings: Interior paints and coatings applied on-site must meet the limitations and restrictions concerning chemical components set by the following standards:
 - 1. Topcoat Paints, Green Seal Standard GS-11, Paints: First Edition, May 20, 1993.
 - 2. Anti-Corrosive and Anti-Rust Paints: Green Seal Standard GS-03, Anti-Corrosive Paints", Second Edition, January 7, 1997. For applications on ferrous metal substrates.
 - 3. "All Other Architectural Coatings, Primers and Undercoats: South Coast Air Quality Management District (SCAQMD) Rule #1113, Architectural Coatings", rules in effect on January 1, 2004.

PART 2 - PRODUCTS

2.01 HIGH-PERFORMANCE COATINGS, GENERAL

- A. Material Compatibility:
 - 1. Provide materials for use within each coating system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
 - 2. Provide products of same manufacturer for each coat in a coating system.
- B. Manufacturers:
 - 1. Carboline Company
 - 2. Duron Inc.
 - 3. Tnemec Co., Inc.
 - 4. Or Approved Equal.

2.02 COMPONENTS

- A. Coatings – General: Furnish complete multi-coat systems formulated and recommended by manufacturer for applications indicated, and 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: As selected by Architect from manufacturer's full line of colors.
- B. High-Build Epoxy Coatings:
 - 1. Type 1: Concrete Walls: High Build: Epoxy coating, two coats.
 - a. Percentages of solids by volume: 99 percent minimum.
 - b. Dry Film Thickness: 8 mils, each coat.

- c. Basis of Design Product: Sanitile 755, solvent-free epoxy, manufactured by Carboline Company. 10 mils minimum.
 - d. Basis of Design Primer: Sanitile 755, solvent-free epoxy, manufactured by Carboline Company. 10 mils minimum.
- 2. Galvanized Metal Substrates: Epoxy Coating System:
 - a. Type 2: Galvanized - SP 7
 - b. Prime: Tnemec Series 27WB Typoxy at 4.0-6.0 mdft
 - c. Finish: Tnemec Series 740 Endura Shield at 2.0-3.0 mdft
 - 3. Steel Substrates: Epoxy Coating System:
 - a. Type 3: Steel lined Concrete Bunker Walls (Alternate Bid #5)
 - b. Prime: Tnemec Series 94-H2O at 2.5-3.5 mdft
 - c. Intermediate: Tnemec Series 27 WB at 3.0-5.0 mdft
 - d. Finish: Tnemec Series 740 Endura Shield at 2.0-3.0 mdft
- C. Primers: As recommend by coating manufacturer for specific substrate, unless otherwise specified.
 - D. Material Compatibility:
 - 1. Provide materials for use within each coating system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
 - 2. Provide products of same manufacturer for each coat in a coating system.
 - E. Colors: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of work.
- B. Maximum Moisture Content of Substrates:
 - 1. Concrete: 12 Percent must be cured a minimum of 45 days.
- C. Verify suitability of substrates, including surface conditions and compatibility with any existing finishes and primers.
- D. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.
 - 1. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.

3.02 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Manual" applicable to substrates indicated.
- B. Remove plates, machined surfaces, and similar items already in place that are not to be coated. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and coating.
 - 1. After completing coating operations, reinstall items that were removed; use workers skilled in the trades involved.

- C. Clean substrates of substances that could impair bond of coatings, including dirt, oil, grease, and incompatible paints and encapsulants.
 - 1. Remove incompatible primers and reprime substrate with compatible primers as required to produce coating systems indicated.
- D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces to be coated exceeds that permitted in manufacturer's written instructions.
 - 1. Clean surfaces with pressurized water. Use pressure range of 1500 to 4000 psi at 6 to 12 inches.
 - 2. Prepare per coating manufacturer's recommendations.
- E. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal fabricated from coil stock by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied coatings. Prepare per coating manufacturer's recommendations.

3.03 APPLICATION

- A. Apply high-performance coatings according to manufacturer's written instructions.
 - 1. Use applicators and techniques suited for coating and substrate indicated.
 - 2. Coat surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, coat surfaces behind permanently fixed equipment or furniture with prime coat only.
 - 3. Coat back sides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
 - 4. Apply in uniform thickness coats.
 - 5. Finish edges, crevices, corners and other changes in dimension with full coating thickness.
- B. If undercoats or other conditions show through final coat, apply additional coats until cured film has a uniform coating finish, color, and appearance.
- C. Apply coatings to produce surface films without cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections. Produce sharp glass lines and color breaks.
- D. Concrete: Prior to priming, patch with masonry filler to produce a smooth surface.

3.04 FIELD QUALITY CONTROL

- A. Owner reserves the right to invoke the following procedure at any time and as often as Owner deems necessary during the period when coatings are being applied:
 - 1. Owner will engage the services of a qualified testing agency to sample coating material being used. Samples of material delivered to Project site will be taken, identified, sealed, and certified in presence of Contractor.
 - 2. Testing agency will perform tests for compliance with specified requirements.
 - 3. Owner may direct Contractor to stop applying coatings if test results show materials being used do not comply with specified requirements. Contractor shall remove noncomplying coating materials from Project site, pay for testing, and recoat surfaces coated with rejected materials. Contractor will be required to remove rejected materials from previously coated surfaces if, on recoating with complying materials, the two coatings are incompatible.

3.05 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing coating application, clean spattered surfaces. Remove spattered coatings by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

- C. Protect work of other trades against damage from coating operation. Correct damage by cleaning, repairing, replacing, and recoating, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced coated surfaces.
- E. After coating has cured, clean and replace finish hardware, fixtures and fitting previously removed.

3.06 HIGH-PERFORMANCE COATING SCHEDULE

- A. Concrete Substrates, Vertical Surfaces:
 - 1. Color: Match PT-6
 - a. Color: PT-6
 - 2. Galvanized Metal Substrates: Epoxy Coating System:
 - a. Color: PT-5
 - 3. Steel Substrates: Epoxy Coating System:
 - a. Color: PT-5

END OF SECTION

SECTION 10 14 00

INFORMATION SPECIALTIES

PART 1: GENERAL

1.01 RELATED DOCUMENTS

- A. Conditions of the Contract and portions of Division One of this Project Manual apply to this Section as though repeated herein.

1.02 WORK INCLUDED

- A. Accessibility Signage.

1.03 REFERENCES

- A. All signage shall be in strict accord with Wisconsin Enrolled Commercial Building Code.

1.04 SUBMITTALS

- A. Submit in accordance with the General Conditions of the Contract.
 - 1. Manufacturer's Literature: Materials description, colors, and application instructions.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Provide protective coverings for identifying devices prior to shipping.
- B. Handle and store to prevent damage and soiling.

PART 2: PRODUCTS

2.01 ADA REQUIRED ACCESSIBILITY SIGNAGE

- A. All interior signage must have tactile/Braille lettering and raised pictograms. Braille must be integral to the sign. Taped on Braille is not acceptable.
 - 1. All Braille to be located at the bottom of the sign.
 - 2. When the word "accessible" is used on a sign or when the symbol for accessibility is used, the word accessible must be included in the Braille text.
- B. Basis of Design: Interior Signs.
 - 1. ADA-Ready™, EmBoss Series™, ASI Sign Systems, Inc.
 - a. ADA Signage
 - 2. Graphics: As indicated on drawings.
 - 3. Sizes: As indicated on drawings.
 - 4. Color: 2, to be selected by Architect from Manufacturer's full line.
- C. Manufacturers
 - 1. ASI Sign Systems.
 - 2. Poblocki Sign Company
 - 3. Best Sign Systems Inc.
 - 4. 2/90 Sign Systems

5. Or approved equal.

- D. Provide proper gender symbol at each door leading to a room designed for handicap use (i.e., toilet rooms with grab bars, etc.).

PART 3: EXECUTION

3.01 INSTALLATION

- A. Comply with manufacturer's specifications and recommendations for the installation of identification devices.
- C. Install devices plumb, level and true to line.
- D. Install room and door identification signs at 5 feet from centerline of signs to finished floor.
 - 1. When used in conjunction with accessibility symbol, mount below symbol.

3.02 CLEANING

- A. Clean surfaces of identifying devices, dedication plaque and surrounding surfaces.
- B. Remove protective coatings, if any.

3.03 SIGNAGE SCHEDULE

- A. ADA Signage to be provided at rooms indicated on drawings.

END OF SECTION 10 14 00

SECTION 10 28 00

TOILET, BATH AND LAUNDRY ACCESSORIES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Conditions of the Contract and portions of Division One of this Project Manual apply to this Section as though repeated herein.

1.02 WORK INCLUDED

- A. Commercial Toilet and Bath Accessories

1.03 RELATED WORK

- A. Section 06 10 00, Rough Carpentry: Wall Blocking.

1.04 REFERENCES

- A. All work of this section shall be in strict accord with Wisconsin Enrolled Commercial Building Code.

1.05 SUBMITTALS

- A. Submit in accordance with the General Conditions of the Contract.
 - 1. Manufacturer's technical data.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in original packaging with seals unbroken and bearing manufacturer's name and product.
- B. Store all materials in secure place to prevent damage.
- C. Remove all damaged materials from project immediately.

1.07 ENVIRONMENTAL REQUIREMENTS

- A. Low-Emitting Materials, Adhesives, and Sealants: Materials used on the interior of the building (defined as inside the weatherproofing system and applied on site) must not exceed the following requirements.
 - 1. Adhesives, Sealants and Sealant Primers: South Coast Air Quality Management (SCAQMD) Rule # 1168, requirements in effect on July 1, 2005, and rule amendment date January 7, 2005.
 - 2. Aerosol Adhesives: Green Seal Standard for Commercial Adhesives GS-36, requirements in effect on October 19, 2000.

PART 2 - PRODUCTS

2.01 COMMERCIAL TOILET ACCESSORY MANUFACTURERS

- A. Bobrick Washroom Equipment, Inc.

- B. Kimberly Clark
- C. Bradley Corporation.
- D. Dyson
- E. Excel
- F. American Specialties, Inc.
- G. Neo Metro.
- H. Hospital Specialty Co.
- I. Georgia Pacific
- J. Sloan Jansan
- K. Or approved equal.

2.02 MANUFACTURED COMMERCIAL UNITS

- A. Paper Towel Dispenser, OFCI:
 - 1. Bradley Corp. Paper Towel Dispenser: 2483
 - 2. Or approved equal.
- B. Waste Bin:
 - 1. Bobrick B-43644 Contura Series Recessed Waste Receptacle
 - 2. Or approved equal.
- C. Toilet Roll Holder OFCI:
 - 1. Georgia Pacific Compact Vertical Double Roll Bathroom Tissue Dispenser, Stainless: 56782
 - 2. Or approved equal.
- D. Sanitary Napkin Disposal:
 - 1. Bobrick B-270 ConturaSeries® Surface-Mounted Sanitary Napkin Disposal
 - 2. Or approved equal.
- E. Grab Bars:
 - 1. Bobrick B-6806 Series Grab Bars, lengths as indicated in drawings.
 - 2. Or approved equal.
- E. Mirrors:
 - 1. Bobrick B-165 Series. Stainless Steel Framed: Sizes per drawings.
 - 2. Or approved equal.
- F. Soap Dispenser, OFCI:
 - 1. Sloan Jansan Soap Dispenser: SJS-11503
 - 2. Or approved equal.
- G. Coat Hook
 - 1. Bobrick, B-542, Stainless Steel
 - 2. Or approved equal

2.03 SEALANT

- A. "G-E silicone sealant", General Electric Company.
- B. "Dow Corning 780", Dow Corning Corporation.
- C. "Pecora 826", Pecora Chemical Corporation.

2.04 FASTENERS

- A. Provide all fastening devices including screws, bolts, anchors, and backplates.
- B. Exposed fasteners shall match finish of accessories.

2.05 FABRICATION

- A. Fabricate all toilet and bath accessories of type 302 or 304 stainless steel with satin finish, unless otherwise specified or approved.
- B. All accessories shall be by one manufacturer unless otherwise specified or approved.
- C. Manufacturer's labels or imprinted name shall not be visible.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine surfaces and recesses to receive toilet and bath accessories for dimensions, plumbness, blocking, and other conditions that affect installation.
- B. Do not proceed until conditions are acceptable.

3.02 INSTALLATION

- A. Install toilet and bath accessories according to manufacturer's direction.
- B. All accessories in any one space shall be of matching design and finish. If discrepancies are found, secure Architect's approval before proceeding.
- C. Set all recessed and semi-recessed accessories with continuous seal of sealant, around entire perimeter of all accessories to prevent moisture from reaching substrate.

3.03 ADJUSTING AND CLEANING

- A. Adjust accessories for proper operation.
- B. Replace damaged or defective items.
- C. Clean and polish accessories after removing labels and protective wrapping.
- D. Delivery accessory keys, service, and parts manual in accordance with the General Conditions of the Contract Closeout.

END OF SECTION 10 28 00

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SECTION 10 44 13

FIRE EXTINGUISHERS AND CABINETS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Conditions of the Contract and portions of Division One of this Project Manual apply to this Section as though repeated herein.

1.02 WORK INCLUDED

- A. Stainless Steel Fire Extinguisher Cabinets.
- B. Fire Extinguishers

1.03 RELATED WORK

- A. Rough Carpentry 06 10 00

1.04 SUBMITTALS

- A. Submit in accordance with the General Conditions of the Contract.
 - 1. Product Data: Manufacturer's catalog information and specifications edited to indicate specific extinguishers, cabinets and accessories to be provided for this Project. Include rough opening dimensions and certification of U.L. rating.

1.05 QUALITY ASSURANCE

- A. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."
- B. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.
 - 1. Provide fire extinguishers approved, listed, and labeled by FMG.

1.06 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace fire extinguishers that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Failure of hydrostatic test according to NFPA 10.
 - b. Faulty operation of valves or release levers.
 - 2. Warranty Period: 6 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Stainless-Steel Sheet: ASTM A 666, Type 304.
- B. Transparent Acrylic Sheet: ASTM D 4802, Category A-1 (cell-cast sheet), 3 mm thick, with Finish 1 (smooth or polished).

2.02 FIRE EXTINGUISHER CABINET

- A. Basis of Design: Larsen Manufacturing, Architectural Series, Vertical Duo, clear acrylic door, #4 stainless steel.
 - 1. FX-1: Recessed
 - 2. FX-2: Semi-recessed.
 - 3. FX-3: Surface mounted.

- B. Products: Subject to compliance with requirements products by additional manufacturers that may be incorporated into the Work include the following; submit for approval:
 - 1. J. L. Industries, Inc., a division of Activar Construction Products Group.
 - 2. Kidde Residential and Commercial Division, Subsidiary of Kidde plc.
 - 3. Potter Roemer LLC.

- C. Cabinet Construction: Nonrated and rated same as adjacent structure.
 - 1. Fire-Rated Cabinets: Construct fire-rated cabinets with double walls fabricated from 0.0428-inch-thick, cold-rolled steel sheet lined with minimum 5/8-inch-thick, fire-barrier material. Provide factory-drilled mounting holes.

- D. Semirecessed Cabinet: Cabinet box partially recessed in walls of sufficient depth to suit style of trim indicated; with one-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend). Provide where walls are of insufficient depth for recessed cabinets but are of sufficient depth to accommodate semirecessed cabinet installation.
 - 1. Square-Edge Trim: 1-1/4- to 1-1/2-inch backbend depth.

- E. Cabinet Trim Material: Same material and finish as door.

- F. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.
 - 1. Provide continuous hinge, of same material and finish as trim, permitting door to open 180 degrees.

- G. Accessories
 - 1. Mounting Bracket: Manufacturer's standard steel, designed to secure fire extinguisher to fire protection cabinet, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.
 - a. For FX-3: Kidde Fire Extinguisher Wall Hanger, model to accommodate extinguisher

 - 2. Lettered Door Handle: One-piece, cast-iron door handle with the word "FIRE" embossed into face.

 - 3. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location.
 - a. Identify fire extinguisher in fire protection cabinet with the words "FIRE EXTINGUISHER."
 - 1) Location: Applied to cabinet glazing.
 - 2) Application Process: Decals.
 - 3) Lettering Color: Red.
 - 4) Orientation: Vertical

 - 4. Alarm: Manufacturer's standard alarm that actuates when fire protection cabinet door is opened and that is powered by batteries.

2.03 FABRICATION

- A. Fire Protection Cabinets: Provide manufacturer's standard box (tub) with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated.
 - 1. Weld joints and grind smooth.
 - 2. Provide factory-drilled mounting holes.
 - 3. Prepare doors and frames to receive locks.
 - 4. Install door locks at factory.
- B. Cabinet Doors: Fabricate doors according to manufacturer's standards, from materials indicated and coordinated with cabinet types and trim styles selected.
 - 1. Fabricate door frames with tubular stiles and rails and hollow-metal design, minimum ½ inch thick.
 - 2. Miter and weld perimeter door frames.
- C. Cabinet Trim: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth.

2.04 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces of fire protection cabinets from damage by applying a strippable, temporary protective covering before shipping.
- C. Finish fire protection cabinets after assembly.
- D. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.05 STAINLESS-STEEL FINISHES

- A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
- B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.
 - 1. Run grain of directional finishes with long dimension of each piece.
 - 2. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
 - 3. Directional Satin Finish: No. 4.

2.06 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

- A. Fire Extinguishers: Type, size, and capacity for each fire protection cabinet indicated.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Larsen's Manufacturing MP2, MP5 and MP5-A where indicated or comparable product by one of the following:
 - a. Amerex
 - b. Ansul, Sentry
 - c. Badger Fire Protection; a Kidde company.
 - d. J. L. Industries, Inc.; a division of Activar Construction Products Group.
 - e. Kidde Residential and Commercial Division; Subsidiary of Kidde plc.
 - f. Potter Roemer LLC.
 - g. Tyco
 - 2. Valves: Manufacturer's standard.
 - 3. Handles and Levers: Manufacturer's standard.
 - 4. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B.

- B. Multipurpose Dry-Chemical Type in Steel Container: UL-rated 1-A:10-B:C, 2.5-lb, 2-A:10-B:C, 5-lb and 3-A:40-B:C, 5-lb nominal capacity, with monoammonium phosphate-based dry chemical in enameled-steel container.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine fire extinguishers for proper charging and tagging.
 - 1. Remove and replace damaged, defective, or undercharged fire extinguishers.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Install all items in conformance with manufacturer's directions.
- B. Prepare recesses in wall for fire extinguisher cabinets.
- C. Securely fasten mounting brackets and fire extinguisher cabinets to structure, square and plumb. No gaps are allowed between cabinet edge and wall surface.
- D. Mount fire extinguishers in cabinets or on wall brackets so the top of the extinguisher is not more than 4 feet above the floor.
- E. Clean fire extinguisher cabinet and extinguisher of all dirt, residue, or smudges.
- F. Replace any damaged components; touch-up is not acceptable.

END OF SECTION 10 44 13

SECTION 11 90 01

CRANE

PART 1 GENERAL

1.01 RELATED DOCUMENTS

Conditions of the Contract and portions of Division One of this Project Manual apply to this Section as though repeated herein.

1.02 DESCRIPTION OF THE WORK

Furnish and install a new overhead supported manual crane in the existing transfer station building, including hoist, trolley and appurtenances, start-up/shake-down, system warranty, O&M Manual, and operator training.

1.03 SYSTEM REQUIREMENTS

All equipment sizing and design criteria noted are estimated and subject to change. Contractor shall be responsible, if they are awarded the contract, for the exact sizing and design of all equipment, to be based on the design capacity provided by Owner, including any adjustment or re-design to electrical wire sizing and control devices for their equipment.

Owner will provide structural engineering evaluation of existing pre-engineered metal building beam to determine adequacy of existing structure or need for reinforcing for support of new crane load/support. Contractor is responsible for confirming the fully loaded weight of the equipment they will provide, providing adequate load supports, and structural support and bracing, if required.

The Drawings represent the overall intent of the Owner for this system, however, they may not indicate every detail necessary or required of the waste processing system. Contractor shall include all hardware, devices, and equipment either necessary or required, whether indicated on the plans or not, so that the system as provided is complete and will be fully operational before turning it over to the Owner.

The Owner may entertain modifications to the system in a Contractor's proposal that may result in minor changes in alignment, location, and/or orientation of the system components or changes in equipment size to meet required capacity, however, these changes must be consistent with all of the other proposed building facility modifications.

1.04 WORK INCLUDED

- A. The work included under this section consists of furnishing and installing a new crane system and connecting it to the facility's electrical power connection, and fully testing and providing the system in operating condition as shown on the Drawings and Specifications.
- B. It is the Owner's intent to obtain a complete system. The Contractor shall provide any item at no extra cost that is necessary to provide a complete and operable system as intended by the Drawings, whether or not that item, equipment or feature is shown on the Drawings or described in the Specifications.

1.05 QUALITY ASSURANCE

- A. Each submittal for equipment and system components shall be accompanied by an "Equipment Warranty and Certification Form". The form shall be duly executed by an authorized principal of the manufacturer warranting and certifying that the equipment and system components proposed meets or exceeds the specifications, is suitable for its intended purpose and will provide satisfactory performance at the design criteria/capacity specified. In the event that the

manufacturer is not the supplier, an authorized principal of the supplier shall also execute the equipment warranty and certification form.

- B. All electrical or electronic devices shall be U.L. listed or Factory Mutual listed.

1.06 SUBMITTALS

- A. Contractor shall provide shop drawings prepared by the manufacturer and submitted to the Engineer for review prior to the manufacture of the proposed equipment. A copy of the manufacturer's warranty shall be included with each submittal. Contractor shall provide the required number of submittals at no extra cost to the Owner. In addition, the shop drawings shall include the following:
 - 1. Comprehensive two dimensional CAD drawing of the equipment exterior as viewed from the front and side. Must also include complete control layout showing location of component parts as well as full electrical schematic of control operation.
 - 2. Manufacturer's warranty which shall cover the entire system and be a minimum of one year length from the date of written acceptance of the system by the Owner.
- B. Operating Instruction: For the equipment and controls under this section, Contractor shall submit operation and maintenance manuals. At a minimum these manuals shall include:
 - 1. General equipment function, description, normal and limiting operating characteristics.
 - 2. Installation instructions.
 - 3. Operation instructions, start up procedure, emergency and normal shutdown, and restart procedures.
 - 4. Troubleshooting guide.
 - 5. Assembly and wiring diagrams.
 - 6. List of spare parts on-hand.
- C. Factory Performance Test Data: A qualified technician from the factory shall be provided to instruct representatives of the Owner and the Engineer on proper operation and maintenance. With the permission of the Owner, this work may be conducted in conjunction with the inspection of the installation and system start-up. If during start-up there is an equipment failure due to the manufacturer's design or fabrication of the equipment, additional services shall be provided at no additional cost to the Owner. System start-up shall be completed by a factory technician. This technician should be a direct employee of the manufacturer who has had first hand dealings with the equipment through its production at the factory.
- D. Certifications: Contractor shall furnish the Owner and Engineer with a written certification signed by the manufacturer that the equipment has been properly installed. The form should indicate that all equipment has been operated without fault and that satisfactory operation has been obtained.
- E. Approved Equal: For alternative equipment to be approved equal under this bid, Contractor must submit any alternative equipment to the Engineer as an RAI prior to the bid. To be considered equal the vendor must demonstrate that the alternative equipment has a successful track record, equivalent operating capacity, similar proposed dimensions and is compatible with existing and proposed equipment at the facility.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver a complete system to include all parts listed in submittal approved by Engineer.
- B. Store in a weather-tight building or suitable covering to protect against damage of any nature.

- C. Handle during delivery, storage and installation in a manner to prevent damage of any nature.

1.08 WARRANTY AND GUARANTEES

- A. The supplier of the crane system shall provide all warranty services against defects in materials and workmanship for a minimum of one year from the date of written acceptance of the system by the Owner to the effect that any defective or damaged equipment shall be repaired or replaced without extra cost or obligation to the Owner.

PART 2 PRODUCTS

2.01 CRANE SYSTEM

- A. Hoist: Monorail wire rope hoist with 3 ton capacity, including wire rope drum, heavy-duty disc brakes, hoist motor, gearing, frame, and limit switches. Four (4) Part Reeved Model as manufactured by Yale Hoists or equal.
- B. Trolley: Trolley shall support 3 ton hoist and include trunnion-style block and hook, electronic hoist monitoring card, hoist and trolley controls, and wheels, as manufactured by Yale Hoists or equal.

PART 3 EXECUTION

3.01 GENERAL

- A. All materials and equipment shall be installed as shown on the Drawings and as recommended by the manufacturer.

3.02 INSPECTION AND TESTING

- A. Field supervisor: A factory-trained representative shall inspect the completed installation, make necessary adjustments and instruct Owner and Engineer in the proper care and operation of the equipment, prior to the final acceptance of the system.
- B. Field Test: When the system is complete and ready for operation, then the system shall be inspected and tested for compliance to the contract documents. Test of equipment shall be made by the Contractor in the presence of the Engineer and the Owner. Owner will supply representative waste for the duration of the test. The equipment tests shall include, but will not be limited to the following:
 - 1. Controls: Control primary elements shall be tested to determine satisfactory performance.
 - 2. Inspection: An inspection of all mechanical and electrical equipment, controls, brackets, mountings, seals, conduit, and component features shall be made while the system is being tested to determine performance and compliance with design requirements and the specification.
 - 3. Repairs, adjustments and replacement: Contractor shall make any and all necessary repairs, adjustments and replace any component parts until performance has been demonstrated to the satisfaction of the Owner and Engineer. Contractor shall bear the cost of any repair, adjustment and replacement.

END OF SECTION

SECTION 13 34 19

METAL BUILDING SYSTEMS

PART 1- GENERAL

1.01 RELATED DOCUMENTS

- A. Conditions of the Contract and portions of Division One of this Project Manual apply to this Section as though repeated herein.

1.02 SUMMARY

- A. Pre-engineered metal building including: shop fabricated structural steel building frame; engineering by Metal Building Systems Manufacturer.
- B. Metal wall and sloped roof system including:
 - a. Soffits
 - b. Gutters, downspouts and flashing
 - c. Roof mounted equipment curbs
 - d. Overhead doors and louvers
 - e. Insulation

1.03 RELATED SECTIONS

- A. Section 03 30 00: Cast-in-Place Concrete
- B. Section 05 40 00: Cold Formed Metal Framing
- C. Section 08 11 13: Hollow Metal Doors and Frames
- D. Section 08 34 16: Hangar Doors (Alternate Bid #1)
- E. Section 08 71 00: Door Hardware

1.04 REFERENCES

- A. AISI – Specification for the Design of Cold-Formed Steel Structural Members – 1986 Edition with 1989 Addendum.
- B. AISC – Specification for Structural Steel Buildings – 1999.
- C. AISC – Code of Standard Practice for Steel Buildings and Bridges – 2000.
- D. ASTM A36-00 – Specification for Structural Steel.
- E. ASTM A-153-00 – Specification for Zinc Coated (Hot Dip) on Iron and Steel Hardware.
- F. ASTM A307-00 – Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile.
- G. ASTM A325-00 – Specification for High Strength Bolts for Structural Steel Joists.
- H. ASTM A123-00 – Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

- I. ASTM A653-00 – Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvanealed) by the Hot-Dip Process.
- J. ASTM A490-00 – Specification for Quenched and Tempered Alloy Steel Bolts for Structural Steel Joints.
- K. ASTM A501-99 – Hot Formed Welded and Seamless Carbon Steel Structural Tubing.
- L. ASTM A529-96 – Structural Steel with 50,000 psi Minimum Yield Point.
- M. ASTM A1011-00 – Specification for Hot-Rolled Carbon Steel Sheet and Strip, Structural Quality.
- N. ASTM 792-99 – Specification for Steel Sheet Aluminum Zinc Alloy Coated by the Hot-Dip Process, General Requirements.
- O. ASTM C991-98 – Specification for Flexible Glass Fiber Insulation for Metal Buildings
- P. ASTM E1514-98 – Specification for Structural Standing Seam Steel Roof Panel Systems.
- Q. AWS A2.4-98 – Standard Welding Symbols.
- R. AWS D1.1-2000 – Structural Welding Code – Steel.
- S. AWS D1.3-98 – Structural Welding Code – Sheet Steel.
- T. IBC (International Building Code) – 1604.3.1. Deflections – 2000 Edition.
- U. MBMA Low Rise Building Systems Manual – 1996 Edition.
- V. NAIMA 404-96 – Standard for Flexible Fiberglass Insulation Systems in Metal Buildings.
- W. SJI – Standard Specifications, Load Tables and Weight Tables for Steel Joists and Joist Girders – 1994.

1.05 SUBMITTALS

- A. Contractor will submit the following documents for review:
 - 1. Engineer’s Letter of Certification
 - 2. Permit Drawings
 - 3. Column Reactions
 - 4. Anchor Rod Plan
 - 5. Building Erection Drawings
 - 6. Wall and roof system dimensioned plan with panel layout and general construction details
 - 7. Provide data confirming gutter and downspout sizes provided meet applicable code.
- B. Installation Instructions: Manufacturer will provide installation instructions that indicate preparation requirements and assembly sequence.

1.06 QUALITY ASSURANCE

- A. Fabricate structural steel members in accordance with MBMA Low Rise Building Systems Manual, and, for items not covered, AISC – Specification for Structural Steel for Buildings.

1.07 QUALIFICATIONS

- A. Manufacturer: The Manufacturer shall have a minimum of five (5) years' experience in the manufacture of metal building systems.
- B. Quality System: Manufacturer shall submit a Quality Policy document stating the Manufacturer's commitment to quality.
- C. Licensed Engineer: Structural framing shall be designed by a Professional Engineer licensed in the state in which the Project is located.
- D. Field Measurements: Metal building contractor shall verify that field measurements are as indicated on the drawings.

1.07.1 PRE-INSTALLATION MEETINGS

- A. Refer to Division 1, General Requirements: Pre-installation meeting.
- B. Convene minimum one week prior to commencing work of this Section.

1.08 WARRANTY

- A. Workmanship: Manufacturer's Workmanship Warranty shall be for of 1 year.
- B. Panel Warranty: Manufacturer's Panel Warranty shall be for 20 years.
- C. All nomenclature shall conform to the MBMA Low Rise Building Systems Manual.
- D. Coordination and administration of the work shall be in accordance with the MBMA Low Rise Building Systems Manual – Common Industry Practices.

PART 2-PRODUCTS

2.01 PRE-ENGINEERED METAL BUILDINGS

- A. Manufacturers
 - 1. Basis of Design: Varco-Pruden Buildings (to match existing).
 - 2. Or approved equal.
 - a. Approved equal must demonstrate compatibility between the existing building and the expansion (Scope of the Work under this section).

2.02 SYSTEM DESCRIPTION

- A. Single span rigid frame.
- B. Bay Spacing: As indicated on drawings.
- C. Primary Framing: Rigid frame or 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, to match existing profile, with sub-girt framing/anchorage assembly, insulation, liner sheets and accessory components.

- F. Roof System: Preformed metal panels of upslope profile, to match existing profile, with sub-girt framing/anchorage assembly, insulation, liner sheets and accessory components.
- G. Roof Slope: ½ inch per foot.

2.03 DESIGN REQUIREMENTS

- A. Thermal Resistance of Installed Wall System
 - 1. Toilet Rooms and Control Tower: R-Value as indicated on drawings.
- B. Thermal Resistance of Installed Roof System:
 - 1. Toilet Rooms and Control Tower: R-Value as indicated on drawings.
- 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.
 - 1. Members to withstand the following loads:
 - b. Building system dead loads.
 - c. Live Load: 20 psf, without tributary area load reduction
 - d. Collateral Load: 15 psf
 - e. Refer to Drawings for any additional actual or estimated loads
 - f. Ground Snow Load: 35 psf , Snow Exposure C.
 - g. Wind Velocity: 90 mph , Wind Exposure C.
 - h. Seismic Acceleration: Ss: 11.1%g, S1=4.4%g, Site class to be verified by Geotechnical Engineer.
 - i. MBMA Building Use Category: 2.
 - 2. All loads shall be proportioned and applied in accordance with the latest edition of the MBMA Low Rise Building Systems Manual.
- 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.

2.04 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.

2.05 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.

2.06 COMPONENTS – WALL AND ROOF SYSTEM

- A. Roof Sheet Steel Stock: ASTM A653 galvanized to G90 designation.
- B. Wall Sheet Steel Stock: KYNAR finish.
 1. Sheet Steel Stock: Zinc-aluminum coated to AZ55 designation as required by manufacturer's design.
- C. Joint Seal Gaskets: Manufacturer's standard type.
- D. Fasteners:
 1. Through-fastened System: Panels shall be attached to the secondary framing members by means of a self-drilling structural carbon steel screw with a zinc-alloy head, finished to match roof panel, and assembled with an EPDM washer.
 2. Wall panels shall be attached to the secondary framing members by means of a self-drilling fastener of carbon steel, hex washer head with EPDM bonded washers.
- E. Bituminous Paint: Asphaltic type.
- F. Sealant: Manufacturer's standard type, non-staining, elastomeric, skinning.
- G. Closures: Manufacturer's standard type, unless noted otherwise on drawings.
- H. Trim:

1. Flashings, caps, facias, infills, internal and external corners, closure pieces, and etc. shall be the same material and finish as adjacent material. Profiles shall be Manufacturer's standard. Color to match existing.
2. Continuous closures: Provide weathertight, sheet metal closure where building abuts existing construction. Closure to match color and material of roof panels. Allow for thermal movement and differential settlement between building and existing construction.

I. Metal Personnel Doors and Frames:

1. Refer to Section 08 11 13 for hollow metal doors and frames.
2. Door jambs shall be constructed for non-hand installation.
3. Door frames shall be provided with head and jamb flashing and optional weather strip.
4. See Section 08 71 00 for door hardware. Coordinate keying with User.
5. Door threshold shall be aluminum, supplied with flat head screws and expansion shields for attachment to concrete floor.

J. Sectional Overhead Doors: Refer to Section 08 36 13: Sectional Overhead Doors.

K. Sliding Hangar Doors: Refer to Section 08 34 16: Hangar Doors (Alternate Bid #1).

L. Translucent Panels:

1. Panels shall be Type I glass fiber reinforced resin.
2. Light Transmission: submit samples for Architect review.
3. Exposed exterior surfaces of panel chemically and permanently treated to protect against surface erosion and extreme weather conditions.

M. Interior Metal Liner Panel:

1. Metal building contractor to provide Interior metal liner panel at all locations noted on drawings.

2.07 FABRICATIONS - PRIMARY FRAMING

- A. Framing Members: Clean in accordance with SSPC-SP2, prepare, and coat with Manufacturer's standard primer.
- B. Hot rolled members shall be fabricated in accordance with AISC Specification for pipe, tube, and rolled structural shapes.
- C. Fabricate built-up members in accordance with MBMA Low Rise Building Systems Manual, Common Industry Practices.
- D. Anchor Bolts: Formed with bent shank, assembled with template for casting into concrete.
- E. Provide framing for all openings.

2.08 FABRICATION – WALL AND ROOF FRAMING

- A. Framing Members: Clean in accordance with SSPC-SP2, prepare, and coat with Manufacturer's standard primer.
- B. Cold Formed Members: Cold formed shapes shall be fabricated in accordance with MBMA Low Rise Building Systems Manual, Common Industry Practices.
- C. Galvanizing for Nuts, Bolts ad Washers: ASTM A153.

2.09 FABRICATION - WALL AND ROOF SYSTEMS

- A. Siding: Minimum 26 gauge metal thickness. Profile as selected by Architect (to match existing condition). Lapped edges fitted with continuous gaskets.
- B. Roofing: Machine seamed standing seam roof.
 - 1. Quadlock with a continuous bead of factory-installed caulk in the seam.
 - 2. Minimum 24 gauge thickness
 - 3. Profile as selected by Architect from manufacturer's full line (to match existing).
- C. Interior Metal Liner Panel:
 - 1. Minimum 26 gauge metal thickness, manufacturer's standard width. Lapped edges
 - 2. Profile as selected by Architect from manufacturer's full line.
 - 3. Color as selected from Manufacturer's full line.
- D. Girts and Purlins: Rolled formed structural shape to receive siding, roofing and liner panel.
- E. Internal and External Corners:
 - 1. Same material thickness and finish as adjacent material.
 - 2. Profile shop cut and factory mitered to required angles.
 - 3. Back brace mitered internal corners with 22 gauge thick sheet.
- F. Expansion Joints: Same material and finish as adjacent material where exposed. Provide manufacturer's standard brake formed type of profile to match siding system.
- G. Fasteners:
 - 1. Provide to maintain load requirements and weather tight installation.
 - 2. Provide same finish as cladding.
 - 3. Non-corrosive type.
- H. Wall Louver: As specified in Division 23.

2.09 FABRICATION – GUTTER

- A. Fabricate gutters of same material and finish as roofing metal.
- B. Form gutters and downspouts of profile and size indicated to collect and remove water.
 - 1. Fabricate with connection pieces.
- C. Form sections in maximum possible lengths. Hem exposed edges. Allow for expansion at joints
- D. Fabricate gutter support straps of Manufacturer's standard material and finish.

2.10 FACORY FINISHING

- A. Exterior surfaces of wall and roof components and accessories to be pre-coated enamel on steel of modified silicon finish.
 - 1. Color as selected by Architect from manufacturer's full range (to match existing).
 - 2. Exterior colors shall match Varco Pruden Panel Colors as follows:
 - a. Exterior Metal Wall Panel Upper Panels: Cool Weathered Copper to match existing.
 - b. Exterior Metal Wall Panel Lower Panels: Cool Sierra Tan to match existing.

- c. Trim (eaves, gutters, downspouts, corner trim and base trim, etc.) Cool Artic White to match existing.
 - d. Doors: Tan Finalcoat to match existing.
- B. Vapor retarder at inter face of insulation (at Toilet Rooms and Control Tower) to be sheet vinyl, 6-mil thick.

PART 3 – EXECUTION

3.01 EXAMINATION:

- A. Verify that placed anchor rods are in correct position.
- B. Provide access to the work as scheduled for Owner provided inspections, if required. The cost of any required inspection is the responsibility of the Contractor.

3.02 ERECTION – FRAMING

- A. Erect framing in accordance with MBMA Low Rise Building Systems Manual, Common Industry Practices.
- B. The Erector shall furnish temporary guys and bracing where needed for squaring, plumbing, and securing the structural framing against loads, such as wind loads acting on the exposed framing and seismic forces, as well as loads due to erection equipment and erection operation, but not including loads resulting from the performance of work by others. Bracing furnished by the Manufacturer for the metal building system cannot be assumed to be adequate during erection. The temporary guys, braces, falseworks and cribbing are the property of the Erector, and the Erector shall remove them immediately upon completion of erection.
- C. Do not cut or alter structural members without approval of the Manufacturer.
- D. After erection, prime welds, abrasions, and surfaces not shop primed.

3.03 ERECTION – WALL AND ROOFING SYSTEMS

- A. Install in accordance with Manufacturer's instructions.
- B. Exercise care when cutting pre-finished material to ensure cuttings do not remain on finish surface.
- C. Fasten cladding to structural supports, aligned level and plumb.

3.04 ERECTION – GUTTER

- A. Rigidly support and secure components.
- B. Joint lengths with formed seams sealed watertight.
- C. Flash and seal gutters to downspouts.
- D. Apply bituminous paint on surfaces in contact with cementitious materials.
- E. Slope gutters minimum 1/8 –inch/ft.
- F. Connect downspouts to storm sewer system.

G. Install gutters downspouts in strict accordance with Manufacturer's instructions.

3.05 TOLERANCES

A. All work shall be performed in a workmanlike manner.

B. Install framing in accordance with MBMA Low Rise Building Systems Manual, Common Industry Practices.

END OF SECTION 13 34 19

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SECTION 21 05 00
COMMON WORK RESULTS FOR FIRE-SUPPRESSION

PART 1 - GENERAL

SCOPE

This section includes information common to two or more technical fire protection specification sections or items that are of a general nature, not conveniently fitting into other technical sections. Included are the following topics:

PART 1 - GENERAL

- Scope
- Related Work
- Related Documents
- Regulatory Requirements
- Reference Standards
- Quality Assurance
- Abbreviations and Symbols
- Definitions
- Coordination
- Continuity of Existing Services
- Protection of Finished Surfaces
- Sleeves and Openings
- Sealing and Firestopping
- Off Site Storage
- Submittals
- Operating and Maintenance Instructions
- Record Drawings
- Testing
- Cleaning
- Warranty

PART 2 - PRODUCTS

- Pipe Penetrations
- Identification
- Equipment Accessories
- Gauges
- Sealing and Firestopping

PART 3 - EXECUTION

- Demolition
- Openings, Cutting and Patching
- Building Access
- Equipment Access
- Coordination of Work
- Pipe Penetrations
- Identification
- Sleeves

RELATED WORK

Provisions of Division 01 shall govern work under this Section.

This section applies to all Division 21 Sections of Fire Suppression.

REGULATORY REQUIREMENTS

Refer to Division 01 of the Project Manual.

Codes and Standards:

Fire Protection work shall conform to the requirements of Wisconsin Building Code (COMM), NFPA Standards, and local regulations regarding design, materials and installation.

Materials and workmanship shall comply with applicable Codes, local ordinances, industry standards and utility regulations. In case of differences between Codes, and the Contract Documents, the most stringent shall govern.

Non-Compliance:

Should the Contractor perform any work that does not comply with the above requirements, he shall bear all costs necessary to correct the deficiencies.

Permits, Inspections, and Fees:

Request and obtain permits and inspection appointments.

Provide fees and charges for approvals, reviews, or other inspections.

Include copies of the certificates in the Operating and Maintenance Instructions.

Fees and charges assessed by local utilities for water or other services shall be included in the bid.

REFERENCE STANDARDS

Abbreviations of standards organizations referenced in this and other sections are as follows:

ANSI	American National Standards Institute
ASME	American Society of Mechanical Engineers
ASPE	American society of Plumbing Engineers
ASTM	American Society for Testing and Materials
AWWA	American Water Works Association
CS	Commercial Standards, Products Standards Sections, Office of Engineering Standards Service, NBS
EPA	Environmental Protection Agency
FM	Factory Mutual System
FS	Federal Specifications, Superintendent of Documents, U.S. Government Printing Office
IAPMO	International Association of Plumbing & Mechanical Officials
IEEE	Institute of Electrical and Electronics Engineers
ISA	Instrument Society of America
MCA	Mechanical Contractors Association
MSS	Manufacturer's Standardization Society of the Valve & Fitting Industry, Inc.
NBS	National Bureau of Standards
NEC	National Electric Code
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association
UL	Underwriters Laboratories Inc.

QUALITY ASSURANCE

Substitution of Materials: Refer to Division 01 of the Project Manual.

All products and materials used are to be new, undamaged, clean and in good condition. Existing products and materials are not to be reused unless specifically indicated.

Where equipment or accessories are used which differ in arrangement, configuration, dimensions, ratings, or engineering parameters from those indicated on the contract documents, the contractor is responsible for all costs involved in integrating the equipment or accessories into the system and for obtaining the intended performance from the system into which these items are placed.

ABBREVIATIONS AND SYMBOLS

Key to abbreviations and symbols shall be on the Drawings.

The following are additional abbreviations used in the Specifications:

A/E	Architect/Engineer
GC	General Contractor
PC	Plumbing Contractor
FPC	Fire Protection Contractor
HC	Heating Ventilating and Air Conditioning Contractor
EC	Electrical Contractor

DEFINITIONS

Furnish:

Supply and deliver to Project site ready for unpacking, assembly and installation

Install:

Operations at Site including unpacking, assembling, erecting, placing, anchoring, applying, finishing, cleaning, and connecting related devices required for product fully functional for intended use after installation.

Provide:

Furnish and install, such that product is fully functional for intended use.

COORDINATION

The Drawings show the general arrangement of piping and equipment and shall be followed as closely as actual building construction and the work of other trades permits. Architectural and Structural Drawings shall take precedence. Because of the scale of the Drawings, it is not possible to indicate all offsets, fittings, and accessories which may be required. Investigate conditions affecting the Work and arrange accordingly, providing offsets, fittings and accessories as may be required to meet conditions.

CONTINUITY OF EXISTING SERVICES

Refer to Division 01 of the Project Manual.

Do not interrupt or change existing services without prior written approval from the Owner's Project Representative. When interruption is required, coordinate scheduling of down-time with the Owner to minimize disruption to his activities. Unless specifically stated, all work involved in interrupting or changing existing services is to be done during normal working hours.

PROTECTION OF FINISHED SURFACES

Refer to Division 01, of the Project Manual.

SEALING AND FIRESTOPPING

Sealing and firestopping of sleeves/openings between piping, etc. and the sleeve or structural opening shall be the responsibility of the contractor whose work penetrates the opening. The contractor responsible shall hire individuals skilled in such work to do the sealing and fireproofing. These individuals hired shall normally and routinely be employed in the sealing and fireproofing occupation.

OFF SITE STORAGE

Refer to Division 01 of the Project Manual.

SUBMITTALS

Refer to Division 01, of the Project Manual.

Submit shop drawings with space for approval stamps of GC and A/E.

Refer to Division 01, of the Project Manual.

Not more than two weeks after award of contract but before any shop drawings are submitted, contractor to submit the following fire protection system data sheet. List piping material types, ASTM number, schedule or pressure class, joint type, manufacturer and model number where appropriate. List valves, specialties and equipment with manufacturer and model number. The approved fire protection system data sheet(s) will be made available to the Owners Project Representative for their use on this project.

FIRE PROTECTION SYSTEM DATA SHEET

<u>Item</u>	<u>Pipe Service/Sizes</u>	<u>Manufacturer/Model No.</u>	<u>Remarks</u>
Pipe			
Fittings			
Hangers & Supports			
Sprinkler Heads			
Valves			
Specialty Valves			
Pipe Specialties			
Fire Protection Specialties			
Fire Protection Equipment			

Shop drawing submittals are to be bound in a three ring binder, labeled, contain the project manual cover page and a material index list page showing item designation, manufacturer and additional items supplied with the installation. Submit for all equipment and systems as indicated in the respective specification sections, marking each submittal with that specification section number. 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 the contract documents. Include wiring diagrams of electrically powered equipment.

Submittals shall be sent to the local Fire Chief or Fire Marshal for review prior to the Architect/Engineer. Include copy of approval letter in submission to Architect/Engineer.

Submit plans indicating water supply location and size, piping layout and size, sprinkler locations and type, hanger locations and type, equipment locations and type, valve locations and type, occupancy classes, hydraulic reference points, design areas and discharge densities.

Submit hydraulic calculations for water supply and sprinkler systems. Include summary sheet and detailed work sheets. Describe characteristics of water supply and location of effective point used in calculations. Include graph illustration of water supply, hose demand, sprinkler demand.

Submit sufficient quantities of data sheets and shop drawings to allow the following distribution:

- Operating and Maintenance Manuals 2 copies
- Architect/Engineer 2 copies
- Local Fire Chief or Marshal 1 copy

Firestop Systems:

Contractor shall submit product data for each firestop system. 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. For non-standard conditions where no UL tested system exists, submit manufacturer's drawings for UL system with known performance for which an engineering judgement can be based upon.

OPERATING AND MAINTENANCE INSTRUCTIONS

Refer to Division 01 of the Project Manual.

Assemble material in three-ring or post binders, using an index at the front of each volume and tabs for each system or type of equipment. In addition to the data indicated in the General Requirements, include the following information:

- Copies of all approved submittals along with approval letters.
- Manufacturer's wiring diagrams for electrically powered equipment.
- Records of tests performed to certify compliance with system requirements.
- Certificates of inspection by regulatory agencies.
- Parts lists for equipment and specialties.
- Manufacturer's installation, operation and maintenance recommendations for equipment and specialties.
- Valve schedules
- Lubrication instructions, including list/frequency of lubrication
- Warranties
- Additional information as indicated in the technical specification sections

RECORD DRAWINGS

Refer to Division 01 of the Project Manual.

In addition to the data indicated in the General Requirements, maintain fire protection layout record drawings and hydraulic calculations on originals prepared by the installing contractor/subcontractor. Include copies of these record drawings and calculations with the Operating and Maintenance manuals.

TESTING

Equipment, material and labor required for testing, shall be provided by the Contractor.

Contractor shall notify Inspector(s) one day prior to the time when the test is ready to be performed. Contractor shall notify the A/E of date and time for tests.

After the test, indicate in writing the time, date, name and title of the person approving the test. This shall also include the description and what portion of the system has been tested. The person approving the test shall sign the certification.

Records shall be maintained of testing that has been completed, and shall be made available at the job site to authorities.

Upon completion of the work, records and certifications approving testing requirements shall be submitted.

Defective work or material shall be replaced or repaired, and the test repeated. Repairs shall be made with new materials.

CLEANING

Contractor shall keep the premises broom clean and free of all surplus materials, rubbish and debris which is caused by his employees or resulting from his work.

Foreign matter shall be blown out, or flushed out, of pipes, tanks, pumps, strainers, motors, devices, switches, and panels.

Identification plates on equipment shall be free of paint and dirt.

The Contractor shall leave his portion of the work ready for operation.

WARRANTY

Warrant that work functions for one year following acceptance of the system(s).

The Contractor shall keep the system in good working order at no expense, unless defects are clearly the result of improper or abnormal usage.

The Contractor shall submit to the A/E upon request for acceptance of the work, written certification that the entire system has been installed and adjusted for operation in accordance with the Contract Documents.

PART 2 - PRODUCTS

ELECTRICAL REQUIREMENTS

General:

Work shall conform to requirements of Division 26.

Provide wiring diagrams.

PIPE PENETRATIONS

Refer to Division 01 requirements as well as the following.

Fire, Smoke And Fire/Smoke Rated Surfaces:

3M CP 25N/S or CP 25S/L caulk, 3M FS 195 wrap/strip with restricting collar, 3M CS 195 composite sheet, Pipe Shields Inc. Series F fire barrier kits, Proset Systems fire rated floor and wall penetrations, Insta-Foam Products Insta-Fire Seal Firestop Foam or Dow Corning Fire Stop System.

All fire stopping systems shall be provided by the same manufacturer.

UL listed or tested by independent testing laboratory, approved by State and Local Code jurisdictions.

Use product that has a 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.

Sleeves in concrete to be Schedule 40 steel pipe with integral water stop unless fire stop material used includes a sleeve that is an integral part of rated assembly.

Use firestop putty, caulk sealant, intumescent wrapstrips, intumescent firestop collars, firestop blocks, firestop mortar or a combination of these products to provide a UL listed system for each application required for this project. Provide mineral wool backing where specified in manufacturer's application detail.

Non-Rated Surfaces:

Stamped steel, chrome plated, hinged, split ring escutcheons or floor/ceiling plates for covering openings in occupied spaces.

In exterior wall openings below grade, use modular mechanical type seal consisting of interlocking synthetic rubber links shaped to continuously fill the annular space between the un-insulated pipe and cored opening or a water-stop type wall sleeve.

At interior partitions where pipe penetrations are sealed, use Tremco Dymonic, Sika Corp. Sikaflex 1a, Sonneborn Sonolastic NPI, or Mameco Vulkan 116 urethane caulk to effectively seal. Use galvanized sheet metal sleeves in hollow wall penetrations.

PIPING AND VALVE IDENTIFICATION

Manufacturers:

Setonply © Style 2060 by Seton Name Plate Company or Emedolite Style EIP by EMED Co., or equal by W. H. Brady.

Pipe Identification:

Pipe identification shall conform to ANSI A13.1 "Scheme for Identification of Piping Systems".

Printed labels identifying the fluid conveyed and direction of flow shall be attached to pipes in accessible locations, at intervals not to exceed 20 feet, not less than once in each room, at each branch, adjacent to each access door or panel, at each valve and where exposed piping passes through walls and floors.

Outside Diameter of Pipe Covering	Minimum Size of Letters
up to 1¼"	½"
1½" to 2"	¾"
2½" to 6"	1½"

Manufacturers:

EMED Co., Seton Name Plate Company, or W. H. Brady.

Stencils:

Not less than 1 inch high letters/numbers for marking pipe and equipment.

Valve Tags:

Identify each valve by means of 1½" diameter brass tag fastened to body of valve with copper or brass chain. Identification number shall be stamped thereon with letters a minimum of ½" high. System identification abbreviation shall be stamped with letters a minimum of ¼" high.

The following prefixes shall be used:

SPKR - Sprinklers

Manufacturers:

EMED Co., Seton Name Plate Company, or W. H. Brady.

Valve Charts:

Furnish three charts listing each valve. Two charts shall be delivered to A/E. An additional chart shall be framed behind glass and hung in location selected by Owner. Charts shall show the following:

Valve number	Size
Manufacturer	Type of valve
Type of service	Location

Furnish typewritten chart indicating equipment or areas served by each numbered valve and incorporate in Operating and Maintenance Manuals.

EQUIPMENT ACCESSORIES

Provide equipment accessories, connections, and incidental items.

Install piping connecting to pumps and other equipment without strain at the piping connection. If requested by the A/E, remove the bolts in these flanged connections, or disconnect piping, to demonstrate that piping has been properly connected.

GAUGES

Acceptable Manufacturers:

American, Taylor, Terrice, U.S. Gauge, Weiss, or Winters Instruments.

Pressure Gauges:

Industrial quality with phosphor bronze bourdon tube, brass socket, 3½ inch dial face, bronze bushed movement, aluminum case with black finish, white background, black figures readable by person standing on floor.

Ranges shall be as follows:

Fire Protection Water:
0 to 200 psig

PART 3 - EXECUTION

GENERAL

Coordination Of Work:

Review the complete set of Drawings and Specifications and report discrepancies to the A/E. Obtain written instructions for changes necessary. Coordinate with each trade prior to beginning installation and make provisions to avoid interferences. Changes required caused by neglect to coordinate shall be made without expense to the project.

Piping shall not be located above electrical panels.

Anchor Bolts, Sleeves, and Supports:

These items required for the Work shall be furnished by the FPC for proper installation of his work. They shall be installed (except as otherwise specified) by the trade furnishing and installing the material in which they are to be located. Location of anchor bolts, sleeves, inserts and supports shall be directed by the trade requiring them. Expense resulting from the improper location or installation of anchor bolts, sleeves, inserts and supports shall be paid for by the Contractor for the trade with responsibility for directing their proper location.

Adjustments In Locations:

Locations of pipes and equipment, shall be adjusted to accommodate the work interferences anticipated and encountered. Prior to fabrication determine the exact route and location of each pipe (subject to A/E's approval).

Right Of Way:

New lines which pitch shall have the right-of-way over those which do not pitch. For example: Gravity drains shall normally have right-of-way. Lines whose elevations cannot be changed shall have the right-of-way over lines whose elevations can be changed. Notify A/E and other trades of conflicts.

Offsets, transitions and changes in direction of electrical raceways, pipes, and ducts shall be made to maintain proper room and pitch of sloping lines whether or not indicated on the Drawings.

DEMOLITION

Perform all demolition as indicated on the drawings to accomplish new work. Where demolition work is to be performed adjacent to existing work that remains in an occupied area, construct temporary dust partition to minimize the amount of contamination of the occupied space. Where pipe is removed and not reconnected with new work, cap ends of existing services as if they were new work. Coordinate work with the Owner to minimize disruption to the existing building occupants.

All pipe, sprinklers, equipment, wiring, associated conduit and similar items demolished, abandoned, or deactivated are to be removed from the site by the Contractor except as specifically noted otherwise. All designated equipment is to be turned over to the Owner for his use at a place and time he so designates. Maintain the condition of material and/or equipment that is indicated to be reused equal to that existing before work began.

OPENINGS, CUTTING AND PATCHING

Refer to Division 01 requirements.

The FPC may perform core drilling for openings in existing walls and floors at the direction of the A/E. Framed openings shall be by the GC.

BUILDING ACCESS

Arrange for the necessary openings in the building to allow for admittance of all apparatus. When the building access was not previously arranged and must be provided by this contractor, restore any opening to its original condition after the apparatus has been brought into the building.

EQUIPMENT ACCESS

Install all piping, valves, and accessories to permit access to equipment for maintenance. Coordinate the exact location of wall and ceiling access panels and doors with the General Contractor, making sure that access is available for all equipment and specialties. Where access is required in plaster walls or ceilings, furnish the access doors to the General Contractor.

Accessible ceilings, (i.e. lay-in ceilings) do not require access panels. Provide color coded thumb tacks or screws, depending on surface, for use in accessible ceilings.

COORDINATION OF WORK

Install systems, equipment and piping in cooperation with other trades. Locations of pipes, equipment, fixtures, etc., shall be adjusted to accommodate the work interferences anticipated and encountered. Prior to fabrication determine the exact route and location of each pipe (subject to A/E's approval).

Any work that is not coordinated and that interferes with other contractor's work shall be removed or relocated at the installing contractor's expense.

Verify that all devices are compatible for the type of construction and surfaces on which they will be used.

Offsets, transitions and changes in direction of electrical raceways, pipes and ducts shall be made as required whether or not indicated on the Drawings.

Provide appropriate sections of work with required wall, roof and floor opening locations and dimensions. If Contractor neglects to coordinate information, openings shall be the responsibility of Contractor.

PIPING INSTALLATION

Installation Arrangement:

Install work to permit removal (without damage to other parts) of parts requiring replacement or maintenance. Arrange pipes and equipment to permit ready access to valves, cocks, traps, starters, motors, and control components and to clear the openings of swinging and overhead doors and of access panels.

Connections Different From Those Shown:

Where equipment requiring different arrangement or connections from those shown is used, install the equipment to operate properly and in harmony with the intent of the Drawings and Specifications. When requested by the A/E, submit drawings showing the proposed installation.

Upon approval of the revisions, make changes in piping, ductwork, supports, insulation, wiring, and panelboards. Provide additional motors, controllers, valves, fittings and other additional equipment required for the proper operation of the system resulting from the selection of equipment, including required changes in affected trades. The Contractor shall be responsible for the proper location of rough-in and connections by other trades.

Changes shall be made at no increase in the Contract amount or additional cost to the other trades.

SLEEVES

Provide galvanized sheet metal sleeves for fire rated pipe penetrations through interior and exterior walls to provide a backing for sealant or firestopping. Patch wall around sleeve to match adjacent wall construction and finish. Grout area around sleeve in masonry construction. In finished spaces where pipe penetration through wall is exposed to view, sheet metal sleeve shall be installed flush with face of wall. In existing poured concrete walls where penetration is core drilled, pipe sleeve is not required. Grout holes directly around steel pipe.

In all piping floor penetrations, fire rated and non-fire rated, top of sleeve shall extend 3/4 inch above the adjacent finished floor. 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. If the pipe penetrating the sleeve is supported by a pipe clamp resting on the sleeve, weld a collar or struts to the sleeve that will transfer weight to existing floor structure.

PIPE PENETRATIONS

General:

Coordinate location of building surface penetrations with appropriate contractors. Furnish sleeves, inserts, and devices to be built into structure to contractor performing Work. Prepare Shop Drawings for approval for penetrations of structural elements, including floor slabs, shear walls, and bearing walls. Do not allow penetrations to be made until Shop Drawings are approved.

Fire Rated Surfaces:

Install products in accordance with the manufacturer's instructions where pipe penetrates a fire rated surface. When pipe is insulated, use product that maintains integrity of insulation and vapor barrier. Where sleeve must be installed in existing floor, grout area around sleeve to restore floor integrity. In wet area floor penetration, top surface of penetration to be 2 inches above adjacent floor with additional height obtained by means of concrete pad poured integral with floor.

Non-Rated Surfaces:

Install escutcheons or floor/ceiling plates where pipe penetrates non-fire rated surfaces in occupied spaces. Size units to accommodate insulation, where applicable. Escutcheons are not required when insulation completely covers wall opening and insulation end is trimmed in a neat manner. Occupied spaces for this Paragraph include only those rooms with finished ceilings and penetration occurs below ceiling.

Install galvanized sheet metal sleeve in hollow wall penetrations to provide backing for sealant. Apply sealant to both sides of penetration in a manner that annular space between pipe sleeve and pipe or insulation is completely blocked.

Completely seal (or caulk) around pipe penetrations through non-rated, smoke tight corridor walls in healthcare facilities. Refer to architectural drawings for additional information.

Completely seal pipe penetrations, as specified below, for walls of the following rooms below:

- Toilet rooms.

ESCUTCHEON PLATES

Provide plates on pipes passing through finished floors, walls and ceilings, with outside diameter to cover sleeve opening and inside diameter to fit snugly around pipe. Set tight to building surface. Escutcheon plates shall be chromium plated metal.

PAINTING

Refer to Division 09.

IDENTIFICATION

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. Use a primer where necessary for proper paint adhesion.

Where stenciling is not appropriate for equipment identification, engraved name plates may be used.

Identify interior piping mains not less than once every 25 feet, not less than once in each room, adjacent to each access door or panel, and on both sides of the partition where exposed piping passes through walls or floors. Place flow directional arrows at each pipe identification location. Use one coat of black enamel against a light background or white enamel against a dark background or approved pipe marking label systems.

Identify valves with signs per NFPA rulings.

Provide hydraulic design information sign of permanently marked weatherproof metal or engraved nameplate material. Secure to main fire risers/valves with brass chain. Information to include location of the design areas, discharge densities, required flow and residual pressure at the base of riser, hose stream demand and sprinkler demand.

END OF SECTION

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SECTION 21 05 29
HANGERS AND SUPPORTS FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT

PART 1 - GENERAL

SCOPE

This section includes specifications for supports of all fire protection equipment and materials as well as piping system anchors. Included are the following topics:

PART 1 - GENERAL

- Scope
- Related Work
- Reference Standards
- Quality Assurance
- Description
- Design Criteria
- Submittals

PART 2 - PRODUCTS

- Manufacturers
- Structural Supports
- Pipe Hangers and Supports
- Beam Clamps
- Riser Clamps
- Concrete Inserts
- Anchors
- Corrosive Atmosphere Coatings

PART 3 - EXECUTION

- Installation
- Hanger and Support Spacing
- Riser Clamps
- Concrete Inserts
- Anchors

RELATED WORK

Provisions of Division 01 shall govern work under this Section.

Division 03 - Concrete

Section 21 05 00 – Common Work Results for Fire-Suppression

Section 21 10 00 – Water-Based Fire-Suppression Systems

REFERENCE STANDARDS

MSS SP-58

MSS SP-69

NFPA 13 Installation of Sprinkler Systems (Latest prevailing addition).

UL Underwriters' Laboratories Listed.

FM Factory Mutual Approved

QUALITY ASSURANCE

Substitution of Materials: Refer to Division 01 of the Project Manual.

DESCRIPTION

Provide all supporting devices as required for the installation of mechanical equipment and materials. All supports and installation procedures are to conform to the latest requirements of the ANSI Code for building piping.

Do not hang any mechanical item directly from a metal deck or run piping so its rests on the bottom chord of any truss or joist.

Fasteners depending on soft lead for holding power or requiring explosive powder actuation will not be accepted.

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.

DESIGN CRITERIA

Materials and application of pipe hangers and supports shall be in accordance with MSS Standard Practice SP-58 and SP-69 unless noted otherwise.

Materials and application of pipe hangers and supports shall be in accordance with NFPA rulings and be UL/FM listed and approved.

SUBMITTALS

Submit data in accordance with Section 21 05 00 and Division 01 of the Project Manual.

Schedule of all hanger and support devices indicating attachment methods and type of device for each pipe size and type of service. Provide details on the working drawings submitted for approval with all pertinent information listed.

PART 2 - PRODUCTS

MANUFACTURERS

B-Line, Fee and Mason, Grinnell, Hilti, Michigan Hanger, Pate, PHD Manufacturing, Piping Technology, Powers/Rawl, Proset, Roof Products & Systems, Unistrut, or Victaulic.

STRUCTURAL SUPPORTS

Provide all supporting steel required for the installation of mechanical equipment and materials, including angles, channels, beams, etc. to suspended or floor supported tanks and equipment. All of this steel may not be specifically indicated on the drawings.

PIPE HANGERS AND SUPPORTS

Hangers for Pipe Sizes 1/2" through 4":

Carbon steel, adjustable swivel ring with 3/8" min. UL/FM approved hanger rods. B-Line B3170NF, Grinnell 69 or 70.

Carbon steel, adjustable clevis, standard, with UL/FM approved size hanger rods. B-Line B3100, Grinnell 260.

Hangers for Pipe Sizes 4" Through 8":

Carbon steel adjustable swivel ring with 1/2" min. UL/FM approved hanger rods. B-Line B3170NF, Grinnell 69 or 70.

Carbon steel, adjustable clevis, standard with UL/FM approved size hanger rods. B-Line B3100, Grinnell 260.

Multiple or Trapeze Hangers:

Manufactured steel channel system with manufacturers slotted interlocking pipe clamps with screw/nut securing and threaded hanger rods or steel channels with welded spacers and threaded hanger rods.

Steel channel, 12-gauge thickness, Dura-Green epoxy coating, B-Line B11. Restrain individual pipes with B-Line B2000 series or Vibraclamp series strut clamps.

Wall Support:

Carbon steel welded bracket with hanger. B-Line 3060 Series, Grinnell 190 Series.
Steel channels with pipe clamps.

Vertical Support:

Carbon steel riser clamp. B-Line B3373, Grinnell 261 for above floor use. Grinnell 40 with bolts and concrete anchors for attachment to underside of concrete floor deck.

Floor Support:

Carbon steel pipe saddle, stand and bolted floor flange. B-Line B3088T/B3093.

Copper Pipe Supports:

All supports, fasteners, clamps, etc. directly connected to copper piping shall be copper plated or polyvinylchloride coated. Where steel channels are used, provide flexible elastomeric/thermoplastic isolation cushion material to completely encircle the piping and avoid contact with the 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.

PIPE HANGER RODS

Steel Hanger Rods:

Threaded both ends, threaded one end, or continuous threaded, complete with adjusting and lock nuts. Steel, electro-plated, threads on both ends, B-Line B3205

Size rods for individual hangers and trapeze support as indicated in the following schedule:

Pipe Size:	Diam. Of Rod:
Up to and Including 4"	3/8" or 9.5mm min.
5",6" and 8"	1/2" or 12.7mm min.

BEAM CLAMPS

MSS SP-69 Types 19 & 23 malleable black iron clamp for attachment to beam flange to 0.62 inches thick with a retaining ring and threaded rod of 3/8, 1/2, and 5/8 inch diameter. Furnish with a hardened steel cup point set screw. B-Line B3036L/B3034, Grinnell 86/92.

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. B-Line B3054, Grinnell 228.

CONCRETE INSERTS

Poured in Place:

MSS SP-69 Type 18 wedge type to be constructed of a black carbon steel body with a removable malleable iron nut that accepts threaded rod to 7/8 inch diameter. Wedge design to allow the insert to be held by concrete in compression to maximize the load carrying capacity. B-Line B2505, Grinnell 281.

MSS SP-69 Type 18 universal type to be constructed of black malleable iron body with a removable malleable iron nut that accepts threaded rod to 7/8 inch diameter. B-Line B3014N, Grinnell 282.

Drilled Fasteners:

Carbon steel expansion anchors, vibration resistant, with ASTM B633 zinc plating. Use drill bit of same manufacturer as anchor. Hilti, Powers/Rawl, Redhead.

ANCHORS

Use welding steel shapes, plates, and bars to secure piping to the structure.

CORROSIVE ATMOSPHERE COATINGS

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. Mechanical galvanize threaded products, ASTM B695 Class 50, 2.0 mil coating. Field cuts and damaged finishes to be field covered with zinc rich paint of comparable thickness to factory coating.

Corrosive atmospheres include the following locations:

- Garage areas.

PART 3 - EXECUTION

INSTALLATION

Size, apply and install supports and anchors in compliance with manufacturers recommendations.

Secure pipe in place to prevent vibration, maintain proper slope and provide for expansion and contraction.

Design supports of strength and rigidity to suit loading, service, and manner which do not unduly stress the building construction. Where support is from concrete construction, take care not to weaken concrete or penetrate waterproofing. Fasten supports and hangers to building steel framing wherever practical. Do not use another pipe for support. Do not use perforated iron, chain or wire as hangers.

Use inserts for suspending hangers from reinforced concrete slabs wherever practical. Where inserts are not practical, provide channels or angles from which to suspend hangers/supports. Fasten structural steel to concrete with expansion bolts.

Provide expansion anchors in concrete slabs for installation of threaded support rods.

Provide hangers capable of vertical adjustment after piping is erected. Do not pierce ductwork with hanger rods. On threaded support rods and bolts, weld nuts to rods, peen threads, or provide double set of nuts with lock washers to prevent loosening. Use beam clamps for attaching hangers to structural steel.

Coordinate hanger and support installation to properly group piping of all trades.

Where piping can be conveniently grouped to allow the use of trapeze type supports, use standard structural shapes or continuous insert channels for the supporting steel. Where continuous insert channels are used, pipe supporting devices made specifically for use with the channels may be substituted for the specified supporting devices provided that similar types are used and all data is submitted for prior approval.

Perform welding in accordance with standards of the American Welding Society.

HANGER AND SUPPORT SPACING

Support horizontal piping per NFPA 13.

Provide vertical support at each floor level as the pipe passes through the floor. For piping that does not pass through the floor, provide adequate support to stabilize the vertical portion of the piping.

Provide galvanized steel supports for steel piping.

Provide CPVC dipped hangers or provide Unistrut "Uni-Cushion" vinyl strip at galvanized hangers for copper lines.

Where several pipes can be installed in parallel and at the same elevation, provide multiple or trapeze hangers.

Support riser piping independently of connected horizontal piping.

Adjust hangers to obtain the slope specified in the piping section of these specifications.

Space hangers for pipe as follows:

Pipe Material:	Pipe Size:	Max. Horiz. Spacing:	Max. Vert. Spacing:
Copper	3/4" through 1"	8'-0"	10'-0"
Copper	1-1/4" through 1-1/2"	10'-0"	10'-0"
Copper	2" through 3"	12'-0"	10'-0"
Steel	1" through 1-1/4"	12'-0"	15'-0"
Steel	1-1/2" through 8"	15'-0"	15'-0"

Unsupported length from the last hanger and an end sprinkler shall be as follows:

Pipe Size:	Length:
1" piping	Not greater than 36"
1-1/4" piping	Not greater than 48"
1-1/2" piping	Not greater than 60" or larger

RISER CLAMPS

Support vertical piping with clamps secured to the piping and resting on the building structure or secured to the building structure below at each floor. Use method of securing the vertical risers to the building structure below in stairwell locations.

ANCHORS

Install where indicated on the drawings and details. Where not specifically indicated, install anchors at ends of principal pipe runs and at intermediate points in pipe runs. Make provisions for preset of anchors as required to accommodate both expansion and contraction of piping.

END OF SECTION

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SECTION 21 10 00
WATER-BASED FIRE-SUPPRESSION SYSTEMS

PART 1 - GENERAL

SCOPE

This section contains specifications for an Automatic Fire Sprinkler System for this project. Included are the following topics:

PART 1 – GENERAL

- Scope
- Related Work
- Reference Standards
- Description
- System Description
- Design Standards
- Quality Assurance
- Submittals

PART 2 – PRODUCTS

- Pipe
- Fittings
- Joints
- Valves
- Flow Switches
- Tamper Switches
- Sprinklers
- Miscellaneous Equipment

PART 3 – EXECUTION

- Installation
- General
- Valves
- Gauges
- Switches
- Sprinklers
- Testing

RELATED WORK

Applicable provisions of Division 01 shall govern work under this Section.

Section 21 05 00 – Common Work Results for Fire-Suppression

Section 21 05 29 – Hangers and Supports for Fire-Suppression Piping and Equipment

REFERENCE STANDARDS

Applicable provisions of Division 01 shall govern work under this section.

Local and State Codes and Regulations.

National Fire Codes (NFC) published by NFPA; latest edition of standards listed:

NFPA 13 - Sprinkler Systems

Local Fire Department requirements.

All items to be UL listed or FM approved for intended usage.

DESCRIPTION

Fire Protection Contractor shall furnish all calculations, design, drawings, material, equipment, labor and related items required to complete the work indicated on drawings and specifications.

The work under this Section includes, but is not limited to the following:

- Provide all components for a complete dry pipe automatic sprinkler system including shutoff valves with supervisory switch as required, main drain valve, test valve(s), alarms, piping, and all necessary components to make a complete, operational, and approved system.

This portion of the project is design build. The contractor shall follow the specifications for type of systems, materials and equipment to use.

The contractor will be the Engineer of Record and shall prepare, seal and submit drawings and calculations as required to obtain approval and building permit from State, Insurance Company, and local authority. Submit drawings and calculations to all authorities as required.

These documents, along with local regulations and codes, will be the basis for the Fire Protection design and construction.

The contractor shall calculate, size and select all systems as defined by the documents. This shall include coordination with other trade contractors including wiring of flow switch(es) and supervisory switch(es). All calculations, sizes, and system layouts shall include provisions for future additions.

SYSTEM DESCRIPTION

Connect to the existing fire protection dry pipe sprinkler main in the ceiling space. Provide a dry pipe automatic sprinkler cross main, and branch piping to connect to sprinkler heads in all spaces of the addition and added toilet rooms.

DESIGN STANDARDS

Sprinkler system shall be designed and hydraulically calculated by the Contractor to provide densities as indicated below. Hydraulically calculate the system based on Ordinary Hazard Occupancy in garage areas.

Design system for the most hydraulically remote area based on the following:

Space Type/ Location:	Occupancy Classification	Density (GPM/Ft ²)	Area (Ft. ²)	Hose (GPM)	Max Vel. (Ft./Sec.)	Duration (Min.)
Toilet Rooms	Light Hazard	0.10	1,500	100	20	60
Garage Areas	Ordinary (Group II)	0.20	1,500	250	20	90

Existing water pressure is close to minimum pressure required to adequately provide sprinkler coverage per NFPA and local AHJ requirements. Contractor shall perform flow test and size all piping conservatively so not to exceed pressure limitations of system.

Contractor shall submit seven (7) copies of hydraulic calculations with shop drawings on standard form specified in NFPA No. 13, Chapter 7, Sections 7-2 through 7-3.5 inclusive and Figures A-7-3.3 and A-7-3.4.

QUALITY ASSURANCE

Substitution of Materials: Refer to Section 21 05 00 and Division 01 of the Project Manual.

Fire protection system components shall be rated for a minimum operating pressure of 175 psig.

To assure uniformity and compatibility of piping components in grooved piping systems, all grooved products utilized shall be supplied by a single manufacturer. Grooving tools shall be supplied from the same manufacturer as the grooved components.

SUBMITTALS

Shop Drawings:

Submit shop drawings of all fire sprinkler system components.

Plans:

Submit contractor-prepared plans/drawings.

Submit per NFPA 13; installation plans, working plans, shop drawings, hydraulic calculations, and manufacturer's data on devices, etc., indicating by model and number to be used for review and approval. Contractor shall obtain the necessary insurance underwriters, State and Local Fire Department approvals prior to submitting shop drawings. Include copy of approval letter in submission to Architect/Engineer.

Prepare drawings at minimum scale of 1/8" per foot for plans and 1/4" per foot or larger for details. Show all piping, lighting, equipment, ductwork, sprinklers, hangers, roof construction and occupancy of each area, including ceiling and roof heights.

Installation shall be coordinated with the latest architectural, structural, mechanical, plumbing and electrical drawings.

Contractor shall submit drawings to Engineer which have been reviewed and stamped "approved" by the authority having jurisdiction. No work shall commence until all approvals have been obtained. Allow sufficient time in the construction schedule for the approvals.

As-Built Drawings:

Maintain at the site an up-to-date marked set of as-built drawings which shall be corrected and delivered to the Architect upon completion of the work.

Furnish the Architect one (1) reproducible print of corrected shop drawings, including plans, revised to show "as built" conditions.

PART 2 - PRODUCTS

PIPE

Dry Systems:

Carbon steel pipe with galvanized finish, thickness per NFPA 13, conforming to ASTM A53, A135, A795, A123.

Sprinkler piping shall be schedule 40 threaded up to 2" in size.

Schedule 10 threaded light wall not allowed.

FITTINGS

Malleable iron, Class 150, threaded, ANSI B16.3.

Ductile iron, grooved end, 1000 lb/in² working pressure rating, UL listed or FM approved for automatic sprinkler.

Ductile or malleable iron, plain end with EPDM gasket, carbon steel bolts or locking lugs UL listed or FM approved for automatic sprinkler, Grinnell "Sock-it".

Carbon steel, butt-welded, class 150, ASTM A234.

Carbon steel, Class 150, flanged, ASTM A105.

Fittings used on galvanized piping shall have galvanized finish.

JOINTS

Iron Pipe:

Tapered pipe threads, with Teflon tape, ANSI B2.1.

Mechanical coupling, EPDM gasket, UL listed or FM approved for automatic sprinkler.

Rigid Type:

Housings shall be cast with offsetting, angle-pattern bolt pads to provide system rigidity and support and hanging in accordance with NFPA 13. Tongue and recess rigid type couplings shall only be permitted if the contractor uses a torque wrench for installation. Required torque shall be in accordance with the manufacturer's latest recommendations. Victaulic FireLock® EZ Style 009H (1-1/4" thru 4") and Victaulic Style 107H QuickVic™ (2" thru 8") shall be installation ready stab-on design, for direct 'stab' installation onto grooved end pipe without prior field disassembly and no loose parts. 10" and larger sizes shall be Victaulic Style 07 Zero-Flex standard rigid coupling.

Flexible Type:

Use in seismic areas and where required by NFPA 13. Victaulic Style 177 QuickVic™ (2" thru 8") shall be installation ready stab-on design, for direct 'stab' installation onto grooved end pipe without prior field disassembly and no loose parts. 10" and larger sizes shall be Victaulic Style 75 or 77 standard flexible coupling.

VALVES

Manufacturers:

Grinnell, Nibco, TYCO, Victaulic, or Wilkins.

Shutoff Valve:

Butterfly Valve:

Ductile iron body, epoxy coated, EPDM encapsulated ductile iron disc, 300 psi maximum working pressure, indicating type, with tamper switch in actuator, grooved end connections, UL Listed or FM approved, Victaulic Figure 705-W.

Check Valve:

Ductile iron body, rubber-encapsulated disc, 250 psi maximum working pressure, grooved end connections. Victaulic style 717.

Test Drain Valve:

Ball valve type, bronze, combination test and drain, with site glass, Sure-Test by G/J Innovations.

If design flow cannot be reached through the inspector's test drain, then the FPC shall install forward flow by-pass around the fire department connection check valve.

FLOW SWITCHES

UL listed and FM approved vane type waterflow switch with metal enclosure, adjustable pneumatic retard and electrical characteristics compatible with alarm system. Equal to Potter Model VSR-F.

TAMPER SWITCHES

For O S & Y valve or post indicator installations, UL listed, FM approved, to monitor position of valve, tamper resistant cover screws, single or double SPDT switch contacts, corrosion resistant, for indoor or outdoor use, NEMA 4 & 6P enclosures. Equal to Potter Model PCVS-1, -2 and OSYSU-1, 2.

SPRINKLERS

Manufacturer:

Products of the following manufacturers determined to be equal by the Architect/Engineer will be accepted: Grinnell, Reliable, TYCO, Victaulic and Viking.

General:

Fusible link or glass bulb type, cast brass or bronze construction. Provide heads with nominal 1/2" discharge orifice except where greater than normal density requires large orifice.

Select fusible link or glass bulb temperature rating to not exceed maximum ambient temperature rating allowed under normal conditions at installed location. Provide ordinary temperature (165 degree) fusible link or glass bulb type except at skylights, sealed display windows, unventilated attics and roof spaces, over cooking equipment, adjacent to diffusers, unit heaters, uninsulated heating pipes or ducts, mechanical rooms, storage rooms, or where otherwise indicated.

Provide quantity of spare heads as noted below and 1 wrench for each type of head and each temperature range installed. Provide 6 spare heads per 300 or less installed heads, 12 per 1000 or less and 24 for more than 1000. Provide steel cabinet for storage of heads and wrenches.

Types:

Refer to Sprinkler Schedule on plans for sprinkler head types and finishes in each area. Provide sprinkler guards in areas where sprinklers may be subject to damage (i.e. mechanical rooms).

Finished Areas (Light Hazard):

Chrome plated bronze body quick response pendent sprinklers with glass bulb heat sensor. Semi-recessed sprinklers shall have adjustable recessed escutcheon.

Unfinished Areas (Ordinary Hazard Group II):

Plain bronze body, upright or pendent, quick response sprinklers, with solder link or glass bulb for wet system. Plain bronze, upright or pendent open sprinkler for dry system.

Ratings:

See sprinkler ratings indicated on Sprinkler Schedule on plans. Use higher temperature-rated sprinkler heads in areas near heat sources, elevator equipment rooms, and elevator shafts.

MISCELLANEOUS EQUIPMENT

Provide other equipment and accessories, not listed, but required for a complete sprinkler system in accordance with NFPA and FM requirements.

PART 3 - EXECUTION

INSTALLATION

Install sprinkler system in accordance with requirements of NFPA 13 and local regulations of the fire marshal.

Grooved joint piping systems shall be installed in accordance with the manufacturer's guidelines and recommendations. The gasket style and elastomeric material (grade) shall be verified as suitable for the intended service as specified. Gaskets shall be molded and produced by Victaulic. Grooved end shall be clean and free from indentations, projections, and roll marks in the area from pipe end to groove for proper gasket sealing. A Victaulic factory-trained field representative shall provide on-site training for contractor's field personnel in the proper use of grooving tools and installation of grooved piping products. Factory-trained representative shall periodically review the product installation. Contractor shall remove and replace any improperly installed products.

The sprinkler bulb protector must remain in place until the sprinkler is completely installed and before the system is placed in service. Remove bulb protectors carefully by hand after installation. Do not use any tools to remove bulb protectors.

GENERAL

Install all piping parallel to building walls and ceilings and at heights which do not obstruct any portion of window, doorway, stairway or passageway. Where interferences develop in the field, offset or reroute piping as required to clear such interferences. Coordinate locations of fire protection piping with piping, ductwork, conduit and equipment of other trades to allow sufficient clearances. In all cases, consult drawings for exact location of pipe spaces, ceiling heights, ceiling grid layout, light fixtures and grilles before installing piping. All exposed overhead piping shall be installed above the bottom chord of roof joists.

Maintain piping in clean condition internally during construction.

Provide clearance for access to valves and piping specialties.

Install piping so that system can be drained. Where possible, slope to main drain valve. Piping may be installed level (WET SYSTEMS ONLY). Where piping cannot be fully drained, install nipple and cap for drainage of less than 5 gallons or valve/nipple/cap for drainage over 5 gallons.

Do not install piping within exterior walls.

Do not route piping above transformers, panelboards, or switchboards, including the required service space for this equipment, unless the piping is serving this equipment.

VALVES

Properly align piping before installation of valves. Do not support weight of piping system on valve ends. Mount valves in locations which allow access for operation, servicing and replacement. Install all valves with the stem in the upright or horizontal position. Valves installed with the stems down will not be accepted. All system shut-off valves shall have a supervisory switch.

GAUGES

Provide a valved pressure gauge in main sprinkler risers.

SWITCHES

Provide valved test connection for flow switch adjacent to flow switch. Test flow switch to verify proper operation.

SPRINKLERS

Locate sprinklers maintaining clearances from obstructions, ceilings and walls. Install sprinklers level in locations not subject to spray pattern interference.

Sprinklers shall be centered in all ceiling panels and tiles. A 1" tolerance for sprinkler placement is acceptable.

TESTING

Refer to Section 21 05 00 – Common Work Results for Fire Suppression.

Hydro-statically pressure test the fire sprinkler system piping as required in NFPA 13. Keep records of all testing for submission in Operation and Maintenance Manuals.

END OF SECTION

SECTION 22 05 00
COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

SCOPE

This section includes information common to two or more technical plumbing specification sections or items that are of a general nature, not conveniently fitting into other technical sections. Included are the following topics:

PART 1 – GENERAL

- Scope
- Related Work
- Regulatory Requirements
- Reference Standards
- Quality Assurance
- Abbreviations and Symbols
- Definitions
- Coordination
- Electronic Drawings
- Continuity of Existing Services
- Protection of Finished Surfaces
- Sealing and Firestopping
- Equipment Furnished by Others
- Off Site Storage
- Submittals
- Specified Materials and Equipment
- Equipment Installation
- Operating and Maintenance Manuals
- Record Drawings
- Testing
- Cleaning
- Warranty

PART 2 - PRODUCTS

- Access Panels and Doors
- Pipe Penetrations
- Equipment, Piping, and Valve Identification
- Equipment Accessories
- Bedding and Backfill

PART 3 - EXECUTION

- General
- Demolition
- Excavation and Backfill
- Surface Restoration
- Openings, Cutting and Patching
- Building Access
- Equipment Access
- Coordination of Work
- Piping Installation
- Sleeves
- Pipe Penetrations
- Escutcheon Plates

Flashing of Roof and Wall Penetrations
Painting
Identification

RELATED WORK

Applicable provisions of Division 01 govern work under this Section.

This section applies to all Division 22 sections of plumbing.

REGULATORY REQUIREMENTS

Codes and Standards:

All plumbing work shall conform to the requirements of Wisconsin Administrative Code SPS 382 and SPS 384, Wisconsin Uniform Plumbing Code.

All materials and workmanship shall comply with applicable Codes, local ordinances, industry standards and utility regulations. In case of differences between such Codes, and the Contract Documents, the most stringent shall govern. Promptly notify the A/E in writing of any such difference.

Non-Compliance:

Should the Contractor perform any work that does not comply with the above requirements, without having notified the A/E, he shall bear all costs necessary to correct the deficiencies.

Permits, Inspections and Fees:

All required, permits, and inspections shall be requested and obtained by the Contractor.

All fees and charges for approvals, reviews, or other inspections shall be paid by the Contractor.

All fees and charges assessed by local utilities for water, sewer, gas or other services shall be included in the bid and shall be paid by the Contractor(s).

REFERENCE STANDARDS

Standards cited in the Specifications shall be the most recent editions.

Abbreviations of standards organizations referenced in this and other sections are as follows:

ANSI American National Standards Institute
ASME American Society of Mechanical Engineers
ASPE American Society of Plumbing Engineers
ASSE American Society of Sanitary Engineering
ASTM American Society for Testing and Materials
AWWA American Water Works Association
CISPI Cast Iron Soil Pipe Institute
CS Commercial Standards, Products Standards Sections, Office of Eng. Standards Service, NBS
FS Federal Specifications, Superintendent of Documents, U.S. Government Printing Office
IAPMO International Association of Plumbing & Mechanical Officials
IEEE Institute of Electrical and Electronics Engineers
MCA Mechanical Contractors Association
MICA Midwest Insulation Contractors Association
MSS Manufacturer's Standardization Society of the Valve & Fitting Industry, Inc.
NBS National Bureau of Standards
NEC National Electric Code
NEMA National Electrical Manufacturers Association
NFPA National Fire Protection Association
NSF National Sanitation Foundation
PDI Plumbing and Drainage Institute
UL Underwriters Laboratories Inc.

Standards referenced in this section:

ACI 614	Recommended Practice for Measuring, Mixing and Placing of Concrete
ASTM D1557	Standard Test Method for Moisture-Density Relations of Soils
ASTM E814	Standard Test Method for Fire Tests of Through-Penetration Fire Stops
ASTM E84	Standard Test Method for Surface Burning Characteristics of Building Materials
UL1479	Fire Tests of Through-Penetration Firestops
UL723	Surface Burning Characteristics of Building Materials

QUALITY ASSURANCE

Substitution of Materials: Refer to Division 01 of the Project Manual.

All products and materials used are to be new, undamaged, clean and in good condition. Existing products and materials are not to be reused unless specifically indicated.

Where equipment or accessories are used which differ in arrangement, configuration, dimensions, ratings, or engineering parameters from those indicated on the contract documents, the contractor is responsible for all costs involved in integrating the equipment or accessories into the system and for obtaining the intended performance from the system into which these items are placed.

ABBREVIATIONS AND SYMBOLS

Key to abbreviations and symbols shall be on the Drawings.

The following are additional abbreviations used in the Specifications:

A/E	Architect/Engineer
GC	General Contractor
PC	Plumbing Contractor
FPC	Fire Protection Contractor
HC	Heating Ventilating and Air Conditioning Contractor
EC	Electrical Contractor

DEFINITIONS

Furnish:

Supply and deliver to Project site ready for unpacking, assembly and installation.

Install:

Operations at Site including unpacking, assembling, erecting, placing, anchoring, applying, finishing, cleaning, and connecting related devices required for product fully functional for intended use after installation.

Provide:

Furnish and install, such that product is fully functional for intended use.

COORDINATION

The Drawings show the general arrangement of piping and equipment and shall be followed as closely as actual building construction and the work of other trades permits. Architectural and Structural Drawings shall take precedence. Because of the scale of the Drawings, it is not possible to indicate all offsets, fittings, and accessories which may be required. Investigate conditions affecting the Work and arrange accordingly, providing offsets, fittings and accessories as may be required to meet conditions.

ELECTRONIC DRAWINGS

Drawings in electronic format will be made available to successful Plumbing contractor at a non-refundable cost specified under Division 01 of Specifications. If no cost is specified in Division 01, default cost shall be \$75 per drawing. Drawings provided may or may not be updated to reflect Addenda items.

Use of Drawings is limited to this Project and may not be forwarded to any other party for any purpose. Use of files will be at Contractor's sole risk and without liability or legal exposure to JDR Engineering, Inc or its employees. Architectural drawings or any other drawings not produced by JDR Engineering will not be provided.

CONTINUITY OF EXISTING SERVICES

Refer to Division 01 of the Project Manual.

Do not interrupt or change existing services without prior approval from Owner, Architect, Engineer or Construction Manager. When interruption is required, coordinate down-time with Owner to reduce disruption to activities. Scope of Work is indicated on Contract Documents or described herein. Unless specifically stated, any work involved in interrupting or changing existing services is to be done during normal working hours.

PROTECTION OF FINISHED SURFACES

Refer to Division 01 of the Project Manual.

Furnish one can of touch-up paint for each different color factory finish to be finished surface of product. Deliver touch-up paint with other "loose and detachable parts" as covered in General Requirements.

SEALING AND FIRESTOPPING

Sealing and firestopping of sleeves/openings between piping, etc. and the sleeve or structural opening shall be the responsibility of the contractor whose work penetrates the opening. The contractor responsible shall hire individuals skilled in such work to do the sealing and fireproofing. These individuals hired shall normally and routinely be employed in the sealing and fireproofing occupation.

EQUIPMENT FURNISHED BY OTHERS

Drawings indicate equipment to be furnished or installed by Others. When providing utility connections, coordinate exact requirements, including quantity, location, elevation size, material, flow and pressure.

OFF SITE STORAGE

Refer to Division 01 of the Project Manual.

SUBMITTALS

Refer to Division 01, of the Project Manual.

Submit shop drawings with space for approval stamps of GC and A/E.

Submit the following plumbing system data sheet for approval by the GC and A/E. List piping material type for each piping service on the project, ASTM number, schedule or pressure class, joint type, manufacturer and model number where appropriate. List valves and specialties for each piping service, fixture and equipment with manufacturer and model number.

PLUMBING SYSTEM DATA SHEET

Item	Pipe Service/Sizes	Manufacturer/Model No.	Remarks
Pipe			
Fittings			
Unions			
Valves:			
Ball			
Butterfly			
Balancing			
Check			
Other			
Hangers & Supports			

Insulation

Plbg. Specialties:

- Floor Drains
- Cleanouts
- Water Hammer Arrestors
- Backflow Preventers
- Wall/Yard Hydrants
- Hose Bibbs
- Hydrants

Plbg. Fixtures:

- Lavatory
- Faucet
- Stop/Supplies
- Waste/Trap
- Water Closet

Submit manufacturer's color charts where finish color is specified to be selected by Architect/Engineer.

Shop drawing submittals are to be bound, labeled, contain the project manual cover page and a material index list page showing item designation, manufacturer and additional items supplied with the installation. Submit for all equipment and systems as indicated in the respective specification sections, marking each submittal with that specification section number. 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 the contract documents. Include wiring diagrams of electrically powered equipment.

Submit sufficient quantities of data sheets and shop drawings to allow the following distribution:

- Operating and Maintenance Manuals 2 copies
- Architect/Engineer 2 copies
- Local Fire Chief or Marshal 1 copy

Firestop Systems:

Contractor shall submit product data for each firestop system. 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. For non-standard conditions where no UL tested system exists, submit manufacturer's drawings for UL system with known performance for which an engineering judgement can be based upon.

SPECIFIED MATERIALS AND EQUIPMENT

Design is based on equipment specified by manufacturer and model number as specified on Drawing Schedules. Where certain items are specified by manufacturer or trade name, Contractor's bid shall be based on use of named item. Where one (1) make is described and other makes are listed, comparable models of other named equipment may also be used, provided they meet requirements of Specifications.

When equipment or accessories used differ in arrangement, configuration, dimensions, ratings, or engineering parameters from those on Drawing schedules, Contractor shall be responsible for costs involved in integrating equipment or accessories into system. Contractor shall be responsible for obtaining original design performance from system into which items are placed, regardless of whether manufacturer/model is specified equivalent or substitute.

If Contractor wishes to use items other than those named in Specifications in base bid, request for approval of substitution must be made in writing to A/E at least 14 days prior to opening of bids. Include complete technical and descriptive data with request. If approved, an Addendum will be issued notifying bidders of approval. Request for approval will be considered only if requested by prime bidding Contractor.

EQUIPMENT INSTALLATION

Drawings show general arrangement and location of equipment and appurtenances. It is Contractor's responsibility to install equipment in a location and manner that allows for proper service and maintenance access to equipment. Work shall generally conform to requirements shown on Drawings. However, location of equipment may require field adjustments to obtain required service space. DO NOT SCALE OFF PLANS to determine proper location of equipment. Because of scale of Drawings, it is not possible to indicate exact routing of piping, and offsets, fittings and accessories required to provide proper service access to equipment. Contractor shall route and install ductwork and piping to provide required service access to equipment.

If, during construction phase of Project, contractor feels inadequate space exists, or equipment locations must be substantially modified to provide proper service and maintenance access, prior to installing equipment, contractor shall notify engineer in writing, outlining general concerns and proposed modifications. Equipment installed without providing manufacturer's required maintenance and service clearance shall be considered defective. Contractor shall remove and relocate piping, ductwork and equipment, to provide required service clearances at contractor's expense.

OPERATING AND MAINTENANCE INSTRUCTIONS

Refer to Division 01 of the Project Manual.

Assemble material in three-ring or post binders, using an index at the front of each volume and tabs for each system or type of equipment. In addition to the data indicated in the General Requirements, include the following information:

- Copies of all approved shop drawings.
- Manufacturer's wiring diagrams for electrically powered equipment
- Records of tests performed to certify compliance with system requirements
- Certificates of inspection by regulatory agencies
- Parts lists for fixtures, equipment, valves and specialties.
- Manufacturer's installation, operation and maintenance recommendations for fixtures, equipment, valves and specialties.
- Valve schedules
- Lubrication instructions, including list/frequency of lubrication
- Warranties
- Additional information as indicated in the technical specification sections

RECORD DRAWINGS

Refer to Division 01 of the Project Manual.

Maintain Record Drawings on daily basis to be turned over at completion of Project.

TESTING

Provide materials, labor, and equipment required for testing.

Notify Inspector(s) one day prior to the time when the test is ready to be performed.

After testing, submit in writing the time, date, name and title of the person approving the test. This shall also include the description and what portion of the system has been tested. The person approving the test shall sign the submittal.

Records shall be maintained of testing that has been completed, and shall be made available at the job site.

Upon completion of the work, records and certifications approving testing requirements shall be submitted.

Defective work or material shall be replaced or repaired, and the test repeated. Repairs shall be made with new materials.

CLEANING

Keep the premises broom clean and free of surplus materials, rubbish and debris.

After fixtures and equipment have been installed, remove stickers, rust stains, labels, and temporary covers.

Foreign matter shall be blown out, or flushed out, of pipes, tanks, pumps, strainers, motors, devices, switches, fixtures, and panels.

Identification plates on equipment shall be free of paint and dirt.

Leave the work in a condition ready for operation.

WARRANTY

Warrant that work shall function for one year immediately following acceptance of the system(s).

Keep the system in good working order at no expense, unless defects are clearly the result of improper or abnormal usage.

Submit for acceptance of the work, written certification that the entire system has been installed and adjusted for operation in accordance with the Contract Documents.

PART 2 – PRODUCTS

ACCESS PANELS AND DOORS

Provide access panels at locations requiring access to mechanical equipment. Locations include, but are not limited to areas above drywall ceilings, shaft enclosures and other furred-in spaces concealing valves, ducts or equipment. Provide UL listed, fire rated access panels when penetrating fire rated chase or shaft areas.

Access panels shall be of size required to provide adequate access to equipment. Minimum size shall be 12 inch by 12 inch for hand access and 24 inch by 24 inch for body access.

Panels shall be Milcor brand or equivalent.

Panels shall include concealed hinges, cam type locking devices, and have frame/border type necessary for particular wall or ceiling construction they are installed. Access panels shall be flush mounted, recessed frame type units. Access panels shall be prime coated steel, able to accept field painting for general applications and stainless steel for use in toilet rooms, shower rooms and similar wet areas.

Refer to Architectural Room Finish Schedule for wall and ceiling surfaces and finishes.

For non-security applications, panel construction shall utilize 16 gauge frame with not less than 18 gauge hinged door panel. Door locks shall be screwdriver operated for panels in general location applications and shall be key locked for public area applications.

PIPE PENETRATIONS

Refer to Division 01 requirements as well as the following.

Fire, Smoke And Fire/Smoke Rated Surfaces:

3M CP 25N/S or CP 25S/L caulk, 3M FS 195 wrap/strip with restricting collar, 3M CS 195 composite sheet, Pipe Shields Inc. Series F fire barrier kits, Proset Systems fire rated floor and wall penetrations, Insta-Foam Products Insta-Fire Seal Firestop Foam or Dow Corning Fire Stop System.

All fire stopping systems shall be provided by the same manufacturer.

UL listed or tested by independent testing laboratory, approved by State and Local Code jurisdictions.

Use product that has a 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.

Sleeves in concrete to be Schedule 40 steel pipe with integral water stop unless fire stop material used includes a sleeve that is an integral part of rated assembly.

Use firestop putty, caulk sealant, intumescent wrapstrips, intumescent firestop collars, firestop blocks, firestop mortar or a combination of these products to provide a UL listed system for each application required for this project. Provide mineral wool backing where specified in manufacturer's application detail.

Non-Rated Surfaces:

Stamped steel, chrome plated, hinged, split ring escutcheons or floor/ceiling plates for covering openings in occupied spaces.

In exterior wall openings below grade, use modular mechanical type seal consisting of interlocking synthetic rubber links shaped to continuously fill the annular space between the un-insulated pipe and cored opening or a water-stop type wall sleeve.

At interior partitions where pipe penetrations are sealed, use Tremco Dymonic, Sika Corp. Sikaflex 1a, Sonneborn Sonolastic NPI, or Mameco Vulken 116 urethane caulk to effect seal. Use galvanized sheet metal sleeves in hollow wall penetrations.

EQUIPMENT, PIPING AND VALVE IDENTIFICATION

Equipment Labels:

After painting and covering, identify equipment, including pumps, tanks, compressors, and control panels. Locate identification conspicuously.

Identification of equipment shall be by engraved white letters on a black 1/16 inch thick plastic laminate panel, beveled edges, screw mounting, permanently attached to the equipment.

Minimum size:

3/4" x 2 1/2" with 3/8" letters.

Manufacturers:

Setonply ® Style 2060 by Seton Name Plate Company or Emedolite Style EIP by EMED Co., or equal by W. H. Brady.

Pipe Identification:

Pipe identification shall conform to ANSI A13.1 "Scheme for Identification of Piping Systems".

Printed labels identifying the fluid conveyed and direction of flow shall be attached to pipes in accessible locations, at intervals not to exceed 20 feet, not less than once in each room, at each branch, adjacent to each access door or panel, at each valve and where exposed piping passes through walls and floors.

Outside Diameter of Pipe Covering	Minimum Size of Letters
up to 1¼"	½"
1½" to 2"	¾"
2½" to 6"	1½"

Manufacturers:
EMED Co., Seton Name Plate Company, or W. H. Brady.

Stencils:
Not less than 1 inch high letters/numbers for marking pipe and equipment.

Valve Tags:
Identify each valve by means of 1½" diameter brass tag fastened to body of valve with copper or brass chain. Identification number shall be stamped thereon with letters a minimum of ½" high. System identification abbreviation shall be stamped with letters a minimum of ¼" high.

The following prefixes shall be used:
PLBG - Plumbing

Manufacturers:
EMED Co., Seton Name Plate Company, or W. H. Brady.

Valve Charts:
Furnish three charts listing each valve. Two charts shall be delivered to A/E. An additional chart shall be framed behind glass and hung in location selected by Owner. Charts shall show the following:

Valve number	Size
Manufacturer	Type of valve
Type of service	Location

Furnish a typewritten chart indicating equipment or areas served by each numbered valve and incorporate in Operating and Maintenance Manuals.

EQUIPMENT ACCESSORIES

Provide equipment accessories, connections, and incidental items.
Install piping connecting to pumps and other equipment without strain at the piping connection. If requested by the A/E, remove the bolts in these flanged connections, or disconnect piping, to demonstrate that piping has been properly connected.

BEDDING AND BACKFILL

Bedding up to a point 12-inches above the top of the pipe shall be thoroughly compacted sand or crushed stone chips meeting the following gradations:

<u>Gradation for Bedding Sand</u>	
Sieve Size	% Passing (by Wt)
1 inch	100
No. 16	45 - 80
No. 200	2 - 10

<u>Gradation for Crushed Stone Chip Bedding</u>	
Sieve Size	% Passing (by Wt)
1/2 inch	100
No. 4	75 - 100
No. 100	10 - 25

Backfill above the bedding in lawn areas shall be thoroughly compacted excavated material free of large stones, organic, perishable, and frozen materials.

Backfill above the bedding under existing and future utilities, paving, sidewalks, curbs, roads and buildings shall be granular materials, pit run sand, gravel, or crushed stone, free from large stones, organic, perishable, and frozen materials.

PART 3 – EXECUTION

GENERAL

Coordination Of Work:

Review the complete set of Drawings and Specifications and report discrepancies to the A/E. Obtain written instructions for changes necessary. Coordinate with each trade prior to beginning installation and make provisions to avoid interferences. Changes required caused by neglect to coordinate shall be made without expense to the project.

Piping shall not be located above electrical panels.

Anchor Bolts, Sleeves, and Supports:

These items required for the Work shall be furnished by the FPC for proper installation of his work. They shall be installed (except as otherwise specified) by the trade furnishing and installing the material in which they are to be located. Location of anchor bolts, sleeves, inserts and supports shall be directed by the trade requiring them. Expense resulting from the improper location or installation of anchor bolts, sleeves, inserts and supports shall be paid for by the Contractor for the trade with responsibility for directing their proper location.

Adjustments In Locations:

Locations of pipes and equipment, shall be adjusted to accommodate the work interferences anticipated and encountered. Prior to fabrication determine the exact route and location of each pipe (subject to A/E's approval).

Right Of Way:

New lines which pitch shall have the right-of-way over those which do not pitch. For example: Gravity drains shall normally have right-of-way. Lines whose elevations cannot be changed shall have the right-of-way over lines whose elevations can be changed. Notify A/E and other trades of conflicts.

Offsets, transitions and changes in direction of electrical raceways, pipes, and ducts shall be made to maintain proper room and pitch of sloping lines whether or not indicated on the Drawings.

DEMOLITION

Perform all demolition as indicated on the drawings to accomplish new work. Where demolition work is to be performed adjacent to existing work that remains in an occupied area, construct temporary dust partition to minimize the amount of contamination of the occupied space. Where pipe is removed and not reconnected with new work, cap ends of existing services as if they were new work. Coordinate work with the Owner to minimize disruption to the existing building occupants.

All pipe, fixtures, equipment, wiring, associated conduit and similar items demolished, abandoned, or deactivated are to be removed from the site by the Contractor except as specifically noted otherwise. All designated equipment is to be turned over to the Owner for his use at a place and time he so designates. Maintain the condition of material and/or equipment that is indicated to be reused equal to that existing before work began.

EXCAVATION AND BACKFILL

Install lines passing under foundations with minimum of 1-1/2 inch clearance to concrete and insure no disturbance of bearing soil.

Before burying piping, mark up Record Drawings and dimensionally locate piping. Deliver information to A/E Field Representative.

Unless otherwise specifically indicated on Drawings, trenches for utilities shall be of depth that provides the following minimum depths of cover from existing grade or from indicated finish grade, whichever is lower.

Existing utility lines to be retained shown on Drawings or locations of which are made known to 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 Contractor at his expense.

SURFACE RESTORATION

Completely restore the surface of all disturbed areas to a like condition of the surface prior to the work. Level off all waste disposal areas and clean up all areas used for the storage of materials or the temporary deposit of excavated earth. Remove all surplus material, tools and equipment.

OPENINGS, CUTTING AND PATCHING

Refer to Division 01 of the Project Manual.

Provisions for openings including chases, holes and clearances through walls, floors, and roof, ceilings and partitions shall be made in advance of construction of each part of the building. Openings shall be provided by the GC for the respective materials in which openings occur, during the construction of the building with the exception of pipe sleeves. The PC shall furnish to the GC opening dimensions and locations.

If the PC neglects to inform the GC of his opening requirements before that portion of the building construction is complete, the PC shall cut the openings and provide framing and lintels. In the event holes must be cut through reinforced concrete, avoid spalling and unnecessary damage or weakening of structural members. No chopping or breaking out is permitted. Before cutting or drilling, obtain permission from the A/E. Patch adjacent materials and repair damage resulting from the cutting.

The PC may perform core drilling for openings in existing walls and floors at the direction of the A/E. Framed openings shall be by the GC.

Patch interior trench excavation to match existing slab-on-grade with concrete: 3500 PSI at 28 days, 3" slump, 3/4" maximum aggregate size, 5.5 bags of cement per cubic yard.

BUILDING ACCESS

Arrange for necessary openings in building to allow for admittance of all apparatus. When building access was not previously arranged and must be provided by Contractor, restore opening to original condition after the apparatus has been brought into building. Coordinate with Architect/Engineer.

EQUIPMENT ACCESS

Install piping, conduit, fixtures, 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 access is available for equipment and specialties. Where access is required in plaster walls or ceilings, furnish and install access doors required. Coordinate for installation of access doors utilizing General Contractor and other appropriate on-site subcontractor for access door installation.

Accessible ceilings, (i.e. lay-in ceilings) do not require access panels. Provide color coded thumb tacks or screws, depending on surface, for use in accessible ceilings.

COORDINATION OF WORK

Install systems, equipment and piping in cooperation with other trades. Locations of pipes, equipment, fixtures, etc., shall be adjusted to accommodate the work interferences anticipated and encountered. Prior to fabrication determine the exact route and location of each pipe (subject to A/E's approval).

Any work that is not coordinated and that interferes with other contractor's work shall be removed or relocated at the installing contractor's expense.

Verify that all devices are compatible for the type of construction and surfaces on which they will be used.

Offsets, transitions and changes in direction of electrical raceways, pipes and ducts shall be made as required to maintain proper room and pitch of sloping lines whether or not indicated on the Drawings. Furnish and install all traps, air vents, sanitary vents, etc., as required to effect the offsets, transitions and changes in direction.

New lines which pitch shall have the right-of-way over those which do not pitch. For example: Gravity drains shall normally have right-of-way. Lines whose elevations cannot be changed shall have the right-of-way over lines whose elevations can be changed. Notify A/E and other trades of any conflicts.

Provide appropriate sections of work with required wall, roof and floor opening locations and dimensions. If Contractor neglects to coordinate information, openings shall be the responsibility of Contractor.

PIPING INSTALLATION

General:

Expansion and contraction of piping shall be provided for by expansion loops, bends, swing joints, or expansion joints to prevent damage to connections, piping, equipment of the building.

Unions or flanges shall be installed on all by-passes, ahead of all traps, adjacent to screw connection valves, and at all connections to equipment, whether or not shown on drawings.

Installation Arrangement:

Install all Work to permit removal (without damage to other parts) of all parts requiring periodic replacement or maintenance. Arrange pipes and equipment to permit ready access to valves, cocks, traps, starters, motors, control components and to clear the openings of swinging and overhead doors and of access panels.

Connections Different From Those Shown:

Where equipment requiring different arrangement or connections from those shown is used, install the equipment to operate properly and in harmony with the intent of the Drawings and Specifications. When requested by the A/E, submit drawings showing the proposed installation.

If the proposed installation is approved, make all incidental changes in piping, ductwork, supports, insulation, wiring, panelboards, etc. Provide any additional motors, controllers, valves, fittings and other additional equipment required for the proper operation of the system resulting from the selection of equipment, including all required changes in affected trades. The Contractor shall be responsible for the proper location of rough-in and connections by other trades.

All changes shall be made at no increase in the Contract amount or additional cost to the other trades.

SLEEVES

Provide galvanized sheet metal sleeves for pipe penetrations through interior and exterior walls to provide a backing for sealant or firestopping. Patch wall around sleeve to match adjacent wall construction and finish. Grout area around sleeve in masonry construction. In finished spaces where pipe penetration through wall is exposed to view, sheet metal sleeve shall be installed flush with face of wall. In existing poured concrete walls where penetration is core drilled, pipe sleeve is not required.

Pipe sleeves are not required in existing poured concrete walls where penetrations are core drilled.

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.

In all piping floor penetrations, fire rated and non-fire rated, top of sleeve shall extend 1 inch above the adjacent finished floor. 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. If the pipe penetrating the sleeve is supported by a pipe clamp resting on the sleeve, weld a collar or struts to the sleeve that will transfer weight to existing floor structure.

For floor penetrations through existing floors in mechanical and wet locations listed below, core drill opening and provide 1-1/2" x 1-1/2" x 1/8" galvanized steel angles fastened to floor surrounding the penetration or group of penetrations to prevent water from entering the penetration. Provide urethane caulk between angles and floor and fasten angles to floor a minimum of 8" on center. Seal corners water tight with urethane caulk. Or, core drill sleeve openings large enough to insert schedule 40 sleeve and grout area around sleeve with hydraulic setting non-shrink grout/cement.

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.

PIPE PENETRATIONS

General:

Coordinate location of building surface penetrations with appropriate contractors. Furnish sleeves, inserts, and devices to be built into structure to contractor performing Work. Prepare Shop Drawings for approval for penetrations of structural elements, including floor slabs, shear walls, and bearing walls. Do not allow penetrations to be made until Shop Drawings are approved.

Fire Rated Surfaces:

Install products in accordance with the manufacturer's instructions where pipe penetrates a fire rated surface. When pipe is insulated, use product that maintains integrity of insulation and vapor barrier. Where sleeve must be installed in existing floor, grout area around sleeve to restore floor integrity. In wet area floor penetration, top surface of penetration to be 2 inches above adjacent floor with additional height obtained by means of concrete pad poured integral with floor.

Non-Rated Surfaces:

Install escutcheons or floor/ceiling plates where pipe penetrates non-fire rated surfaces in occupied spaces. Size units to accommodate insulation, where applicable. Escutcheons are not required when insulation completely covers wall opening and insulation end is trimmed in a neat manner. Occupied spaces for this Paragraph include only those rooms with finished ceilings and penetration occurs below ceiling.

In exterior wall openings below grade, place water-stop type wall sleeve before concrete pour or core drill opening after pour. Assemble rubber links to proper size for pipe and tighten in place in accordance with manufacturer's instructions.

Install galvanized sheet metal sleeve in hollow wall penetrations to provide backing for sealant. Apply sealant to both sides of penetration in a manner that annular space between pipe sleeve and pipe or insulation is completely blocked.

Completely seal (or caulk) around pipe penetrations through non-rated, smoke tight corridor walls in healthcare facilities. Refer to architectural drawings for additional information.

Completely seal pipe penetrations, as specified below, for walls of the following rooms below:

- Toilet Rooms.

ESCUTCHEON PLATES

Provide plates on pipes passing through finished floors, walls and ceilings, with outside diameter to cover sleeve opening and inside diameter to fit snugly around pipe. Set tight to building surface. Escutcheon plates shall be chromium plated metal.

FLASHING OF ROOF AND WALL PENETRATIONS

Flashings on the roof shall be closely coordinated. Install flashings to insure proper vapor barrier.

Roof attachments, equipment supports, piping systems and other roof penetrations shall be waterproofed.

PAINTING

Refer to Division 09.

All exposed steel support structures (all metal surfaces located both inside and outside the building) shall be painted after installation with one coat of a compatible metal primer coat and two coats of a finish coat of paint for the application. Color shall be gray unless otherwise specified.

IDENTIFICATION

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. Use a primer where necessary for proper paint adhesion.

Where stenciling is not appropriate for equipment identification, engraved name plates may be used.

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 the partition where accessible piping passes through walls or floors. Place flow directional arrows at each pipe identification location. Use one coat of black enamel against a light background or white enamel against a dark background.

Identify valves with brass tags bearing a system identification and a valve sequence number. Identify medical gas and vacuum valves with brass tags and wall or cabinet mounted color coded engraved nameplate with the following "(Type of Gas) Shutoff Valve for (Location or Zone)". Valve tags are not required at a terminal device unless the valves are greater than ten feet from the device, located in another room or not visible from device. Provide a typewritten valve schedule and pipe identification schedule indicating the valve number and the equipment or areas supplied by each valve and the symbols used for pipe identification; locate schedules in mechanical room and in each Operating and Maintenance manual. Schedule in mechanical room to be framed under clear plastic.

END OF SECTION

SECTION 22 05 29
HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

SCOPE

This section includes specifications for supports of all plumbing equipment and materials as well as piping system anchors. Included are the following topics:

PART 1 - GENERAL

- Scope
- Related Work
- Reference Standards
- Quality Assurance
- Design Criteria
- Submittals

PART 2 - PRODUCTS

- Manufacturers
- Pipe Hangers and Supports
- Pipe Hanger Rods
- Beam Clamps
- Riser Clamps
- Concrete Inserts
- Anchors
- Equipment Support
- Corrosive Atmosphere Coatings

PART 3 - EXECUTION

- Installation
- Structural Supports
- Hanger and Support Spacing
- Riser Clamps
- Concrete Inserts
- Anchors
- Roof Mounted Piping Supports

RELATED WORK

Applicable provisions of Division 01 shall govern work under this section.

- Section 22 05 00 – Common Work Results for Plumbing
- Section 22 07 00 – Plumbing Insulation
- Section 22 11 00 – Facility Water Distribution
- Section 22 13 00 – Facility Sanitary Sewerage
- Section 22 40 00 – Plumbing Fixtures

REFERENCE STANDARDS

- MSS SP-58
- MSS SP-69

QUALITY ASSURANCE

Refer to Division 01, of the Project Manual.

DESIGN CRITERIA

Materials and application of pipe hangers and supports shall be in accordance with MSS Standard Practice SP-58 and SP-69 unless noted otherwise.

Piping connected to 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 the equipment, whichever is greater. Standard pipe hangers/supports as specified in this section are required beyond the 100 pipe diameter/3 support distance.

Do not hang any mechanical item directly from a metal deck or run piping so its rests on the bottom chord of any truss or joist.

General:

Secure pipe in place to prevent vibration, maintain proper slope and provide for expansion and contraction.

Design supports of strength and rigidity to suit loading, service, and manner which do not unduly stress the building construction. Where support is from concrete construction, take care not to weaken concrete or penetrate waterproofing. Fasten supports and hangers to building steel framing wherever practical. Do not use another pipe for support. Do not use perforated iron, chain or wire as hangers.

Use inserts for suspending hangers from reinforced concrete slabs wherever practical. Where inserts are not practical, provide channels or angles from which to suspend hangers/supports. Fasten structural steel to concrete with expansion bolts.

Provide expansion anchors in concrete slabs for installation of threaded support rods.

Provide hangers capable of vertical adjustment after piping is erected. Do not pierce ductwork with hanger rods. On threaded support rods and bolts, weld nuts to rods, peen threads, or provide double set of nuts with lock washers to prevent loosening. Use beam clamps for attaching hangers to structural steel.

On piping insulated with vapor barrier covering, use protection shield to cover bottom one-half of insulated pipe. Shield to be a minimum of 12" long and of 16 gauge galvanized steel.

Exception:

For insulated drain pipe, the pipe may rest on the hanger and the insulation to wrap around the hanger and pipe.

Submit anchor drawings for approval upon request.

Hangers, supports, and support methods other than those specified shall not be used without obtaining approval on method of support by the Structural Engineer prior to installing piping systems. Submit support method arrangement, pipe weight and spacing scheme for approval.

Space hangers for pipe as follows:

Pipe Material	Pipe Size	Max. Horiz. Spacing	Max. Vert. 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"
Steel	1/2" through 1-1/4"	7'-0"	15'-0"
Plastic	Drain and Vent	4'-0"	10'-0"

SUBMITTALS

Submit data in accordance with Section 22 05 00 and Division 01 of the Project Manual.

Schedule of all hanger and support devices indicating attachment methods and type of device for each pipe size and type of service.

Submit anchor drawings to the A/E for approval upon request.

PART 2 - PRODUCTS

MANUFACTURERS

B-Line, Fee and Mason, Grinnell, Michigan Hanger, Pate, PHD Manufacturing, Piping Technology, Powers/Rawl, Proset, Roof Products & Systems, Unistrut, or Victaulic.

PIPE HANGERS AND SUPPORTS

Overhead Supports:

Adjustable clevis hanger, steel, Dura-Green epoxy coating or electro-plated, B-Line Figure B3100.

Adjustable J hook hanger, steel, Dura-Green epoxy coating or electro-plated, B-Line figure B3690.

Adjustable band hanger, steel, Dura-Green epoxy coating or electro-plated, B-Line Figure B3172.

Multiple or Trapeze Hangers:

Where several pipes are running parallel and pitching in the same direction, strut style support may be used. Steel channel, 12-gauge thickness, Dura-Green epoxy coating or electro-plated, B-Line B11. Restrain individual pipes with B-Line B2000 series or Vibraclamp series strut clamps.

Wall Support:

Carbon steel welded bracket with hanger. B-Line 3068 Series, Grinnell 194 Series.

Perforated, epoxy painted finish, 16-12 gauge, min., steel channels securely anchored to wall structure, with interlocking, split-type, bolt secured, galvanized pipe/tubing clamps. B-Line type S channel with B-2000 series clamps, Grinnell type PS 200 H with PS 1200 clamps.

When copper piping is being supported, provide flexible elastomeric/thermoplastic isolation cushion material to completely encircle the piping and avoid contact with the 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.

Vertical Support:

Riser clamp, steel, Dura-Green epoxy coating or electro-plated, B-Line Figure B3373.

Riser clamp, flexible sleeve with stainless steel band, Proset PS #33.

Floor Support:

Carbon steel pipe saddle, stand and bolted floor flange. B-Line B3088T/B3093.

Copper Pipe Supports:

All supports, fasteners, clamps, etc. directly connected to copper piping shall be copper plated or polyvinylchloride coated. Where steel channels are used, provide isolation collar between supports/clamps/fasteners and copper piping.

PIPE HANGER RODS

Steel Hanger Rods:

Steel, electro-plated, threaded both ends, threaded one end, or continuous threaded, complete with adjusting and lock nuts. B-Line B3205.

Size rods for individual hangers and trapeze support as indicated in the following schedule:

Total weight of equipment, including valves, fittings, pipe, pipe content, and insulation, are not to exceed the limits indicated.

Maximum Load (Lbs.) (650°F Maximum Temp.)	Rod Diameter (inches)
610	3/8
1130	1/2
1810	5/8
2710	3/4

BEAM CLAMPS

MSS SP-69 Types 19 & 23 malleable black iron clamp for attachment to beam flange to 0.62 inches thick with a retaining ring and threaded rod of 3/8, 1/2, and 5/8 inch diameter. Furnish with a hardened steel cup point set screw. B-Line B3036L/B3034, Grinnell 86/92.

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. B-Line B3054, Grinnell 228.

CONCRETE INSERTS

Poured in Place:

MSS SP-69 Type 18 wedge type to be constructed of a black carbon steel body with a removable malleable iron nut that accepts threaded rod to 7/8 inch diameter. Wedge design to allow the insert to be held by concrete in compression to maximize the load carrying capacity. B-Line B2505, Grinnell 281.

MSS SP-69 Type 18 universal type to be constructed of black malleable iron body with a removable malleable iron nut that accepts threaded rod to 7/8 inch diameter. B-Line B3014N, Grinnell 282.

Drilled Fasteners:

Carbon steel expansion anchors, vibration resistant, with ASTM B633 zinc plating, minimum tension load of 3200 pounds. Use drill bit of same manufacturer as anchor.

Manufactured By:

Hilti, Powers/Rawl, Redhead.

ANCHORS

Use welding steel shapes, plates, and bars to secure piping to the structure.

EQUIPMENT SUPPORT

Examine Drawings, and manufacturer's data to determine how equipment, fixtures, and piping are to be supported, mounted or suspended. Support all equipment plumb, rigid, and true to line. Provide rods, bolts, inserts, pipe stands, brackets and accessories for proper support.

Equipment Stands:

Use structural steel members welded to and supported by pipe supports. Clean, prime and coat with three coat rust inhibiting alkyd paint or one coat epoxy mastic. Where exposed to weather, treat with corrosive atmosphere coatings.

CORROSIVE ATMOSPHERE COATINGS

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. Mechanical galvanize threaded products, ASTM B695 Class 50, 2.0 mil coating. Field cuts and damaged finishes to be field covered with zinc rich paint of comparable thickness to factory coating.

Corrosive atmospheres include the following locations:

- Exterior locations
- Garage areas
- Swimming pool equipment rooms
- Chemical storage and hazardous waste storage rooms

PART 3 - EXECUTION

INSTALLATION

Size, apply and install supports and anchors in compliance with manufacturers recommendations.

Install supports to provide for free expansion of the piping system. Support all piping from the structure using concrete inserts, beam clamps, ceiling plates, wall brackets, or floor stands. Fasten ceiling plates and wall brackets securely to the structure and test to demonstrate the adequacy of the fastening.

Coordinate hanger and support installation to properly group piping of all trades.

Where piping can be conveniently grouped to allow the use of trapeze type supports, use standard structural shapes or continuous insert channels for the supporting steel. Where continuous insert channels are used, pipe supporting devices made specifically for use with the channels may be substituted for the specified supporting devices provided that similar types are used and all data is submitted for prior approval.

Size and install hangers and supports, except for riser clamps, for installation on the exterior of piping insulation. Where a vapor barrier is not required, hangers may be installed either on the exterior of pipe insulation or directly on piping.

Perform welding in accordance with standards of the American Welding Society.

STRUCTURAL SUPPORTS

Provide all supporting steel required for the installation of mechanical equipment and materials, including angles, channels, beams, etc. to suspended or floor supported tanks and equipment. All of this steel may not be specifically indicated on the drawings.

RISER CLAMPS

Support vertical piping with clamps secured to the piping and resting on the building structure or secured to the building structure below at each floor.

CONCRETE INSERTS

Select size based on the manufacturer's stated load capacity and weight of material that will be supported. Furnish inserts to the General Contractor for placement in concrete formwork. Use inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inch size. Where concrete slabs form finished ceiling, provide inserts that are flush with the slab surface.

ANCHORS

Install where indicated on the drawings and details. Where not specifically indicated, install anchors at ends of principal pipe runs and at intermediate points in pipe runs between expansion loops. Make provisions for preset of anchors as required to accommodate both expansion and contraction of piping.

END OF SECTION

SECTION 22 07 00
PLUMBING INSULATION

PART 1 - GENERAL

SCOPE

This Section includes insulation specifications for plumbing systems. Included are the following requirements:

PART 1 – GENERAL

- Scope
- Related Work
- Description
- Quality Assurance
- Definitions
- Submittals

PART 2 – PRODUCTS

- Acceptable Manufacturers
- Insulation and Jackets

PART 3 - EXECUTION

- General
- Installation
- Pipe Insulation Schedule

RELATED WORK

Requirements of Division 01 shall govern work under this Section.

Section 22 05 00 - Common Work Results for Plumbing
Section 22 05 29 - Hangers and Supports for Plumbing Piping and Equipment
Section 22 11 00 - Facility Water Distribution
Section 22 13 00 - Facility Sanitary Sewerage

DESCRIPTION

Furnish and install insulating materials, fittings, finishes, and accessories specified for piping and related equipment. The following types of insulation are specified in this Section:

- Pipe insulation

Install insulation materials in accordance with the latest edition of MICA (Midwest Insulation Contractors Association) Standard 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.

QUALITY ASSURANCE

Substitution of Materials: Refer to Section 22 05 00 and Division 01 of the Project Manual.

Label insulating products delivered to construction site with the manufacturer's name and description of materials.

DEFINITIONS

Concealed:

Shafts, furred spaces, space above finished ceilings, utility tunnels and crawl spaces. Other areas, including walk-through tunnels, shall be considered as exposed.

Exposed to weather:

Located outdoors, either on grade, on a wall, or on a roof, in location where sun, wind, rain, snow and other elements will come in contact with it.

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.

SUBMITTALS

Submit data in accordance with Section 22 05 00 and Division 01 of the Project Manual

Include manufacturer's data for the following:

- Pipe insulation

Submittal shall include the following information:

Manufacturer's technical data sheets for each product with the following information:

- Density
- Thermal characteristics
- Temperature limitations
- Jacket type
- Materials of composition
- Material safety data sheets

Schedule of all insulating materials to be used including:

- Application / intended use of each insulation type
- Insulation type and thickness
- Jacket type
- Fastening methods and adhesive type

PART 2 - PRODUCTS

ACCEPTABLE MANUFACTURERS

Armstrong, Halstead, Johns-Manville, Knauf, or Owens-Corning.

INSULATION AND JACKETS

Glass Fiber:

Manville Micro-Lok meeting ASTM C547; rigid molded, non-combustible, "K" Value: 0.23 at 75°F, maximum service temperature: 850°F, with vapor Retarder Jacket: AP-T Plus White Kraft paper reinforced with glass fiber yarn and bonded to aluminum foil, secure with self-sealing longitudinal laps and butt strips or AP Jacket with outward clinch expanding staples or vapor barrier mastic as needed.

PVC Fitting Covers and Jackets:

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 .02 inch (20 mil).

PART 3 - EXECUTION

GENERAL

Application of insulation to piping equipment shall be done in accordance with the manufacturer's installation recommendations. Where thickness of insulation is not specified, use thickness recommended by manufacturer or required by applicable Codes.

Insulation shall be applied in as warm an environment as possible, and in no instance below 25°F.

No pipe shall be covered until after it has been installed, inspected, tested and approved.

INSTALLATION

All pipe insulation shall be installed with joints butted firmly together. All valves and fittings shall be insulated with mitered sections of insulation equal in density and thickness to the adjoining insulation, or with insulating cement equal in thickness to the adjoining insulation, or with "Zeston" type, premolded PVC fittings installed in accordance with the manufacturer's instructions. Fittings are to be finished with 8 oz. glass mesh and mastic (use breather mastic on systems operating above 50°F except where Zeston PVC covers are used). Jackets on pipe insulation may be stapled using outward clinch staples spaced 3" apart at least ¼" in from the lap edge on systems operating at 60°F and above; below 50°F the laps are to be vapor sealed using self-sealing lap, lap-seal tape gun or adhesive such as Armstrong 520. All insulation ends are to be tapered and sealed regardless of service.

On all piping insulated with vapor barrier covering, use protection shield to over bottom one-half of insulated pipe. Shield to be minimum of 12" long and 16 gauge galvanized steel. Provide half-round, 12" long, hanger block at the bottom half of the pipe in place of the fiberglass pipe insulation. The hanger blocks shall be molded cork or calcium silicate pipe insulation of the same thickness as the adjoining fiberglass pipe insulation. The vapor barrier jacket shall be continuous through the hanger location.

Vapor barrier jackets shall be applied with a continuous, unbroken vapor seal. Pipe hangers shall be sized large enough to be installed over the outer surfaces of the insulation.

Exception:

For insulated drain pipe, the pipe may rest directly on the hanger and the insulation to wrap around the hanger and pipe.

Omit insulation for:

- Unions and flanges.
- Vents to atmosphere, discharges from safety and relief valves and drain pipes.

Provide finished edges at all access doors and end.

Protective Jackets:

Provide a protective PVC jacket for the following insulated piping:

- Garages.

Lap seams and joints a minimum of 2 inches and continuously seal with welding solvent recommended by jacket manufacturer. Lap slip joint ends 4" without fasteners where required to absorb expansion and contraction. For sections where vapor barrier is not required and jacket requires routine removal, tack fasteners may be used.

PIPE INSULATION SCHEDULE

Provide insulation on new and remodeled piping.

Minimum Insulation Thickness:

SYSTEMS	PIPE SIZE			
	1" or less	1-1/4" to 2"	2-1/2" to 4"	5" and up
Domestic Cold Water	1/2"	1/2"	1"	1"
Domestic Hot Water	1"	1"	1-1/2"	1-1/2"
Domestic Hot Water Return	1"	1"	1-1/2"	---
Non-Potable Cold Water	1/2"	1/2"	1"	---

END OF SECTION

SECTION 22 11 00
FACILITY WATER DISTRIBUTION

PART 1 - GENERAL

SCOPE

This section contains specifications for plumbing pipe and pipe fittings for this project. Included are the following topics:

PART 1 – GENERAL

- Scope
- Related Work
- Description
- Quality Assurance
- Submittals

PART 2 – PRODUCTS

- Water Distribution Pipe and Fittings
- Valves
- Unions and Flanges
- Dielectric Couplings
- Water Hammer Suppressors

PART 3 – EXECUTION

- Water Piping System
- Testing

RELATED WORK

Requirements of Division 01 shall govern work under this Section.

22 05 00 – Common Work Results for Plumbing

22 05 29 – Hangers and Supports for Plumbing Piping and Equipment

DESCRIPTION

Provide a domestic water distribution system including hot and cold water supply piping, hot water return piping, tempered water piping, pure water piping, valves, fittings, hardware, and specialties. Connect to plumbing fixtures, specialties, and equipment.

QUALITY ASSURANCE

Substitution of Materials: Refer to Section 22 05 00 and Division 01 of the Project Manual.

Order all pipe with each length marked with the name or trademark of the manufacturer and type of pipe; with each shipping unit marked with the purchase order number, metal or alloy designation, temper, size, and name of supplier.

Any installed material not meeting the specification requirements must be replaced with material that meets these specifications without additional cost to the Owner.

To assure uniformity and compatibility of piping components in grooved piping systems, all grooved products utilized shall be supplied by a single manufacturer. Grooving tools shall be supplied from the same manufacturer as the grooved components.

SUBMITTALS

Submit valve product data sheets in accordance with Section 22 05 00 and Division 01 of the Project Manual.

Include materials of construction, dimensional data, ratings/capacities/ranges, approvals, test data, and identification as referenced in this section and/or on the drawings.

PART 2 - PRODUCTS

WATER DISTRIBUTION PIPE AND FITTINGS

Above Ground:

Copper tube, Type L, hard temper, ASTM B88; with wrought copper fittings, ANSI B16.22. Join using lead free flux, ASTM B813, and solder, ASTM B32.

Wrought copper, ANSI B16.22 or cast bronze, ANSI B16.18 fittings, copper tube dimensioned grooved ends (flaring of tube and fitting ends to IPS dimensions is not permitted), joined with mechanical couplings, synthetic rubber gasket seal, Victaulic style 607 QuickVic™ Installation Ready stab-on design, for direct 'stab' installation onto roll grooved copper tube without prior field disassembly and no loose parts.

Mechanical formed tees with brazed joint by T-Drill.

VALVES

Manufacturer:

Valves throughout the project shall be by one manufacturer, unless otherwise specified.

Standard valves are based on Nibco models. Equivalent style valves as manufactured by Apollo, Crane, DeZurik, Gustin-Bacon, Grinnell, Hammond, Jenkins, Lunkenheimer, Milwaukee Valve, Stockham, Victaulic, or Watts are acceptable. Valves shall be of standard dimensions, comparable to the number specified.

Balancing valves are based on Bell & Gossett models. Equivalent style valves by Armstrong, Flowset, Nibco, Taco, or Victaulic/TA Hydronics are acceptable.

Shutoff Valves:

Except as otherwise specified, all shutoff valves 2-1/2 inch and smaller shall be ball valves and shutoff valves 3 inch and larger shall be butterfly valves, unless required otherwise by local Water Utility specifications.

Ball Valves:

Bronze, two piece full port ball valves with bronze body, solder or threaded ends, chromium plated brass or stainless steel ball, reinforced Teflon seats and seals, blowout proof stem design, rated at 600 PSI non-shock WOG, Nibco model T/S-585-70. Include handle extension for insulated piping, NIB-SEAL by Nibco.

Bronze, two piece full port ball valves with bronze body, solder or threaded ends, stainless steel ball, reinforced Teflon seats and seals, blowout proof stem design, rated at 600 PSI non-shock WOG, Nibco model T/S-585-70-66. Include handle extension for insulated piping, NIB-SEAL by Nibco.

Bronze, three piece full port ball valves with bronze body, solder or threaded ends, stainless steel ball, reinforced Teflon seats and seals, blowout proof stem design, rated at 600 PSI non-shock WOG, Nibco model T/S-595-66. Include handle extension for insulated piping, NIB-SEAL by Nibco.

Balancing Valves:

½" thru 2":

Bronze body balancing valve with sweat or threaded ends, calibrated brass orifice, integral adjustment knob with calibrated scale, memory stop indicator, drain tapping and differential pressure metering connections, Bell & Gossett "Circuit Setter".

Ametal® brass copper alloy, y-pattern, globe type balancing valve with soldered or threaded ends, EPDM o-ring seals, 4-turn digital readout hand wheel with locking, tamper-proof setting, and differential pressure metering connections, separate shutoff valve not required, 300 psi at 250 deg F. Victaulic/Tour & Andersson Series 786, 787 & 78K balancing valves with Victaulic Series 799 or 79V Koil-Kit™ coil pack consisting of Victaulic Series 78U union port fitting, Series 78Y strainer/ball valve or Series 78T union/ball valve combination, and flexible hoses to complete terminal hookup at coil outlet.

UNIONS AND FLANGES

Unions:

Bronze, solder connection, Nibco figure 733.

Flanges:

Cast copper alloy, class 125, MSS SP-106, Nibco figure 741.

DIELECTRIC COUPLINGS

Steel casing, zinc electroplated, with inert thermoplastic lining, various end types, Clearflow, style 47 by Victaulic.

Dielectric flanges 2" and larger; with iron female pipe thread to copper solder joint or brass female pipe thread end connections, non-asbestos gaskets and pressure rating of not less than 175 psig at 180 degrees Fahrenheit. Watts Regulator Company, Lochinvar, Wilkins, Epcos Sales, Inc.

WATER HAMMER SUPPRESSORS

Acceptable manufacturers are MIFAB, PPP, Sioux Chief, and Watts.

Piston compressed air column type, with sealed air chamber.

Water supply piping serving fixtures, appliances, equipment and devices with quick closing and/or solenoid-actuated valves shall be provided with water hammer arrestors. Also provide where indicated on the water supply piping as shown on the water supply isometrics. Devices shall be mechanical arrestors installed in accordance with PDI Standard WH201. Air chambers are not considered to be equal.

Shop drawings are required. Submit to A/E for approval prior to installation.

Water hammer arrestors must be accessible for inspection and replacement. Provide access panel.

PART 3 - EXECUTION

WATER PIPING SYSTEM

Piping shall be pitched to drain entire system; install drain valves at low points. Provide unions at equipment and valves. Provide offsets and transition fittings as required. Avoid dips or depressions in pipe runs.

No water piping shall be installed in exterior walls, unless adequately protected from freezing. Two inch insulation shall be installed on back and sides of chase, front shall be open to room heat, covered only by finished wall material.

Install unions, couplings, or flanges at all final equipment connections and as required to facilitate removal of equipment.

Install dielectric couplings at every connection between copper pipe and other metals. Use dielectric unions for connecting copper and steel piping.

Provide backflow devices as required by Code on water connections to HVAC equipment and other equipment.

Extend hot water piping from water heater and connect to all fixtures and equipment as required.

Hot water and cold water lines shall be kept at least 6 inches apart whenever possible.

Mechanically Formed Tee Fittings:

Form mechanically extracted collars in continuous operation of consisting of drilling pilot hole out of tube surface to form collar, having height of not less than 3 times thickness of tube wall. Use adjustable collaring device. Notch and dimple branch tube.

To form couplings, anneal end of tubing to be expanded, insert expander and reform tube to accept size OD. Socket expansion shall be at least 3 times base tube wall thickness in depth.

Braze joints and couplings in accordance with American Welding Society "lap joint" weld, and Copper Development Association copper tube handbook using BCup filler metal. Soft solder joints will not be permitted with mechanical tee fittings joints.

Hot Water Re-Circulating System:

Install return system including check valves, balancing valves, and pumps. Pitch and grade all lines as required to ensure satisfactory circulation.

Adjust each balancing valve and set position stop. Balance system to minimum flow in return piping branches needed to maintain even supply water temperature and to provide continuous circulation throughout building. Provide balancing report along with O&M manual submittals. Test and demonstrate to A/E upon request.

Valve Installation:

Install shutoff valves with stem vertical. Exception; the stem may be horizontal if a vertical installation would not allow access to the valve handle

All valves with screwed ends shall be installed using "Teflon" tape applied on male portion of piping fitting.

Each individual fixture or piece of equipment shall have an independent shut-off valve adjacent to fixture in addition to the required branch shut-off. Where valves are installed in walls an access panel shall be provided.

Branches:

Valve shut-off full size of branch for each branch take-off to supply stack or fixture group.

Drains:

Provide valved drains at low points of systems as required or directed. All piping shall be arranged to drain through valved drains.

Flushing Mains and Branch Piping:

Upon completion of the water distribution system, test all valves to insure their full opening and flush out the system progressively by opening drain valves and building outlets and permitting the flow to continue from each until the water runs clear.

Pipe Insulation:

Provide pipe insulation for all domestic water piping per Section 22 07 00.

Sterilization of Water Distribution System:

As soon as the water distribution system has been flushed out as above specified, it shall be sterilized in accordance with the requirements of the local Health Department/Water Utility or in the absence of such, by the following method:

Introduce chlorine or a solution of calcium or sodium hypochlorite, filling the lines slowly and applying the sterilizing agent at a rate of 50 parts per million of chlorine, as determined by residual chlorine tests at the ends of the lines. Open and close all valves and hydrants while the system is being chlorinated.

After the sterilizing agent has been applied for 24 hours, test for residual chlorine at the ends of the lines. If less than 5 PPM as indicated, repeat the sterilization process.

When tests show at least 5 PPM of residual chlorine flush out the system until all traces of the chemical used are removed.

Samples

After disinfecting the water distribution system, take water samples to check for bacteria. Take 5 water samples from remote faucets, plus the main entrance. Send the samples to the Wisconsin Department of Health Lab to sample for a safe water supply system.

TESTING

Refer to Division 01, "Starting of Systems" and Section 22 05 00.

Hydro-statically pressure test water piping to 150 psig for 4 hours. No decrease in pressure is allowed. Provide pressure gauge with shutoff and a bleeder valve at the highest point of the system tested. Inspect joints in system under test. No leaks allowed.

Do not conceal pipe until satisfactorily tested.

Testing with air will not be allowed.

END OF SECTION

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SECTION 22 13 00
FACILITY SANITARY SEWERAGE

PART 1 - GENERAL

SCOPE

This section contains specifications for plumbing pipe and pipe fittings for this project. Included are the following topics:

PART 1 – GENERAL

- Scope
- Related Work
- Description
- Quality Assurance
- Submittals

PART 2 – PRODUCTS

- Underground Pipe Fittings
- Above Ground Pipe and Fittings
- Drains and Cleanouts

PART 3 - EXECUTION

- Drain and Vent Piping System
- Pipe Joints
- Safings
- Vent Flashing
- Cleanouts
- Traps
- Testing

RELATED WORK

Requirements of Division 01 shall govern work under this Section.

22 05 00 – Common Work Results for Plumbing

22 05 29 – Hangers and Supports for Plumbing Piping and Equipment

DESCRIPTION

Interior sanitary waste and vent and acid drain and vent piping systems including branches, drains, cleanouts, stacks, fittings and hardware.

Work under this section shall commence from 5 feet outside the building wall with connections to sanitary building sewer lateral(s).

QUALITY ASSURANCE

Substitution of Materials: Refer to Section 22 05 00 and Division 01 of the Project Manual.

Order all pipe with each length marked with the name or trademark of the manufacturer and type of pipe; with each shipping unit marked with the purchase order number, metal or alloy designation, temper, size, and name of supplier.

Any installed material not meeting the specification requirements must be replaced with material that meets these specifications without additional cost to the Owner.

SUBMITTALS

Submit data in accordance with Section 22 05 00 and Division 01 of the Project Manual.

Schedule from the contractor indicating the ASTM, or CISPI specification number of the pipe being proposed along with its type and grade, and sufficient information to indicate the type and rating of fittings for each service.

Include materials of construction, dimensional data, ratings/capacities/ranges, approvals, test data, and identification as referenced in this section and/or on the drawings.

PART 2 - PRODUCTS

UNDERGROUND PIPE AND FITTINGS

Cast iron, no-hub, service weight, ASTM A888, CISPI 301, with rubber gasket couplings, ASTM C564, and stainless steel clamp, CISPI 310. Pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute or receive prior approval of the engineer. Piping and fittings shall be manufactured by AB&I, Charlotte, or Tyler.

Cast iron soil pipe, bell and spigot, service weight, coated, ASTM A74, with rubber gaskets, ASTM C564. Pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute or receive prior approval of the engineer. Piping and fittings shall be manufactured by AB&I, Charlotte, or Tyler.

PVC, Schedule 40, Type I, ASTM D-1785, and PVC drain-waste-vent fittings, ASTM D-2665, with solvent weld joints, ASTM D2855. Solid wall PVC only.

ABOVE GROUND PIPE AND FITTINGS

Cast iron, no-hub, service weight, ASTM A888, CISPI 301, with rubber gasket couplings, ASTM C564, and stainless steel clamp, CISPI 310. Pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute or receive prior approval of the engineer. Piping and fittings shall be manufactured by AB&I, Charlotte, or Tyler.

PVC, Schedule 40, Type I, ASTM D-1785, and PVC drain-waste-vent fittings, ASTM D-2665, with solvent weld joints, ASTM D2855. Solid wall PVC only.

DRAINS AND CLEANOUTS

Drains and cleanouts manufactured by J.R. Smith, Josam, Sioux Chief, Wade, Watts, or Zurn.

Refer to Plumbing Drain and Cleanout Schedule.

PART 3 - EXECUTION

DRAIN AND VENT PIPING SYSTEM

Connect all drain and vent piping to each fixture and piece of equipment and install all required piping as shown on drawings. Provide all necessary fittings and hardware to make required offsets and transitions.

Changes in direction of drainage piping shall be made by the appropriate use of 45 degree wyes, long or short sweep 1/4 bends, 1/6, 1/8, 1/16 bends or combination.

Fittings to be installed to make for the least possibility of stoppage. All horizontal drainage piping less than 3 inches shall be pitched a minimum of 1/4 inch per foot of run. Pitch drainage piping 3 inch and larger a minimum of 1/8" per foot of run.

When running drain piping below a footing and parallel to it, piping shall be in all cases be at least one foot greater in distance away from footing than below its bottom. Where possible, run sewers at centerpoint between two parallel footings and maintain above-mentioned distances at a minimum. When running drain piping under a footing, disturb as little of the soil under footing as possible. Provide concrete fill under all footings where excavations wider than 18" are required.

When running drain piping through a footing, provide a steel pipe sleeve with 2" thick minimum compressible wrap.

Connect to all drains, fixtures and equipment as required.

PIPE JOINTS

Install cast iron pipe and fittings, hubless pattern, as recommended by CISPI standards 301, 310, and in their publication "Installation Suggestions for Cast Iron No-Hub Pipe and Fittings".

Prepare PVC pipe ends as recommended by manufacturer. Use a P-70 type primer (for PVC) and a PVC solvent cement appropriate to the pipe size and temperature range.

VENT FLASHING

All vent pipes passing through roof shall be covered with sheet lead weighing not less than 4 pounds per square foot. Sheet lead shall be well flashed onto the roof, 12" around pipe. Vent pipes shall extend a minimum of 12" above roof.

CLEANOUTS

Provide and install cleanouts as shown on plans and as required by Code.

TRAPS

Trap all fixtures and equipment. Trap seals shall be standard depth, except when deep seals are required by Code. Traps shall be set true and level and located within the limits of the Code requirements. A trap shall not be used as a separator, interceptor or other type of device to retain solids. All traps above grade shall be provided with approved screw-type cleanout plugs.

Traps shall be protected during construction and sealed to prevent foreign matter from entering. Provide adjustable expansion plug, plastic cap, or approved equivalent.

TESTING

Refer to Testing paragraph of Section 22 05 00.

Hydro-statically pressure test all piping to 10 feet of water column pressure for 2 hours. No leaks allowed. Provide mint test of entire system as required by local inspector.

END OF SECTION

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SECTION 22 40 00
PLUMBING FIXTURES

PART 1 - GENERAL

SCOPE

This section includes specifications for plumbing fixtures, faucets and trim for this project. Included are the following topics:

PART 1 – GENERAL

- Scope
- Related Work
- Description
- Reference Standards
- Quality Assurance
- Submittals

PART 2 – PRODUCTS

- General
- Manufacturers

PART 2 - EXECUTION

- Installation

RELATED WORK

Requirements of Division 01 shall govern work under this Section.

Section 22 05 00 – Common Work Results for Plumbing

Section 22 05 29 – Hangers and Supports for Plumbing Piping and Equipment

Section 22 11 00 – Facility Water Distribution

Section 22 13 00 – Facility Sanitary Sewerage

DESCRIPTION

Furnish and install plumbing fixtures with traps, drains, stops, faucets, flush valves, carriers and hardware.

REFERENCE STANDARDS

ANSI A112.6.1M-88	Supports for Off-the Floor Plumbing Fixtures for Public Use.
ANSI A112.18.1-94	Finished and Rough Brass Plumbing Fixture Fittings.
ANSI A112.19.2M-82	Vitreous China Plumbing Fixtures.
ANSI A112.19.5-79(R1990)	Trim for Water Closet Bowls, Tanks and Urinals.
ASSE 1011-93	Hose Connection Vacuum Breakers.

QUALITY ASSURANCE

Substitution of Materials: Refer to 22 05 00 and Division 01 of the Project Manual.

Plumbing products requiring approval by the State of Wisconsin Dept. of Commerce must be approved or have pending approval at the time of shop drawing submission.

SUBMITTALS

Submit product data sheets in accordance with Division 01 and Section 22 05 00.

Include 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.

PART 2 - PRODUCTS

GENERAL

Fixtures must conform to general requirements given below and to specified requirements for each type.

Vitreous china fixtures shall conform to ANSI A112.19.2M.

Stainless steel fixtures shall conform to ANSI A112.19.3.

Fixtures shall be installed so that parts are accessible for repairs when fixtures are in place. Manufacturer's trademark or name shall be visible on fixtures.

Faucets, traps, exposed fittings and trim shall be polished chrome plated unless otherwise specified. Provide polished chrome plated nipples at all lavatories.

Exposed piping penetrating walls, floors or ceilings shall have chrome plated escutcheons, or flanges of sufficient depth to seal the opening.

Fixture stops shall be heavy duty commercial grade, slow compression angle valves with 1/2" inlet and 3/8" or 1/2" chrome plated flexible riser.

Traps shall be semi-cast 17-gauge brass, chrome plated, with cleanout and escutcheon. Sink traps shall be 1-1/2" minimum.

MANUFACTURERS

Vitreous china fixtures shall be manufactured by American-Standard, Kohler, or Sloan. Fixture color shall be white unless specified otherwise.

Flush valves shall be manufactured by Sloan ("Royal" series), or Zurn ("Aquavantage" series).

Solid plastic toilet seats shall be manufactured by Bemis, Benneke, Centoco, Church, Olsonite, Kohler, or Zurn. Seat color shall match fixture unless specified otherwise.

Carriers for wall-mounted fixtures shall be manufactured by J.R. Smith, Josam, MIFAB, Wade, Watts, or Zurn.

Stainless steel sinks shall be manufactured by Advance-Tabco, Elkay, or Just.

Manual faucets shall be manufactured by American Standard, Chicago Faucet, Kohler, Moen Commercial, Speakman, Symmons, T&S Brass, Sloan (Polaris), or Zurn.

Emergency eyewash and shower equipment shall be manufactured by Bradley, Chicago Faucet, Encon, Guardian, Haws, or Speakman.

Emergency equipment mixing valves shall be manufactured by Bradley, Haws, Lawler, Leonard, or Powers.

Heavy duty stops and supplies shall be manufactured by Chicago Faucet, Dearborn, EBC, Kohler, McGuire, T&S Brass, or Zurn.

Lavatory drains shall be offset type, 1-1/4" size, with flat grid strainer, manufactured by Dearborn, EBC, Keeney, Kohler, McGuire, or Zurn.

Traps shall be semi-cast 17 gauge brass, chrome plated, with cleanout and escutcheon as manufactured by Dearborn, EBC, Keeney, Kohler, McGuire, or Zurn.

Supply, drain and trap insulating kits shall be manufactured by Brocar, EBC, McGuire, Plumberex, or Truebro.

Special traps and solids interceptors shall be manufactured by J.R. Smith, Josam, Wade, Watts, or Zurn.

Fixtures:

See Plumbing Fixture Schedule on drawings for type, manufacturer, and model for fixtures.

PART 3 - EXECUTION

INSTALLATION

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.

Install each fixture with trap easily removable for servicing and cleaning. Install fixture stops in readily accessible location for servicing. Individual supplies to fixtures shall be provided with support to prevent movement.

Install barrier free fixtures in compliance with COMM 52, 69 and Federal ADA Accessibility Guidelines. Install barrier free lavatory traps parallel and adjacent to wall and supplies and stops elevated to avoid contact by wheelchair users.

Seal joints between countertop, wall, floor and fixtures with G.E. Silicone caulk; white, clear or color to match fixture with colored caulk by fixture manufacturer.

Each fixture shall have a stop valve installation to control the fixture. Stop valves shall be heavy duty type with brass stems and screwed or sweat inlet connections. Compression type inlets are not acceptable.

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.

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.

After installation, fixtures shall be protected to prevent scratching or other damage during construction.

Prior to acceptance, fixtures shall be cleaned with compounds recommended by the respective manufacturer.

END OF SECTION

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SECTION 23 05 00

COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

SCOPE

This section includes information common to two or more technical specification sections or items that are of a general nature, not conveniently fitting into other technical sections. Included are the following topics:

PART 1 - GENERAL

- Scope
- Related Work
- Reference Standards
- Quality Assurance
- Abbreviations
- Definitions
- Drawings
- Electronic Drawings
- Codes and Standards
- Continuity of Existing Services
- Protection of Finished Surfaces
- Submittals
- Specified Materials and Equipment
- Equipment Installation
- Off Site Storage
- Certificates and Inspections
- Operating and Maintenance Instructions
- Training of Owner Personnel
- Record Drawings
- Project Closeout
- Commissioning
- Testing and Balancing
- Temporary Heating and Cooling

PART 2 - PRODUCTS

- Access Panels
- Pipe Penetrations
- Duct Penetrations
- Identification

PART 3 - EXECUTION

- Demolition
- Cutting and Patching
- Building Access
- Equipment Access
- Coordination of Work
- Pipe Penetrations
- Duct Penetrations
- Cleaning
- Identification
- Lubrication
- Project Closeout

Division 23 work as specified shall be provided by HVAC Contractor unless otherwise specified on Bid Form.

RELATED WORK

Conditions of the Contract and portions of Division One of this Project Manual apply to this Section as though repeated herein.

Applicable provisions of Division 01 govern work under this Section.

Section 01 91 00 - Commissioning
Section 23 05 13 - Common Motor Requirements for HVAC.
Section 23 05 93 – Testing, Adjusting and Balancing for HVAC
Section 23 33 00 - Air Duct Accessories.

REFERENCE

Applicable provisions of Division 1 govern work under this section.

REFERENCE STANDARDS

Abbreviations of standards organizations referenced in other sections are as follows:

AABC	Associated Air Balance Council
ABMA	American Boiler Manufacturers Association
ADC	Air Diffusion Council
AGA	American Gas Association
AMCA	Air Movement and Control Association
ANSI	American National Standards Institute
ARI	Air-Conditioning and Refrigeration Institute
ASHRAE	American Society of Heating, Refrigerating and Air Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
AWWA	American Water Works Association
AWS	American Welding Society
CGA	Compressed Gas Association
CTI	Cooling Tower Institute
EPA	Environmental Protection Agency
GAMA	Gas Appliance Manufacturers Association
IEEE	Institute of Electrical and Electronics Engineers
ISA	Instrument Society of America
MCA	Mechanical Contractors Association
MICA	Midwest Insulation Contractors Association
MSS	Manufacturer's Standardization Society of the Valve & Fitting Industry, Inc.
NBS	National Bureau of Standards
NEBB	National Environmental Balancing Bureau
NEC	National Electric Code
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association
SMACNA	Sheet Metal and Air Conditioning Contractors' National Association, Inc.
UL	Underwriters Laboratories Inc.
ASTM E814	Standard Test Method for Fire Tests of Through-Penetration Fire Stops
ASTM E84	Standard Test Method for Surface Burning Characteristics of Building Materials
UL1479	Fire Tests of Through-Penetration Firestops
UL723	Surface Burning Characteristics of Building Materials

QUALITY ASSURANCE

Substitution of Materials: Refer to Division 01 and the General Conditions of the Contract, Article 3.

Contractor shall review his own work for compliance with Construction Documents. Prior to punch list activity by A/E, contractor shall provide documentation to A/E that a review has taken place and shall issue a letter indicating that Work has been performed in compliance with Construction Documents. In the event Contractor does not satisfactorily review his own work and results in additional site visits by A/E, Contractor shall reimburse A/E for additional time required to close out Project.

ABBREVIATIONS

A/E	Architect/Engineer
CxA	Commissioning Authority
GC	General Contractor
FPC	Fire Protection Contractor
PC	Plumbing Contractor
HC	Heating Contractor
EC	Electrical Contractor
TCC	Temperature Contractor
DDC	Direct Digital Controls
BAS	Building Automation System
TCS	Temperature Control System

DEFINITIONS

Furnish:

Supply and deliver to Project site ready for unpacking, assembly and installation

Install:

Operations at Site including unpacking, assembling, erecting, placing, anchoring, applying, finishing, cleaning, and connecting related devices required for product fully functional for intended use after installation.

Provide:

Furnish and install, such that product is fully functional for intended use.

DRAWINGS

Drawings show general arrangement of piping, equipment and appurtenances and shall be followed as closely as actual building construction and work of other trades permits. Work shall conform to requirements shown on Drawings. General and structural drawings shall take precedence. Because of the scale of Drawings, it is not possible to indicate all offsets, fittings and accessories required. Investigate structural and finish conditions affecting work and arrange work accordingly, providing offsets, fittings and accessories required to meet constructed conditions.

HVAC equipment and systems, including piping and ductwork shall be installed as high as possible unless otherwise noted on Drawings. Equipment and systems shall also be installed to maintain required operation and maintenance clearances.

ELECTRONIC DRAWINGS

Drawings in electronic format will be made available to successful HVAC contractor. Drawings provided may or may not be updated to reflect Addenda items. Use of Drawings is limited to this Project and may not be forwarded to any other party for any purpose. Use of files will be at Contractor's sole risk and without liability or legal exposure to JDR Engineering, Inc or its employees. Architectural drawings or any other drawings not produced by JDR Engineering will not be provided.

CODES AND STANDARDS

Materials and workmanship shall comply with applicable codes, specifications, local ordinances, industry standards and utility company regulations. In case of differences between building codes, specifications, state laws, local ordinances, industry standards and utility company regulations and contract documents, the most stringent shall govern. Promptly notify A/E in writing of differences.

Non-Compliance:

If Contractor installs materials or performs Work that does not comply with above requirements, he shall correct Work and shall bear costs arising from correcting deficiencies.

CONTINUITY OF EXISTING SERVICES

Refer to Division 01 of the Project Manual.

Do not interrupt or change existing services without prior approval from Owner, Architect, Engineer or Construction Manager. When interruption is required, coordinate down-time with Owner to reduce disruption to activities. Scope of Work is indicated on Contract Documents or described herein. Unless specifically stated, any work involved in interrupting or changing existing services is to be done during normal working hours.

PROTECTION OF FINISHED SURFACES

Refer to Division 01 of the Project Manual.

Furnish 1 can of touch-up paint for each different color factory finish to be finished surface of product. Deliver touch-up paint with other "loose and detachable parts" as covered in General Requirements.

SLEEVES AND OPENINGS

Refer to Division 01 of the Project Manual.

SEALING AND FIRE STOPPING

Sealing and firestopping of sleeves/openings between ductwork, piping, etc. and the sleeve, structural or partition opening shall be the responsibility of the contractor whose work penetrates the opening. The contractor responsible shall hire individuals skilled in such work to do the sealing and fireproofing. These individuals hired shall normally and routinely be employed in the sealing and fireproofing occupation.

SUBMITTALS

Refer to Division 01 and General Conditions of the Contract.

Shop Drawings are to be reviewed by lead contractor and HVAC contractor before submission to A/E. Submittals shall be stamped by contractor and clearly indicate corrections made by contractor during review process. Submittals not reviewed and stamped by contractor will be automatically rejected.

Submit for equipment and systems specified in respective specification sections, marking each submittal with specification section number. Mark general catalog sheets and drawings to indicate specific items being submitted and proper identification of equipment by name and number, as identified in Contract Documents. Include plan designation mark (i.e. "AHU-1") on submittals. Include dimensions, capacities, ratings, and installation instructions.

Before submitting electrically powered equipment, verify electrical power and control requirements for equipment are in agreement with motor schedule on HVAC and electrical drawings. Include statement on Shop Drawing transmittal to Architect/Engineer if equipment submitted and motor schedules are not in agreement, indicating discrepancies. See related comments in Section 23 05 13, Part 1 under Electrical Coordination.

Include wiring diagrams of electrically powered equipment.

Firestop Systems:

Contractor shall submit product data for each firestop system. 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. 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.

Submit manufacturer's color charts where finish color is specified to be selected by Architect/Engineer.

Submit quantity of Shop Drawings specified under Division 01 Specification Section titled "Submittals."

Submittals shall be legible, clear and complete. Shop Drawings submitted incomplete, illegible or not specific to Project will be returned as "not reviewed". In addition, equipment installed without having approved Shop Drawings will be considered defective and shall be removed and replaced with approved equipment at no expense to Project.

SPECIFIED MATERIALS AND EQUIPMENT

Design is based on equipment specified by manufacturer and model number as specified on drawing schedules. Where certain items are specified by manufacturer or trade name, Contractor's bid shall be based on use of named item. Where 1 make is described and other makes are listed, comparable models of other named equipment may also be used, provided they meet requirements of Specifications.

When equipment or accessories used differ in arrangement, configuration, dimensions, ratings, or engineering parameters from those on Drawing schedules, Contractor shall be responsible for costs involved in integrating equipment or accessories into system. Contractor shall be responsible for obtaining original design performance from system into which items are placed, regardless of whether manufacturer/model is specified equivalent or substitute. This may include changes found necessary during testing, adjusting, and balancing phase of Project.

If Contractor wishes to use items other than those named in Specifications in base bid, request for approval of substitution must be made in writing to A/E at least 14 days prior to opening of bids. Include complete technical and descriptive data with request. If approved, an Addendum will be issued notifying bidders of approval. Request for approval will be considered only if requested by prime bidding Contractor.

EQUIPMENT INSTALLATION

Drawings show general arrangement and location of equipment and appurtenances. It is Contractor's responsibility to install equipment in a location and manner that allows for proper service and maintenance access to equipment. Work shall generally conform to requirements shown on Drawings. However, location of equipment may require field adjustments to obtain required service space. DO NOT SCALE OFF PLANS to determine proper location of equipment. Because of scale of Drawings, it is not possible to indicate exact routing of ductwork and piping, and offsets, fittings and accessories required to provide proper service access to equipment. Contractor shall route and install ductwork and piping to provide required service access to equipment.

If, during construction phase of Project, contractor feels inadequate space exists, or equipment locations must be substantially modified to provide proper service and maintenance access, prior to installing equipment, contractor shall notify engineer in writing, outlining general concerns and proposed modifications. Equipment installed without providing manufacturer's required maintenance and service clearance shall be considered defective. Contractor shall remove and relocate piping, ductwork and equipment, to provide required service clearances at contractor's expense.

OFF-SITE STORAGE

Refer to Division 01 of the Project Manual.

CERTIFICATES AND INSPECTIONS

Refer to the General Conditions of the Contract, Article 13.

Obtain and pay for required Federal, State and local installation inspections, certificates and permits required, except those provided by Architect/Engineer in accordance with State and local Codes. Deliver originals of certificates to Architect or Construction Manager.

OPERATION AND MAINTENANCE DATA

Refer to Division 01 of the Project Manual.

Provide HVAC systems and equipment operation and maintenance manuals in accordance with requirements of Project Specifications.

Assemble material in 3-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 the following information:

- Copies of all approved shop drawings.
- Manufacturer's instructions for installation, operation, and maintenance.
- Manufacturer's wiring diagrams for electrically powered equipment.
- Records of tests performed to indicate compliance with system requirements (system start-up reports).
- Temperature control Record Drawings and control sequences.
- Parts lists for manufactured equipment.
- Valve schedules.
- Lubrication instructions, including list/frequency of lubrication done during construction.
- Warranties.
- Testing, adjusting and balancing data.
- Additional information as required in technical specification sections.

TRAINING OF OWNER PERSONNEL

Instruct Owner's personnel in proper operation and maintenance of systems and equipment provided as part of Project, using Operating and Maintenance manuals during instruction. Demonstrate startup and shutdown procedures for equipment. Training shall be during normal working hours.

Provide a total of 16.0 hours of training (minimum) over a total of 4.0 training sessions. Coordinate with Owner at least 2 weeks prior to scheduling training systems.

All training sessions shall be videotaped and included in the operation and maintenance manuals. The contractor shall provide the video camera and camera operator. Video files shall be in electronic format (DVD).

RECORD DRAWINGS

Refer to Division 01 of the Project Manual.

Maintain Record Drawings on daily basis to be turned over at completion of Project.

Maintain temperature control record drawings on originals prepared by installing contractor/subcontractor. Include copies of record drawings with Operating and Maintenance manuals.

PROJECT CLOSEOUT

Refer to Division 01 of Project Manual.

The Contractor shall complete and provide items and materials, training and start-up associated with project closeout as specified under Division 1 of the Project Manual. In addition to these items, the Contractor shall provide the following items prior to acceptance of the installation as specified in accordance with all applicable Codes and all Sections of this Specification:

- Final air and water system balancing completed in accordance with the requirements of Section 23 05 93 and code, including the submission of testing, adjusting and balancing reports. Reports shall indicate the amount of total supply air, return air and outside ventilation air being provided to the spaces and to the air handling system(s).

- Submission of Operating and Maintenance instructions in accordance with the requirements of Division 1, of this Section, and code. Operation and Maintenance Manuals shall include a copy of completed testing, adjusting and balancing report for Owner's records.
- Submission of start-up report for temperature control system, signed by technician in responsible charge of control system, indicating system has been adjusted, calibrated and put into operation in accordance with requirements of this specification and code.

COMMISSIONING

The project will be commissioned by an independent third party commissioning authority. See specification Section 01 91 00 for contractor commissioning requirements.

TESTING AND BALANCING

Testing and balancing of HVAC systems will be contracted separately by the owner. This contractor shall fully coordinate with the test and balance contractor during testing and balancing.

TEMPORARY HEATING AND COOLING

No HVAC equipment, ductwork, piping, etc. shall be used for temporary building heating, cooling or ventilation at any time during construction of the building. The owner (Dane County) and Commissioning Agent shall give approval prior to energizing any HVAC equipment at the completion of the project.

PART 2 - PRODUCTS

ACCESS PANELS

Provide access panels at locations requiring access to mechanical equipment. Locations include, but are not limited to areas above drywall ceilings, shaft enclosures and other furred-in spaces concealing valves, ducts or equipment. Provide UL listed, fire rated access panels when penetrating fire rated chase or shaft areas.

Access panels shall be of size required to provide adequate access to equipment. Minimum size shall be 12 inch by 12 inch for hand access and 24 inch by 24 inch for body access.

Panels shall be Milcor brand or equivalent.

Panels shall include concealed hinges, cam type locking devices, and have frame/border type necessary for particular wall or ceiling construction they are installed. Access panels shall be flush mounted, recessed frame type units. Access panels shall be prime coated steel, able to accept field painting for general office applications and stainless steel for use in labs, toilet rooms, shower rooms and similar wet areas.

Refer to Architectural Room Finish Schedule for wall and ceiling surfaces and finishes.

Panel construction shall utilize 16 gauge frame with not less than 18 gauge hinged door panel. Door locks shall be screwdriver operated for panels in general location applications and shall be key locked for public area applications.

PIPE PENETRATIONS

Fire, Smoke and Fire/Smoke Rated Surfaces:

3M CP 25N/S or CP 25S/L caulk, 3M FS 195 wrap/strip with restricting collar, 3M CS 195 composite sheet, Pipe Shields Inc. Series F fire barrier kits, Proset Systems fire rated floor and wall penetrations, Insta-Foam Products Insta-Fire Seal Firestop Foam or Dow Corning Fire Stop System.

All fire stopping systems shall be provided by the same manufacturer.

UL listed or tested by independent testing laboratory, approved by State and Local Code jurisdictions. Use product that has a rating not less than rating of wall or floor being penetrated.

Sleeves in concrete to be Schedule 40 steel pipe with integral water stop unless fire stop material used includes a sleeve that is an integral part of rated assembly.

Non-Rated Surfaces:

Stamped steel, chrome plated, hinged, split ring escutcheons or floor/ceiling plates for covering openings in occupied spaces.

In exterior wall openings below grade, use modular mechanical type seal consisting of interlocking synthetic rubber links shaped to continuously fill the annular space between the un-insulated pipe and cored opening or a water-stop type wall sleeve.

At interior partitions where pipe penetrations are sealed, use Tremco Dymonic, Sika Corp. Sikaflex 1a, Sonneborn Sonolastic NPI, or Mameco Vulken 116 urethane caulk to effect seal. Use galvanized sheet metal sleeves in hollow wall penetrations.

DUCT PENETRATIONS

Fire, Smoke and Fire/Smoke Rated Surfaces:

3M CP 25N/S or CP 25S/L caulk, 3M FS 195 wrap/strip with restricting collar, Insta-Foam Products Insta-Fire Seal Firestop Foam or Dow Corning Fire Stop System.

UL listed or tested by independent testing laboratory, approved by State and Local Code jurisdictions. Use a product that has a rating not less than rating of wall or floor being penetrated. Sleeves in concrete to be minimum 16 gauge galvanized steel sleeves.

Non-Rated Surfaces:

Pack annular space with fiberglass batt insulation or mineral wool insulation. Provide 4" sheet metal escutcheon around on both side of partition or floor to cover annular space.

IDENTIFICATION

Stencils:

Not less than 1 inch high letters/numbers for marking pipe and equipment.

Engraved Name Plates:

White letters on black background, 1/16 inch thick plastic laminate, beveled edges, screw mounting, Setonply ® Style 2060 by Seton Name Plate Company or Emedolite Style EIP by EMED Co., or equal by W. H. Brady.

Valve Tags:

Round brass tags with ½ inch numbers, ¼ inch system identification abbreviation, 1¼ inch minimum diameter, with brass jack chains or brass "S" hooks around valve stem, available from EMED Co., Seton Name Plate Company, or W. H. Brady.

Pipe Markers:

At least ¾ inch high legend for piping under 3 inch diameter and at least 2 inch high legend for piping 3 inch diameter and larger. Include flow arrows. Manufacturers: W.H. Brady Co., EMED Co. or Seton Name Plate Company.

PART 3 - EXECUTION

DEMOLITION

Perform all demolition as indicated on the drawings to accomplish new work. Where demolition work is to be performed adjacent to existing work that remains in an occupied area, construct temporary dust partition to minimize the amount of contamination of the occupied space. Where pipe or duct is removed and not reconnected with new work, cap ends of existing services as if they were new work. Coordinate work with the Owner to minimize disruption to the existing building occupants.

All pipe, wiring and associated conduit, insulation, ductwork, and similar items demolished, abandoned, or deactivated are to be removed from the site by the Contractor. All piping and ductwork specialties are to be removed from the site by the Contractor unless they are dismantled and removed or stored by the Owner. All designated equipment is to be turned over to the Owner for their use at a place and time so designated. Maintain the condition of material and/or equipment that is indicated to be reused equal to that existing before work began.

CUTTING AND PATCHING

Refer to Division 01 requirements.

BUILDING ACCESS

Arrange for necessary openings in building to allow for admittance of all apparatus. When building access was not previously arranged and must be provided by Contractor, restore opening to original condition after the apparatus has been brought into building. Coordinate with Architect/Engineer.

EQUIPMENT ACCESS

Install piping, conduit, ductwork, 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 access is available for equipment and specialties. Where access is required in plaster walls or ceilings, furnish and install access doors required. Coordinate for installation of access doors utilizing General Contractor and other appropriate on-site subcontractor for access door installation.

Accessible ceilings, (i.e. lay-in ceilings) do not require access panels. Provide color coded thumb tacks or screws, depending on surface, for use in accessible ceilings.

COORDINATION OF WORK

Verify devices are compatible for surfaces on which they are used. This includes, but is not limited to, diffusers, registers, grilles, and recessed or semi-recessed heating and cooling terminal units installed in/on architectural surfaces.

Coordinate work with other contractors prior to installation. Installed work not coordinated and that interferes with other contractor's work shall be removed or relocated at installing contractor's expense.

Verify system completion prior to start of testing and balancing. Work to be completed prior to testing and balancing shall include, but not be limited to the following: flushing, pressure testing, chemical treatment, filling of hydronic systems, proper pressurization and air venting of hydronic systems, cleaning and replacement of filters, cleaning of strainers, duct and pipe system cleaning, adjusting and calibration of controls, controls cycled through their sequences. Install dampers, shutoff and balancing valves, flow measuring devices, gauges, temperature controls for fully functional and balanced systems. Demonstrate starting, interlocking and control features of each system so test and balance agency can perform work. Provide appropriate sections of work with required wall, roof and floor opening locations and dimensions. If Contractor neglects to coordinate information, openings shall be the responsibility of Contractor.

PIPE PENETRATIONS

General:

Coordinate location of building surface penetrations with appropriate contractors. Furnish sleeves, inserts, and devices to be built into structure to contractor performing Work. Prepare Shop Drawings for approval for penetrations of structural elements, including floor slabs, shear walls, and bearing walls. Do not allow penetrations to be made until Shop Drawings are approved.

Fire Rated Surfaces:

Install products in accordance with the manufacturer's instructions where pipe penetrates a fire rated surface. When pipe is insulated, use product that maintains integrity of insulation and vapor barrier. Where sleeve must be installed in existing floor, grout area around sleeve to restore floor integrity. In wet area floor penetration, top surface of penetration to be 2 inches above adjacent floor with additional height obtained by means of concrete pad poured integral with floor.

Wet areas for this Paragraph are rooms or spaces containing air handling unit coils, convertors, pumps, chillers, boilers, and similar equipment.

Non-Rated Surfaces:

Install escutcheons or floor/ceiling plates where pipe penetrates non-fire rated surfaces. Size units to accommodate insulation, where applicable.

In exterior wall openings below grade, place water-stop type wall sleeve before concrete pour or core drill opening after pour. Assemble rubber links to proper size for pipe and tighten in place in accordance with manufacturer's instructions.

Install galvanized sheet metal sleeve in hollow wall penetrations to provide backing for sealant. Apply sealant to both sides of penetration in a manner that annular space between pipe sleeve and pipe or insulation is completely blocked.

Completely seal pipe penetrations through all interior walls. All penetrations for piping thru interior walls are required to be air tight.

DUCT PENETRATIONS

General:

Coordinate location of building surface penetrations with appropriate contractors. Furnish sleeves, inserts, and other devices to be built into structure to contractor performing Work. Prepare Shop Drawings for approval for penetrations of structural elements, including floor slabs, shear walls, and bearing walls. Do not allow penetrations to be made until Shop Drawings are approved.

In wet area, top surface of penetration to be 2 inches above adjacent floor. Additional height shall be obtained by means of concrete pad or pipe sleeve poured integral with floor. Wet areas are mechanical equipment rooms or spaces containing air handling unit coils, convertors, pumps, chillers, boilers, and similar equipment.

Fire Rated Surfaces:

Install products in accordance with manufacturer's instructions where duct penetrates fire rated surface. When duct work is insulated, use product that maintains integrity of insulation and vapor barrier. Where sleeve must be installed in existing floor, grout area around sleeve to restore floor integrity. In a wet area floor penetration, top surface of penetration to be 2 inches above adjacent floor with additional height obtained by means of concrete pad poured integral with floor. Wet areas for this Paragraph are rooms or spaces containing air handling unit coils, convertors, pumps, chillers, boilers, and similar equipment.

Non-Rated Surfaces:

Install sheet metal blank-off plates and caulk where ducts penetrate non-fire rated surfaces. Size units to accommodate insulation, where applicable.

Install galvanized sheet metal sleeve to provide backing for sealant. Apply sealant to both sides of penetration in manner that annular space between duct sleeve and duct or insulation is completely blocked.

Completely seal duct penetration through all interior walls. All penetrations for duct thru interior walls are required to be air tight.

CLEANING

Contractor shall, at all times, keep premises free of waste or surplus materials, rubbish and debris caused by his employees or resulting from his work.

After equipment and fixtures have been installed, Contractor shall remove stickers, stains, labels and temporary covers.

Foreign matter shall be removed from pipes, tanks, pumps, fans, motors, devices, switches, fixtures, panels and ductwork before acceptance of systems.

Contractor shall leave his portion of Work in safe and clean condition ready for operation.

In case of dispute, Owner may remove rubbish, excess materials or do cleaning, and charge cost to Contractor.

IDENTIFICATION

Identify equipment in mechanical equipment rooms and above ceilings, including terminal heating devices by stenciling equipment number and service with 1 coat of black enamel against light background or white enamel against dark background. Use primer where necessary for proper paint adhesion. Do not label equipment in occupied spaces (for example cabinet heaters and ceiling fans).

Identification plates on equipment shall be free of excess paint and shall be legible.

Where stenciling is not appropriate for equipment identification, engraved nameplates shall be used.

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. Place flow directional arrows at each pipe identification location. Use 1 coat of black enamel against light background or white enamel against dark background.

Identify valves with brass tags bearing system identification and valve sequence number. Valve tags are not required at terminal device unless valves are greater than 10 feet from device or located in another room not visible from terminal unit. Provide 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. Schedules in mechanical rooms shall be framed under clear plastic.

Use engraved nameplates to identify control equipment and motor starters. Motor starters shall be provided with engraved nameplate identifying piece of equipment it serves by plan identification (i.e. "AHU-1").

Identify fire dampers. Dampers shall be permanently identified on exterior of duct with label (or painted) having a minimum letter height of 1 inch. Identification shall read "FIRE DAMPER".

LUBRICATION

Lubricate bearings with lubricant as recommended by manufacturer before equipment is operated for any reason. Once equipment has been run, maintain lubrication in accordance with manufacturer's instructions until Owner accepts Work. Maintain log of lubricants used and frequency of lubrication. Include information in Operating and Maintenance Manuals at completion of Project.

PROJECT CLOSEOUT

Contractor shall provide the following submittal data prior to final site walk-through review (found on next page). If this closeout work is not completed or is inaccurately completed, the Contractor shall be responsible for the expense of additional site reviews made by A/E.

END OF SECTION

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SECTION 23 05 13

COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

SCOPE

This sections includes requirements for single and three phase motors that are used with equipment specified in other sections. Included are the following topics:

PART 1 - GENERAL

- Scope
- Related Work
- Reference
- Reference Standards
- Quality Assurance
- Shop Drawings
- Operating and Maintenance Data
- Electrical Coordination
- Product Criteria

PART 2 - PRODUCTS

- Three Phase, Single Speed Motors
- Single Phase, Single Speed Motors

PART 3 - EXECUTION

- Installation

RELATED WORK

- Section 01 91 00 - Commissioning
- Section 23 09 14 - Pneumatic and Electric Instrumentation and Control Devices for HVAC

Division 26 00 00 - Electrical

REFERENCE

Applicable provisions of Division 1 govern work under this section.

REFERENCE STANDARDS

ANSI/IEEE 112	Test Procedure for Polyphase Induction Motors and Generators
ANSI/NEMA MG-1	Motors and Generators
ANSI/NFPA 70	National Electrical Code

QUALITY ASSURANCE

Refer to division 1, General Conditions, Equals and Substitutions.

SHOP DRAWINGS

Refer to division 1, General Conditions, Submittals.

Include with the equipment which the motor drives the following motor information: motor manufacturer, horsepower, voltage, phase, hertz, rpm, full load efficiency. Include project wiring diagrams prepared by the contractor specifically for this work.

OPERATION AND MAINTENANCE DATA

All operations and maintenance data shall comply with the submission and content requirements specified under section GENERAL REQUIREMENTS.

In addition to the general content specified under GENERAL REQUIREMENTS supply the following additional documentation:

1. Lubrication instructions, including list/frequency of lubrication
2. Table noting full load power factor, service factor, NEMA design designation, insulation class and frame type for each motor provided

ELECTRICAL COORDINATION

All starters, overload relay heater coils, disconnect switches and fuses, relays, wire, conduit, pushbuttons, pilot lights, and other devices required for the control of motors or electrical equipment are furnished and installed by the Electrical Contractor, except as specifically noted elsewhere in this division of specifications.

Electrical drawings and/or specifications show number and horsepower rating of all motors furnished by this Contractor, together with their actuating devices if these devices are furnished by the Electrical Contractor. Should any 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 the architect/engineer of such discrepancy. Costs involved in any changes required due to equipment substitutions initiated by this contractor will be the responsibility of this contractor. See related comments in Section 23 05 00 - Common Work Results for HVAC, under Shop Drawings.

Electrical Contractor will provide all power wiring and control wiring, except temperature control wiring.

Furnish project specific wiring diagrams to Electrical Contractor for all equipment and devices furnished by this Contractor and indicated to be wired by the Electrical Contractor.

PRODUCT CRITERIA

Motors to conform to all applicable requirements of NEMA, IEEE, ANSI, and NEC standards and shall be listed by U.L. for the service specified.

Select motors for conditions in which they will be required to perform; i.e., general purpose, splashproof, explosion proof, standard duty, high torque or any other special type as required by the equipment or motor manufacturer's recommendations.

Furnish motors for starting in accordance with utility requirements and compatible with starters as specified.

PART 2 - PRODUCTS

THREE PHASE, SINGLE SPEED MOTORS

Use NEMA rated 460 volt, three phase, 60 hertz motors for all motors 1/2 HP and larger unless specifically indicated.

Use NEMA general purpose, continuous duty, Design B , normal starting torque, T-frame or U-frame motors with Class B or better insulation unless the manufacturer of the equipment on which the motor is being used has different requirements. Use open drip-proof motors unless totally enclosed fan-cooled, totally enclosed non-ventilated, explosion-proof, or encapsulated motors are specified in the equipment sections.

Use grease lubricated anti-friction ball bearings with housings equipped with plugged/capped provision for relubrication, rated for minimum AFBMA 9, L-10 life of 20,000 hours. Calculate bearing load with NEMA minimum V-belt pulley with belt center line at the end of NEMA standard shaft extension. Stamp bearing sizes on nameplate.

All open drip-proof motors to have a 1.15 service factor. Other motor types may have minimum 1.0 service factors.

All 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 the values listed below when tested in accordance with NEMA MG 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

MOTOR HP	----Totally Enclosed Fan-Cooled---- -----Nominal Motor Speed-----		
	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

SINGLE PHASE, SINGLE SPEED MOTORS

Use NEMA rated 115 volt, single phase, 60 hertz motors for all motors 1/3 HP and smaller.

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.

PART 3 - EXECUTION

INSTALLATION

Mount motors on a rigid base designed to accept a motor, using shims if required under each mounting foot to get a secure installation.

When motor will be flexible coupled to the driven device, mount coupling to the shafts in accordance with the coupling manufacturer's recommendations. Using a dial indicator, check angular misalignment of the two shafts; adjust motor position as necessary so that the angular misalignment of the shafts does not exceed 0.002 inches per inch diameter of the coupling hub. Again using the dial indicator, check the shaft for run-out to assure concentricity of the shafts; adjust as necessary so that run-out does not exceed 0.002 inch.

When motor will be connected to the driven device by means of a belt drive, mount sheaves on the appropriate shafts in accordance with the manufacturer's instructions. Use a straight edge to check alignment of the sheaves; reposition sheaves as necessary so that the straight edge contacts both sheave faces squarely. After sheaves are aligned, loosen the adjustable motor base so that the belt(s) can be added and tighten the base so that the belt tension is in accordance with the drive manufacturer's recommendations. Frequently recheck belt tension and adjust if necessary during the first day of operation and again after 80 hours of operation.

Verify the proper rotation of each three-phase motor as it is being wired or before the motor is energized for any reason.

Lubricate all motors requiring lubrication. Record lubrication material used and the frequency of use. Include this information in the maintenance manuals.

END OF SECTION

SECTION 23 05 15

PIPING SPECIALTIES

PART 1 - GENERAL

SCOPE

This section contains specifications for HVAC piping specialties for all piping systems. Included are the following topics:

PART 1 - GENERAL

- Scope
- Related Work
- Reference
- Quality Assurance
- Shop Drawings
- Operation and Maintenance Data
- Design Criteria

PART 2 - PRODUCTS

- Thermometers
- Thermometer Sockets
- Test Wells
- P/T (Pressure/Temperature) Test Plugs
- Hose Connection Caps
- Pressure Gauges
- Air Vents
- Suction Diffusers

PART 3 - EXECUTION

- Thermometers
- Thermometer Sockets
- Test Wells
- P/T (Pressure/Temperature) Test Plugs
- Pressure Gauges
- Air Vents
- Suction Diffusers
- Construction Verification Items

RELATED WORK

- Section 01 91 00 – Commissioning
- Section 23 05 23 - General-Duty Valves for HVAC Piping
- Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment
- Section 23 07 00 - HVAC Insulation
- Section 23 21 13 - Hydronic Piping
- Section 23 21 25 – Radiant Floor Heating

REFERENCE

Applicable provisions of Division 1 govern work under this section.

QUALITY ASSURANCE

Refer to division 1, General Conditions, Equals and Substitutions.

SHOP DRAWINGS

Refer to division 1, General Conditions, Submittals.

Required for all items in this section. Include materials of construction, dimensional data, ratings/capacities/ranges, pressure drop data where appropriate, and identification as referenced in this section and/or on the drawings.

OPERATION AND MAINTENANCE DATA

All operations and maintenance data shall comply with the submission and content requirements specified under section GENERAL REQUIREMENTS.

DESIGN CRITERIA

All piping specialties are to be rated 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.

PART 2 - PRODUCTS

THERMOMETERS

Manufacturers: Ashcroft, Marsh, Taylor, H. O. Trerice, U. S. Gauge, Weiss, Weksler.

Stem Type, cast aluminum case, nine inch scale, clear acrylic window. adjustable angle brass stem with stem of sufficient length so the end of the stem is near the middle of a pipe without reducing the thickness of any insulation, red indicating fluid, black lettering against a white background, with scale ranges as follows:

Service	Scale Range, °F	Min. Increment, °F
Hot Water	30 - 240	2

THERMOMETER SOCKETS

Brass with threaded connections suitable for thermometer stems and temperature control sensing elements in pipeline. Furnish with extension necks for insulated piping systems.

TEST WELLS

Similar to thermometer sockets except with a brass cap that thread into the inside of the test well to prevent dirt from accumulating. Secure cap to body with a short chain. Furnish with extension necks, where appropriate, to accommodate the pipeline insulation.

P/T (PRESSURE/TEMPERATURE) TEST PLUGS

Brass plug with 1/4" NPT threads, EPDM or neoprene valve core, knurled cap with cap strap. Use extended length plugs to clear insulated piping. Adaptors shall have 1/4" FPT connection for standard pressure gauges.

HOSE CONNECTON CAPS

Hose connection caps shall be pressure rated for 150 psig at 180 deg F.

PRESSURE GAUGES

Manufacturers: Ametek/U. S. Gauge Division, Ashcroft, Marsh, Taylor, H. O. Trerice, Weiss, Weksler.

Cast aluminum case of not less than 4.5 inches in diameter, double strength glass window, black lettering on a white background, phosphor bronze bourdon tube with bronze bushings, recalibration from the front of the dial, 99% accuracy over the middle half of the scale, 98.5% accuracy over the remainder of the scale, with scale range as follows:

Service	Scale Range, psig	Min. Increment, psig
Hot Water	0 - 60	0.5

PRESSURE SNUBBERS:

Bronze construction, suitable for system working pressure, 1/4" size.

COIL SYPHONS:

Bronze or steel construction, suitable for system working pressure, 1/4" size.

GAUGE VALVES:

Use valves as specified in Section 23 05 23 - General-Duty Valves for HVAC Piping. For water systems, use 1/4" ball valves. For steam systems, use 1/4" gate valves suitable for system working pressure.

AIR VENTS

MANUAL KEY TYPE VENTS:

Bell and Gossett Model 4V; Eaton/Dole Model 9, 9B, or 14A.

Bronze body with nonferrous internal parts, screwdriver operated, designed to relieve air from the system when vent is opened, rated at not less than 125 psig at 220°F.

MANUAL BALL VALVE VENTS:

Provide 1/4" ball valves for manual venting of air handling unit coils and where indicated elsewhere on drawings and details. Reference specifications section 23 05 23.

SUCTION DIFFUSERS

Manufacturers: Amtrol/Thrush, Armstrong Pumps, Bell and Gossett, Taco.

Designed to replace the suction line strainer and the long entrance pipe at a pump suction; constructed with a strainer blowdown 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°F.

CLOSED SYSTEMS:

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 blowdown 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°F.

PART 3 - EXECUTION

THERMOMETERS

STEM TYPE:

Install in piping systems as indicated on the drawings and/or details using a separable socket in each location.

DIAL TYPE FOR AIR TEMPERATURE MEASUREMENT:

Install in ductwork where detailed or specified. Support capillary inside duct so it measures a uniform sample of air. Mount readout so it is readily visible on a portion of ductwork that is not externally insulated or on a sheet metal angle support secured to a nearby structural element.

THERMOMETER SOCKETS

Install at each point where a thermometer or temperature control sensing element is located in a pipeline.

TEST WELLS

Install in piping systems as indicated on the drawings and/or details wherever provisions are needed for inserting a thermometer at a later date.

P/T (PRESSURE/TEMPERATURE) TEST PLUGS

Install in piping systems as indicated on the drawings and/or details. Do not insulate over test plugs.

PRESSURE GAUGES

Install in locations where indicated on the drawings and/or details, including any gauge piping, with scale range appropriate to the system operating pressures.

PRESSURE SNUBBERS:

Install in gauge piping for all gauges used on water services.

COIL SYPHONS:

Install in gauge piping for all gauges used on steam services.

GAUGE VALVES

Install at each gauge location as close to the main as possible and at each location where a gauge tapping is indicated.

AIR VENTS

MANUAL KEY TYPE VENTS:

Install at all high points where air may collect and not be carried by the system fluid. Use a soft Type L copper "pigtail" so the vent can be positioned for venting and collecting any water that might escape.

MANUAL BALL VALVE VENTS:

Install on air handling coils and where indicated elsewhere as shown on drawings and details.

SUCTION DIFFUSERS

Install at each pump suction connection for end suction pumps where shown. Provide sufficient space for removal of the strainer. Install a capped drain valve in the blowdown connection. Install support below the suction diffuser so the weight of the suction piping does not rest on the pump suction connection.

Install a pressure gauge across the suction diffuser, valved so that a single gauge can be used to read the inlet pressure and the outlet pressure across the strainer. Use gauge valves as specified with the gauges. This gauge can be the same one used to read pressures across the pump. Select gauge range appropriate to the system pressures.

Open the drain valve and blowdown the strainer after system cleaning and again after 30 days of operation. If the unit is furnished with a fine mesh startup strainer, remove this strainer after the system has been flushed and cleaned.

On applications involving open systems, such as but not limited to cooling towers, remove the fine mesh startup strainer prior to pump operation if the suction diffuser includes such a strainer.

CONSTRUCTION VERIFICATION ITEMS

Contractor is responsible for utilizing the construction verification checklists in accordance with the procedures defined for construction verification in Section 01 91 00.

END OF SECTION

SECTION 23 05 20

VARIABLE FREQUENCY DRIVES

PART 1 - GENERAL

SCOPE

Section includes variable frequency drives and bypass starters when needed by system. Included are the following requirements:

PART 1 - GENERAL

- Scope
- Related Work
- Reference Standards
- Representation
- Shop Drawings
- Operating and Maintenance Instructions
- Delivery, Storage, and Handling
- Equipment Startup and Training
- Warranty
- Motor Compatibility

PART 2 - PRODUCTS

- Manufacturers
- Design and Construction
- Performance Requirements
- Control Features
- Protection Features
- Diagnostics
- Quality Assurance Tests
- Motor Control Equipment

PART 3 - EXECUTION

- Variable Frequency Drives
- Construction verification Items
- Functional performance Testing

RELATED WORK

Conditions of the Contract and portions of Division One of this Project Manual apply to this Section as though repeated herein.

Applicable provisions of Division 01 govern work under this Section.

- Section 01 91 00 – Commissioning
- Section 23 05 00 – Common Work Results for HVAC
- Section 23 05 13 – Common Motor Requirements for HVAC Equipment
- Section 23 21 23 – Hydronic Pumps
- Section 23 34 00 – HVAC Fans
- Section 23 09 23 – Direct Digital Control for HVAC
- Division 26 - Electrical Work

REFERENCE STANDARDS

- ANSI/IEEE 519 Guide for Harmonic Control and Reactive Compensation of Static Power Convertors
- NEMA 250 Enclosures for Electrical Equipment (1000 Volts Maximum)
- NFPA 70 National Electrical Code (NEC)

REPRESENTATION

The variable speed drive manufacturer shall have local representation within 75 miles or 1.5 hour drive from the project site.

SHOP DRAWINGS

Include physical, electrical, and performance characteristics of each variable frequency drive and associated components, including dimensions; weight; input and output performance; voltage, phase, current and overcurrent characteristics; installation instructions; protective features; wiring and block diagrams indicating specified options; electrical noise attenuation equipment where required to meet criteria specified; line side voltage notch waveform and line side current harmonics; certified efficiency versus load and speed curves; and required operating environment.

OPERATING AND MAINTENANCE INSTRUCTIONS

Instructions to include recommended maintenance procedures, maintenance schedules, recommended spare parts list, and vendor name for parts.

DELIVERY, STORAGE AND HANDLING

Ship, handle, and store equipment in original factory shipping cartons/crates until time of installation. Store inside and protected from weather or other conditions harmful to equipment.

EQUIPMENT STARTUP AND TRAINING

Provide services of factory trained engineer to review installation, start-up, test and adjust for proper operation. Upon completion of equipment startup, submit complete report, including startup and test log, signed by factory trained engineer.

WARRANTY

Variable frequency drive shall be covered by manufacturer's standard 2 year warranty.

MOTOR COMPATIBILITY

Motors in HVAC equipment shall be compatible for use with VFD applications.

PART 2 - PRODUCTS

MANUFACTURERS

ABB are the basis of design.

Graham is acceptable with prior owner approval, provided all specification requirements are satisfied.

DESIGN AND CONSTRUCTION

Unit to be constant or variable torque, solid state, modular design for control of standard squirrel cage, induction, alternating current motors.

Use solid state electronics to provide specified performance, control specified parameters, and protect motor and drive under abnormal conditions.

Drive enclosure shall be NEMA 12, and provided with hinged and lockable door. Provide door mounted fused disconnect switch to prevent access to enclosure with power on. Drives under 100 HP shall be wall mounted. For drives 100 HP and larger, drive shall be configured for floor mounting on concrete pad.

Include the following operating and monitoring devices mounted on front cover:

- Fused disconnect switch with door interlocked handle,
- Operating mode selector switch marked "manual-off-automatic",
- Manual speed control adjustment,
- Automatic transfer switch to select power through drive or bypass.
- "Power on" indicator light and inverter fault indicator light.
- Speed indicating meter reading from 0 percent to 100 percent.

Variable frequency drive assembly to be listed by Underwriters Laboratories, Canadian Standards Association, or ETL Testing Laboratories.

Electrically and physically isolate control circuitry and conductors from power circuitry and power conductors. Use shielded control conductors.

Provide partitioning within drive enclosure to separate and isolate bypass section from variable frequency drive section and to house bypass wiring, contactors, relays, and automatic transfer switch so devices within drive compartment are able to be serviced with no live power in drive section.

Provide automatic transfer switch and bypass starter to allow operation in bypass mode in the event of drive failure or shutdown. Automatic transfer switch to also allow manual transfer to bypass operation.

Full nameplate motor horsepower plus specified service factor to be available to driven device when motors are being operated in variable frequency drive mode. Coordinate proper drive capacity with motor manufacturer.

Design control circuitry on plug-in, plug-out modular basis.

Use full wave diode bridge rectifier in convertor.

Provide RFI clamping device to eliminate 3rd harmonic on single phase drives, 5th and 7th harmonic on 3 phase 6 pulse drives, and 11th and 13th harmonic on 3 phase 12 pulse drives.

Use pulse width modulated (PWM) inverter, incorporating power transistors; SCR components are not acceptable. DC bus shall have capacitive filter to reduce ripple of rectified voltage to maintain near constant DC voltage.

Units shall function in operating environment from 0 degrees C to 40 degrees C temperature and humidity up to 90 percent non-condensing.

VFD to include cooling for drive (fan ventilation/conditioned environment).

PERFORMANCE REQUIREMENTS

Units shall be rated for input power as scheduled on Drawings and shall have tolerance of plus/minus 10 percent on input voltage and plus/minus 2 percent on input frequency.

Limit harmonic content, as measured on line side, to voltage distortion factor of 5 percent or less and line notch depth of 25 percent or less as defined in IEEE Standard 519, latest edition. Provide additional line reactors and power conditioners to meet criteria.

Use fixed or adjustable current limiting control device to limit output current to 100 percent continuous and 120 percent for 1 minute; also refer to Protection Features in this Section. Full load output current available from drive shall not be less than motor nameplate amperage.

Output power shall be capable of driving standard NEMA B design, 3 phase alternating current induction motors at full rated speed with capability of 10:1 turndown.

Additional performance capabilities to include the following:

- Ride through momentary power outage of 3 cycles,
- Start into rotating load without damage to drive components or motor,
- Capable of automatic restart into rotating load after preset, adjustable time delay following power outage.

After 3 restart attempts, trip automatic transfer switch, causing backup starter to furnish power to driven load.

Input power factor: Min 0.95 throughout speed range.
Minimum efficiency: 97 percent at 100 percent speed.

CONTROL FEATURES

Use control circuits compatible with input signal from temperature control system in automatic mode and from manual speed in manual mode. Vary motor speed in response to input control signal. Include components necessary to accept signal from temperature control system in form that is sent.

Include the following additional control features:

- Vary acceleration and deceleration rate so that time period from start to full speed and from full speed to stop can be field adjusted;
- Adjustable minimum and maximum speed settings for both automatic and manual modes of operation;
- Field adjustment of minimum and maximum output frequency.

Contacts for remote control of start/stop function;

- Auxiliary contact for remote indication of variable frequency drive fault condition;
- Control logic for automatic transfer from variable frequency drive operation to bypass starter in case of drive failure or shutdown;
- 1 normally open and 1 normally closed auxiliary contact in each drive for use in remote monitoring of drive or bypass operation by a central energy management system; activate contacts on drive failure of any kind.

PROTECTION FEATURES

Use electronic protection circuitry in power circuits to provide orderly shutdown of drive without blowing fuses or tripping circuit breakers and prevent component loss under the following abnormal conditions:

- Activation of any safety device.
- Instantaneous overcurrent or over voltage of output.
- Power line overvoltage and under-voltage protection.
- Phase loss.
- Single and 3 phase short circuit protection.
- Ground fault protection for all 3 phases.
- Control circuit malfunction.
- Over-temperature protection.
- Output current limit.

Provide visual indication of item causing drive to be de-energized.

Provide the following additional protective features:

- Input transient overvoltage protection up to 3000 volts per ANSI 37 90A
- DC bus fusing or other electronic controls which limit rate of rise of DC bus current as well as de-energizing drive at predetermined current level
- Fusing for control circuit transformer
- Grounded control chassis
- Devices and control circuitry to interlock variable frequency drive and bypass starter so both are not energized and driving motor simultaneously.

DIAGNOSTICS

Provide diagnostic light emitting diode [LED] indicators for the following:

- Phase loss
- Ground fault
- Overcurrent
- Overvoltage
- Under-voltage
- Over-temperature
- Overload
- DC bus status

QUALITY ASSURANCE TESTS

Use factory heat stress test to verify proper operation of drive functions and components under full load.

Variable frequency drive manufacturer or designated representative to perform field test of each drive, in presence of Owner's representative, for the following items:

- General inspection to verify proper installation
- Drive reaction to simulated power interruptions of 2 seconds and 60 seconds
- Adequate protection during switching from variable frequency drive operation to bypass starter operation and back again

MOTOR CONTROL EQUIPMENT

Bypass Starters:

Use across-the-line magnetic bypass starters in NEMA 1 enclosures.

Provide thermally actuated heaters and temperature compensated overload relays in each phase. Select heaters on measured full load amps of particular motor with motor and driven device in bypass operation. Provide temporary heaters until final heaters have been sized.

Use 120 volt control transformer with fused primary in each magnetic starter. Size control transformer per starter manufacturer's recommendations. Starter control circuit components to be 120 volt.

Equip each starter with 2 normally open and 2 normally closed auxiliary contacts for interlocking and control wiring.

PART 3 - EXECUTION

VARIABLE FREQUENCY DRIVES

Install where indicated on Drawings and in accordance with approved Submittals and manufacturer's published recommendations.

Drives shall not be set below the following minimum speeds:

- Pump applications - 20 hertz (30%)
- Fan applications - 12 hertz (20%)

CONSTRUCTION VERIFICATION

Contractor is responsible for utilizing the construction verification checklists in accordance with the procedures defined for construction verification in Section 01 91 00.

FUNCTIONAL PERFORMANCE TESTING

Contractor is responsible for utilizing the functional performance test forms in accordance with the procedures defined for functional performance testing in Section 01 91 00.

END OF SECTION

SECTION 23 05 23

GENERAL-DUTY VALVES FOR HVAC PIPING

PART 1 - GENERAL

SCOPE

This section includes valve specifications for all HVAC systems except where indicated under Related Work. Included are the following topics:

PART 1 - GENERAL

- Scope
- Related Work
- Reference
- Quality Assurance
- Submittals
- Operation and Maintenance Data
- Design Criteria

PART 2 - PRODUCTS

- Manufacturers
- Water System Valves
 - Gate Valves
 - Ball Valves
 - Swing Check Valves
 - Spring Loaded Check Valves
 - Balance Valves
 - Drain Valves
 - Combination Shut-off, Check, and Balancing Valves
- Specialty Valves and Valve Accessories
- Gauge Valves

PART 3 - EXECUTION

- General
- Shut-off Valves
- Balancing Valves
- Calibrated Balancing Valves
- Drain Valves
- Spring Loaded Check Valves
- Swing Check Valves
- Combination Shut-off, Check, and Balancing Valves

RELATED WORK

- Section 01 91 00 - Commissioning
- Section 23 05 15 - Piping Specialties
- Section 23 09 14 - Pneumatic and Electric Instrumentation and Control Devices for HVAC

REFERENCE

Applicable provisions of Division 1 govern work under this section.

QUALITY ASSURANCE

Refer to division 1, General Conditions, Equals and Substitutions.

SUBMITTALS

Refer to division 1, General Conditions, Submittals.

Contractors shall submit a schedule of all valves indicating type of service, dimensions, materials of construction, and pressure/temperature ratings for all valves to be used on the project. Temperature ratings specified are for continuous operation.

OPERATION AND MAINTENANCE DATA

All operations and maintenance data shall comply with the submission and content requirements specified under section GENERAL REQUIREMENTS.

DESIGN CRITERIA

Where valves are specified for individual mechanical services (i.e. hot water heating, steam, etc.) all valves shall be of the same manufacturer unless prior written approval is obtained from A/E.

PART 2 - PRODUCTS

MANUFACTURERS

Anvil, Apollo, Armstrong, Bell & Gossett, Cash-Acme, Dresser Consolidated, Conval, Crane, Anderson Greenwood and Crosby, Danfoss-Flomatic, DeZurik, Durco, Fisher, Grinnell, Griswold, Hammond, Hancock, Hoffman, Jamesbury, Keystone, Kunkle, Leslie, Lunkenheimer/Cincinnati, Metraflex, Milwaukee, Mueller, Newco, Nexus, Nibco, Powell, RP&C, Sarco, Spence, Stockham, Taco, Tasco, Thrush-Amtrol, Vogt, Watts, or approved equal.

WATER SYSTEM VALVES

All water system valves to be rated at not less than 125 psig water working pressure at 240°F unless noted otherwise.

GATE VALVES:

2" and smaller: Use ball valves; gate valves will not be accepted in sizes 2" and smaller.

2-1/2" and larger: Use butterfly valves; gate valves will not be accepted in sizes 2-1/2" and larger.

BALL VALVES:

2" and smaller: Two piece bronze body; threaded or soldered ends, as appropriate to the 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.

Valve stems shall allow operators to clear insulation without interference. Provide stem extensions when valve operators interfere with pipe insulation.

Apollo 70-100/200 series, Hammond 8301/8311, Milwaukee BA100/150, Nibco T/S 585-70, Stockham S206/216.

2-1/2" and over: Ball valves will not be accepted in sizes over 2 inch.

SWING CHECK VALVES:

2" and smaller: 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.

Crane 137/1342, Hammond IB912/IB940, Lunkenheimer 2144/2145, Milwaukee 509/1509, Nibco T-413-B/S-413-B, Powell 578/1825, Stockham B-309/B-319.

2-1/2" and larger: 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.

Crane 373, Hammond IR1124, Lunkenheimer 1790, Milwaukee F2974, Nibco F918, Powell 559, Stockham G-931.

SPRING LOADED CHECK VALVES:

2" and smaller: Class 125, bronze body, threaded, solder or wafer ends, bronze trim, stainless steel spring, teflon seat unless only bronze available.

APCO 300 series, ConBraCo 61 series, Mueller 303BP, Nibco T-480-Y/S-480-Y, Val-Matic 1400 series.

2-1/2" and larger: Class 125, cast iron or semi-steel body, wafer or globe flanged type, bronze trim, bronze or EPDM seat, stainless steel spring, stainless steel stem if stem is required. Valves with ductile iron in contact with the working fluid will not be accepted.

APCO 600 series, Metraflex 900 series, Milwaukee 1800 series, Mueller Steam 101M-AP/105M-AP, Nibco F910 series, Val-Matic 1800 series, Victaulic series 716.

BALANCE VALVES:

2" and smaller: 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°F.

Armstrong CBV, Bell & Gossett Circuit Setter Plus, Griswold Quickset, Nexus Orturi, Nibco 1710 Series, Taco Accu-Flo, Tour & Anderson STAS/STAD, Victaulic series 786/787.

DRAIN VALVES:

Use 3/4 inch ball valve with threaded hose adapter except strainer blowdown valves to be the same size as the blowdown connection.

COMBINATION SHUT-OFF, CHECK, AND BALANCE VALVES:

2 inch and larger: 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°F when used in hot water heating systems.

Armstrong Flo-Trex, Bell & Gossett Triple Duty, Taco Multi-Purpose Valve, Thrush-Amtrol Tri-Flow.

SPECIALTY VALVES AND VALVE ACCESSORIES

GAUGE VALVES:

Water Service: Use 1/4" ball valves.

Steam Service: Use 1/4" gate valves suitable for system operating pressure.

STEM EXTENSIONS:

Provide stem extensions when valve operators interfere with pipe insulation.

PART 3 - EXECUTION

GENERAL

Properly align piping before installation of valves in an upright position; operators installed below the valves will not be accepted.

Install valves in strict accordance with valve manufacturer's installation recommendations. Do not support weight of piping system on valve ends.

Install all temperature control valves.

Install all valves with the stem in the upright position. Valves may be installed with the stem in the horizontal position only where space limitations do not allow installation in an upright position or where large valves are provided with chain wheel operators. Where valves 2-1/2" and larger are located more than 12'-0" above mechanical room floors, install valve with stem in the horizontal position and provide a chain wheel operator. Valves installed with the stems down, will not be accepted.

Install stem extensions when shipped loose from valve.

Prior to flushing of piping systems, place all valves in the full-open position.

SHUT-OFF VALVES

Install shut-off valves at all equipment, at each branch take-off from mains, and at each automatic valve for isolation or repair.

WATER SYSTEM:

Butterfly valves installed at the location of a flow sensing device are to have a memory stop.

BALANCING VALVES

Provide balancing valves for all major equipment and at each major branch takeoff and at the discharge of each pump as indicated on drawings and details.

CALIBRATED BALANCE VALVES:

Install where indicated on the drawings and details for balancing of hydronic systems. Retain the shipping container for use as removable insulation.

DRAIN VALVES

Provide drain valves for complete drainage of all systems. 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.

SPRING LOADED CHECK VALVES

Install a spring loaded check valve in each pump discharge line where two pumps operate in parallel and no combination shutoff, check and balancing valve is being used.

SWING CHECK VALVES

Provide swing check valves where specified, detailed, and at steam condensate lines where they rise at outlet of traps. In such cases, provide isolation valves to allow repair or replacement of check valve.

COMBINATION SHUT-OFF, CHECK, AND BALANCING VALVES

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.

END OF SECTION

SECTION 23 05 29

HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

SCOPE

This section includes specifications for supports of all HVAC equipment and materials as well as piping system anchors. Included are the following topics:

PART 1 - GENERAL

- Scope
- Related Work
- Reference
- Reference Standards
- Quality Assurance
- Description
- Shop Drawings
- Design Criteria

PART 2 - PRODUCTS

- Pipe Hanger and Support Manufacturers
- Structural Supports
- Pipe Hangers and Supports
- Beam Clamps
- Concrete Inserts
- Equipment Curbs
- Corrosive Atmosphere Coatings

PART 3 - EXECUTION

- Installation
- Hanger and Support Spacing
- Vertical Riser Clamps
- Equipment Curbs

RELATED WORK

- Section 01 91 00 - Commissioning
- Section 23 07 00 - HVAC Insulation

REFERENCE

Applicable provisions of Division 1 shall govern work under this section.

REFERENCE STANDARDS

MSS SP-58 Materials, Design, Manufacture, Selection, Application, and Installation

QUALITY ASSURANCE

Refer to Division 1, General Conditions, Equals and Substitutions.

DESCRIPTION

Provide all supporting devices as required for the installation of mechanical equipment and materials. All supports and installation procedures are to conform to the latest requirements of the ANSI Code for pressure piping.

Do not hang any mechanical item directly from a metal deck or run piping so it rests on the bottom chord of any truss or joist.

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.

Protect insulation at all hanger points; see Related Work above.

SHOP DRAWINGS

Refer to division 1, General Conditions, Submittals.

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.

All submittals are to comply with submission and content requirements specified in specification Section 01 91 00.

DESIGN CRITERIA

Materials and application of pipe hangers and supports shall be in accordance with MSS Standard Practice SP-58 unless noted otherwise.

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 the equipment, whichever is greater. Standard pipe hangers/supports as specified in this section are required beyond the 100 pipe diameter/3 support distance.

Piping flexible connections and vibration isolation supports are required for piping connected to coils that are in a fan assembly where the entire assembly is mounted on vibration supports; the vibration isolation supports are required for a distance of one hundred pipe diameters or three supports away from the equipment, whichever is greater. Piping flexible connection and vibration isolation supports are not required when the fan section is separately and independently isolated by means of vibration supports and duct flexible connections. Standard pipe hangers/supports as specified in this section are required when there are no vibration isolation devices in the piping and beyond the 100 pipe diameter/3 support distance.

Piping supported by laying on the bottom chord of joists or trusses will not be accepted.

Fasteners depending on soft lead for holding power or requiring powder actuation will not be accepted.

Allow sufficient space between adjacent pipes and ducts for insulation, valve operation, routine maintenance, etc.

PART 2 - PRODUCTS

PIPE HANGER AND SUPPORT MANUFACTURERS

Anvil, B-Line, Fee and Mason, Kindorf, Michigan Hanger, Unistrut, or approved equal. Anvil figure numbers are listed below; equivalent material by other manufacturers is acceptable.

STRUCTURAL SUPPORTS

Provide all supporting steel required for the 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.

PIPE HANGERS AND SUPPORTS

HANGERS FOR STEEL PIPE SIZES 1/2" THROUGH 2":

Carbon steel, adjustable, clevis, black finish. Anvil figure 65 or 260.

HANGERS FOR STEEL PIPE SIZES 2-1/2" AND OVER:

Carbon steel, adjustable, clevis, black finish. Anvil figure 260.

Adjustable steel yoke, cast iron roll, double hanger. Anvil figure 181.

MULTIPLE OR TRAPEZE HANGERS:

Steel channels with welded spacers and hanger rods if calculations are submitted.

WALL SUPPORT:

Welded steel bracket with hanger. B-Line 3068 Series, Anvil 194 Series.

Perforated epoxy painted finish, 16-12 gauge min., steel channels securely anchored to wall structure with interlocking, split type, bolt secured, galvanized pipe/tubing clamps. B-Line type S channel with B-2000 series clamps, Anvil type AS200 H with AS 1200 clamps. When copper piping is being supported, provide flexible elastomeric/thermoplastic isolation cushion material to completely encircle the piping and avoid contact with the channel or clamp, equal to B-Line B1999 Vibra Cushion or provide manufacturers clamp and cushion assemblies, B-Line BVT series, Anvil cushion clamp assembly.

VERTICAL RISER SUPPORT:

Carbon steel riser clamp, copper plated when used with copper pipe. Anvil figure 261 for steel pipe, figure CT121 for copper pipe.

FLOOR SUPPORT FOR PIPE SIZES THROUGH 4”:

Cast iron adjustable pipe saddle, locknut nipple, floor flange, and concrete pier or steel support.

COPPER PIPE SUPPORT:

Carbon steel ring, adjustable, copper plated or polyvinylchloride coated.

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 Anvil figure 167.

STEEL HANGER RODS:

Threaded both ends, threaded one end, or continuous threaded, black finish.

Size rods for individual hangers and trapeze support as indicated in the following schedule.

Total weight of equipment, including valves, fittings, pipe, pipe content, and insulation, are not to exceed the limits indicated.

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

Provide rods complete with adjusting and lock nuts.

BEAM CLAMPS

MSS SP-58 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 a hardened steel cup point set screw. Anvil figure 86.

MSS SP-58 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. Anvil figure 228.

CONCRETE INSERTS

Carbon steel expansion anchors, vibration resistant, with ASTM B633 zinc plating. Use drill bit of same manufacturer as anchor. Hilti, Rawl, Redhead.

EQUIPMENT CURBS

Prefabricated Metal Curb:

Constructed of not less than 18 gauge galvanized steel reinforced so it is structurally capable of supporting the intended load with no penetrations through the curb flashing, inside and outside corner sections that are mitered and continuously welded, filled with 3 pound density rigid fiberglass insulation, integral deck mounting flange, nominal two inch wood nailer, galvanized steel counter flashing. Do not use built-in metal base flashings or cants. Use 18 inch high equipment curbs where the curb completely surrounds the perimeter of the equipment and there is no roof exposed to the weather.

CORROSIVE ATMOSPHERE COATINGS

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. Mechanical galvanize threaded products, ASTM B695 Class 150, 2.0 mil coating. Field cuts and damaged finishes to be field covered with zinc rich paint of comparable thickness to factory coating.

Corrosive atmospheres include the following locations:

- Exterior locations
- Tipping floor area
- WTS area
- Sorting platform area
- Chemical storage and hazardous waste storage rooms
- Locker/shower rooms

PART 3 - EXECUTION

INSTALLATION

Install supports to provide for free expansion of the piping and duct system. Support all piping from the structure using concrete inserts, beam clamps, ceiling plates, wall brackets, or floor stands. Fasten ceiling plates and wall brackets securely to the structure and test to demonstrate the adequacy of the fastening.

Piping shall be supported independently from ductwork and all other trades.

Where piping can be conveniently grouped to allow the use of trapeze type supports, use standard structural shapes for the supporting steel.

Perform all welding in accordance with standards of the American Welding Society. Clean surfaces of loose scale, rust, paint or other foreign matter and properly align before welding. Use wire brush on welds after welding. Welds shall show uniform section, smoothness of weld metal and freedom from porosity and clinkers. Where necessary to achieve smooth connections, joints shall be dressed smooth.

HANGER AND SUPPORT SPACING

Place a hanger within 12 inches of each horizontal elbow, valve, strainer, or similar piping specialty item.

Where several pipes can be installed in parallel and at the same elevation, provide multiple or trapeze hangers.

Support riser piping independently of connected horizontal piping.

Adjust hangers to obtain the slope specified in the piping section of this specification.

Space hangers for pipe as follows:

<u>Pipe Material</u>	<u>Pipe Size</u>	<u>Max. Spacing</u>
Steel	1/2" through 1-1/4"	6'-6"
Steel	1-1/2" through 6"	10'-0"
Copper	1/2" through 1-1/4"	5'-0"
Copper	1-1/2" and larger	8'-0"

VERTICAL RISER CLAMPS

Support vertical piping with clamps secured to the piping and resting on the building structure or secured to the building structure below at each floor.

EQUIPMENT CURBS

Secure bottom of support flat on roof deck. Secure equipment to curb in accordance with equipment manufacturer's instructions. Flashing and counter flashing by the Division 07 Contractor.

Fill the entire void space with compressible fiberglass insulation.

END OF SECTION

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SECTION 23 05 93

TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

SCOPE

This section includes air and water testing, adjusting and balancing for the entire project. Included are the following topics:

PART 1 - GENERAL

- Scope
- Related Work
- Reference
- Reference Standards
- Description
- Pre-Installation Meeting and Scheduling
- Pre-Balance Conference
- Submittals

PART 2 - PRODUCTS

- Instrumentation

PART 3 - EXECUTION

- Preliminary Procedures
- Existing Equipment
- Performing Testing, Adjusting and Balancing
- Deficiencies

RELATED WORK

- Section 01 91 00 - Commissioning
- Section 23 05 00 - Common Work Results for HVAC
- Section 23 07 00 - HVAC Insulation
- Section 23 09 14 - Pneumatic and Electric Instrumentation and Control Devices for HVAC
- Section 23 09 23 - Direct Digital Control System for HVAC

REFERENCE

Applicable provisions of the General Conditions, Supplementary General Conditions and General Requirements in Division 1 govern work under this section.

REFERENCE STANDARDS

AABC	National Standards for Total System Balance, Sixth Edition, 2002.
ASHRAE	ASHRAE Handbook, 2007 HVAC Applications, Chapter 37, Testing Adjusting and Balancing.
NEBB	Procedural Standards for Testing Adjusting Balancing of Environmental Systems, Seventh Edition, 2005.
TABB	Tab Procedural Guide, First Edition, 2003.

DESCRIPTION

The Contractor will separately contract with an independent test and balance contractor to perform all testing, adjusting, and balancing of air and hydronic systems required for this project. Work related to the testing, adjusting, and balancing that must be performed by the installing mechanical contractor is specified in other section of these specifications.

Provide total mechanical systems testing, adjusting and balancing. Requirements include the balance of air and water distribution, adjustment of new and existing systems and equipment to provide design requirements indicated on the drawings, electrical measurement and verification of performance of all mechanical equipment, all in accordance with standards published by AABC, NEBB, or TABB.

Test, adjust and balance all air and hydronic systems so that each room, piece of equipment or terminal device meets the design requirements indicated on the drawings and in the specifications.

Accomplish testing, adjusting and balancing work in a timely manner that allows partial occupancy of major buildings, occupancy of one building when the project involves many buildings, and completion of the entire project in the time stated in the Instruction to Bidders and in accordance with the completion schedule established for this project.

Verify that provisions are being made to accomplish the specified testing, adjusting and balancing work. If problems are found, handle as specified in Part 3 under Deficiencies.

QUALITY ASSURANCE

Qualifications

An independent Firm specializing in the Testing and Balancing of HVAC systems for a minimum of 3 years. A Firm not engaged in the commerce of furnishing or providing equipment or material generally related to HVAC work other than that specifically related to installing Testing and Balancing components necessary for work in this section such as, but not limited to sheaves, pulleys, and balancing dampers.

A certified member of AABC or certified by NEBB or TABB in the specific area of work performed. Maintain certification for the entire duration of the project. If certification of firm or any staff performing work is terminated or expires during the duration of the project, contact the A/E immediately.

Technicians on this project must have satisfactorily completed work on a minimum of (3) three projects of at least 50% in size, and of similar complexity. Size is defined as the quantity of each specific individual item requiring testing and balancing such as, but not limited to, equipment, devices, terminal devices, and grilles and diffusers.

PRE-INSTALLATION MEETING AND SCHEDULING

The test and balance contractor is required to attend a pre-installation meeting with all other project contractors before the construction process is started. The test and balance contractor shall give the Mechanical Contractor a detailed schedule of testing and balancing tasks for incorporation into the project schedule.

PRE-BALANCE CONFERENCE

90 days prior to beginning testing, adjusting and balancing, schedule and conduct a conference with the Architect/Engineer, Project Representative and the mechanical system and temperature control system installing Contractors. Provide AE and Commissioning Provider (CxP) with a complete copy of the TAB plan for the project. The objective is final coordination and verification of system operation and readiness for testing, adjusting and balancing procedures and scheduling procedures with the above mentioned parties. Indicate work required to be completed prior to testing, adjusting, and balancing and identify the party responsible for completion of that work.

SUBMITTALS

See also Related Work in this section.

Submit testing, adjusting and balancing reports bearing the seal and signature of the NEBB, AABC or TABB Certified Test and Balance Supervisor. The reports certify that the systems have been tested, adjusted and balanced in accordance with the referenced standards; are an accurate representation of how the systems have been installed and are operating; and are an accurate record of all final quantities measured to establish normal operating values of the systems.

Submission:

Distribute electronic copies of the Report to the Contractor and the A/E.

Format: Cover page identifying project name, project number and descriptive title of contents. Divide the contents of the report into the below listed divisions:

- General Information
- Summary
- Air Systems
- Hydronic Systems
- Special Systems

Contents: Provide the following minimum information, forms and data:

General Information: Inside cover sheet identifying Test and Balance Contractor, Contractor, Architect, Engineer, Project Name and Project Number. Include addresses, contact names and telephone numbers. Also include a certification sheet containing the seal and signature of the Test and Balance Supervisor.

Summary: Provide summary sheet describing mechanical system deficiencies. Describe objectionable noise or drafts found during testing, adjusting and balancing. Provide recommendations for correcting unsatisfactory performances and indicate whether modifications required are within the scope of the contract, are design related or installation related. List instrumentation used during testing, adjusting and balancing procedures.

The remainder of the report to contain the appropriate standard NEBB, AABC, or TABB forms for each respective item and system. Fill out forms completely. Where information cannot be obtained or is not applicable indicate same.

PART 2 - PRODUCTS

INSTRUMENTATION

Provide all required instrumentation to obtain proper measurements. Application of instruments and accuracy of instruments and measurements to be in accordance with the requirements of NEBB, AABC, or TABB Standards and instrument manufacturer's specifications.

All instruments used for measurements shall be accurate, and calibration histories for each instrument to be available for examination by DD upon request. Calibration and maintenance of all instruments to be in accordance with the requirements of NEBB, AABC, or TABB Standards

PART 3 - EXECUTION

DAILY REPORTS

Submit to Project Representative daily work activity reports for each day on which testing and balancing work is performed. Reports shall include description of day's activities and description of any system deficiencies.

PRELIMINARY PROCEDURES

Review preconstruction meeting report, applicable construction bulletins, applicable change orders and approved shop drawings of equipment, outlets/inlets and temperature controls.

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.

Notify Project Representative on a daily basis during balancing. Identify deficiencies preventing completion of testing, adjusting and balancing procedures. Do not proceed until systems are fully operational with all components necessary for complete testing, adjusting and balancing. Installing Contractors are required to provide personnel to check and verify system completion, readiness for balancing and assist Balancing Contractor in providing specified system performance.

EXISTING EQUIPMENT

Perform testing, adjusting and balancing procedures on existing MAU-1 as noted on drawings, in accordance with the detailed procedures outlined in the referenced standards except as may be modified below.

Perform testing, adjusting and balancing procedures on existing HWP-3 & 4 to achieve a total water flow of 80 gpm at 35' of head, in accordance with the detailed procedures outlined in the referenced standards except as may be modified below.

PERFORMING TESTING, ADJUSTING AND BALANCING

Perform testing, adjusting and balancing procedures on each system identified, in accordance with the detailed procedures outlined in the referenced standards except as may be modified below.

Unless specifically instructed in writing, all work in this specification section is to be performed during the normal workday.

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. If the ceiling construction is such that access panels are required for the work of this section and the panels have not been provided, inform the owner's project representative.

Cut insulation, ductwork and piping for installation of test probes to the minimum extent necessary for adequate performance of procedures. Patch using materials identical to those removed, maintaining vapor barrier integrity and pressure rating of systems.

In air systems employing filters, blank off sufficient filter area to simulate a pressure drop that is midway between that of a clean filter and that of a dirty filter.

Measure and record system measurements at the fan and/or pump to determine total flow. Adjust equipment as required to yield specified total flow at terminals. Proceed taking measurements in mains and branches as required for final terminal balancing. Perform terminal balancing to specified flows balancing branch dampers, deflectors, extractors and valves prior to adjustment of terminals.

Measure and record static air pressure conditions across fans, coils and filters. Indicate in report if cooling coil measurements were made on a wet or dry coil and if filter measurements were made on a clean or dirty filter. Spot check static air pressure conditions directly ahead of terminal units.

Adjust outside air, return air and relief air dampers for design conditions at both the minimum and maximum settings and record both sets of data. Balance modulating dampers at extreme conditions and record both sets of data. Balance variable air volume systems at maximum air flow rate, full cooling, and minimum flow rate, full heating; record all data.

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 the capabilities of the installed system.

Provide fan and motor drive sheave adjustments necessary to obtain design performance. Provide drive changes specifically noted on drawings, if any. If work of this section indicates that any drive or motor is inadequate for the application, advise the owner's project representative by giving the representative properly sized motor/drive information (in accordance with manufacturers original service factor and installed motor horsepower requirements); Confirm any change will keep the duct/piping system within its design limitations with respect to speed of the device and pressure classification of the distribution system. Required motor/drive changes not specifically noted on drawings or in specifications will be considered an extra cost and will require an itemized cost breakdown submitted to owner's project representative. Prior authorization is needed before this work is started.

Areas or rooms designed to maintain positive, negative or balanced air pressures with respect to adjacent spaces, as indicated by the design air quantities, require special attention. Adjust fan drives, distribution dampers, terminals and controls to maintain indicated pressure relationship.

Final air system measurements to be within the following range of specified cfm:

Fans	0% to +10%
Supply grilles, registers, diffusers	0% to +10%
Return/exhaust grilles, registers	0% to -10%

Final water system measurements must be within the following range of specified gpm:

Heating flow rates	0% to -10%
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Contact the temperature control Contractor for assistance in operation and adjustment of controls during testing, adjusting and balancing procedures. Cycle controls and verify proper operation and setpoints. Include in report description of temperature control operation and any deficiencies found.

Permanently mark equipment settings, including damper and valve positions, control settings, and similar devices allowing settings to be restored. Set and lock memory stops.

Leave systems in proper working order, replacing belt guards, closing access doors and electrical boxes, and restoring temperature controls to normal operating settings.

Coordinate and assist CxP with all verification activities defined within section (01 91 01, 02) including providing all required sampling data necessary for the commissioning process.

Coordinate air handling unit minimum outside air set points with the Temperature Control Contractor.

HYDRONIC SYSTEM DIFFERENTIAL PRESSURE CONTROL SET POINT

For hydronic systems with variable speed pumping, determine the minimum required system differential pressure set point needed to insure that all terminal devices are operating at their design water flows with the most demanding terminals device control valve wide open. Provide the differential control setting set point to the DDC temperature control contractor and record them in the T&B report for each system.

For HVAC pumps 10 horsepower or less, valve throttling alone may be used for hydronic system balancing.

Throttling of triple-duty valves shall not exceed 50% closed. Where additional throttling would be necessary to achieve the system design flow the impellor shall be trimmed.

Verify Triple duty valve utilized on systems with Variable Frequency Drives are 100% open when balancing work is complete.

The pressure drop across triple duty valves shall not exceed 25 ft. w.g. Where additional throttling would be necessary to achieve the system design flow the impellor shall be trimmed.

Future fouling of an open piping system may be considered when determining impellor trim requirements.

Verify butterfly valves utilized for hydronic system balancing are provided with position-lock operators (memory stops) in accordance with Section 23 05 23. The adjustment and marking of lever-lock operators that use throttling notches will not be accepted. Lock all memory stops so the valves can be reopened to their balanced positions if they are used for isolation purposes.

DEFICIENCIES

Division 23 00 00 contractor to correct any installation deficiencies found by the test and balance contractor that were specified and/or shown on the Contract Documents to be performed as part of that division of work. Test and balance contractor shall notify the Project Representative of these items and instructions shall be issued to the Division 23 00 00 contractor for correction of the deficient work. All corrective work to be done at no cost to the Owner. Retest mechanical systems, equipment, and devices once corrective work is complete as specified.

FUNCTIONAL PERFORMANCE TESTING

Contractor is responsible for utilizing the functional performance test forms in accordance with the procedures defined for functional performance testing in Section 01 91 00. Notify the A/E and commissioning provider 5 business days prior to performing functional performance testing so that they may witness.

END OF SECTION

SECTION 23 07 00

HVAC INSULATION

PART 1 - GENERAL

SCOPE

This section includes insulation specifications for heating, ventilating and air conditioning piping, ductwork and equipment. Included are the following topics:

PART 1 - GENERAL

- Scope
- Related Work
- Reference
- Reference Standards
- Quality Assurance
- Description
- Definitions
- Shop Drawings
- Operation and Maintenance Data
- Environmental Requirements

PART 2 - PRODUCTS

- Materials
- Insulation Types
- Adhesives, Mastics, Sealants, and Reinforcing Materials Jackets
- Insulation Inserts and Pipe Shields
- Expansion Joint and Valve Insulation Blankets
- Accessories

PART 3 - EXECUTION

- Examination
- Installation
- Protective Jacket Installation
- Piping, Valve and Fitting Insulation
- Piping Protective Jackets
- Pipe Insulation Schedule
- Duct Insulation
- Duct Insulation Schedule
- Equipment Insulation
- Equipment Insulation Schedule
- Construction Verification Items

RELATED WORK

- Section 01 91 00 - Commissioning
- Section 23 05 00 - Common Work Results for HVAC
- Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment
- Section 23 21 13 - Hydronic Piping
- Section 23 21 25 - Radiant Floor Heating
- Section 23 31 00 - HVAC Ducts and Casings

REFERENCE

Applicable provisions of Division 1 govern work under this section.

REFERENCE STANDARDS

ASTM B209 Aluminum and Aluminum Alloy Sheet and Plate

ASTM C165	Test Method for Compressive Properties of Thermal Insulations
ASTM C177	Heat Flux and Thermal Transmission Properties
ASTM C195	Mineral Fiber Thermal Insulation Cement
ASTM C240	Cellular Glass Insulation Block
ASTM C302	Density of Preformed Pipe Insulation
ASTM C272	Water Absorption of Core Materials for Sandwich Constructions
ASTM C303	Density of Preformed Block Insulation
ASTM C355	Test Methods for Test for Water Vapor Transmission of Thick Materials
ASTM C449	Mineral Fiber Hydraulic Setting Thermal Insulation Cement
ASTM C518	Heat Flux and Thermal Transmission Properties
ASTM C533	Calcium Silicate Block and Pipe Thermal Insulation
ASTM C534	Preformed Flexible Elastomeric Thermal Insulation
ASTM C547	Mineral Fiber Preformed Pipe Insulation
ASTM C552	Cellular Glass Block and Pipe Thermal Insulation
ASTM C553	Mineral Fiber Blanket and Felt Insulation
ASTM C578	Preformed, Block Type Cellular Polystyrene Thermal Insulation
ASTM C612	Mineral Fiber Block and Board Thermal Insulation
ASTM C921	Properties of Jacketing Materials for Thermal Insulation
ASTM C1136	Flexible Low Permeance Vapor Retarders for Thermal Insulation
ASTM C1728	Standard for Aerogel Insulation
ASTM D412	Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers-Tension
ASTM D1000	Methods for Pressure-Sensitive Adhesive-Coated Tapes Used for Electrical and Electronic Applications
ASTM D1621	Standard Test Method for Compressive Properties Of Rigid Cellular Plastics
ASTM D1622	Standard Test Method for Apparent Density of Rigid Cellular Plastics
ASTM D1940	Method of Test for Porosity of Rigid Cellular Plastics
ASTM D2126	Method for Response of Rigid Cellular Plastics to Thermal and Humid Aging
ASTM D2240	Standard Test Method for Rubber Property—Durometer Hardness
ASTM D5590	Test Method for Determining the Resistance of Coatings to Fungal Defacement
ASTM E84	Surface Burning Characteristics of Building Materials
ASTM E814	Standard Test Method for Fire Tests of Penetration Firestop Systems
ASTM E2336	Standard Test Methods for Fire Resistive Grease Duct Enclosure Systems
MICA	National Commercial & Industrial Insulation Standards
NFPA 225	Surface Burning Characteristics of Building Materials
UL 723	Surface Burning Characteristics of Building Materials

QUALITY ASSURANCE

Refer to division 1, General Conditions, Equals and Substitutions

Label all insulating products delivered to the construction site with the manufacturer's name and description of materials.

Insulation systems shall be applied by experienced contractors. Within the past five (5) years, the contractor shall be able to document the successful completion of a minimum of three (3) projects of at least 50% of the size and similar scope of the work specified in this section.

DESCRIPTION

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:

- Pipe Insulation
- Duct Insulation

Install all insulation in accordance with the latest edition of MICA (Midwest Insulation Contractors Association) Standard 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 the Project Representative.

DEFINITIONS

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.

SHOP DRAWINGS

Refer to division 1, General Conditions, Submittals.

Submit a schedule of all insulating materials to be used on the 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.

OPERATION AND MAINTENANCE DATA

All operations and maintenance data shall comply with the submission and content requirements specified under section GENERAL REQUIREMENTS.

ENVIRONMENTAL REQUIREMENTS

Do not store insulation materials on grade or where they are at risk of becoming wet. Do not install insulation products that have been exposed to water.

Protect installed insulation work with plastic sheeting to prevent water damage.

PART 2 - PRODUCTS

MATERIALS

Manufacturers: Armacell, CertainTeed, Manson, Childers, Dow, Extol, Fibrex, Halstead, Foster, Imcoa, Johns Manville, Knauf, Owens-Corning, , Pittsburgh Corning, , VentureTape or approved equal.

Materials or accessories containing asbestos will not be accepted.

Use composite insulation systems (insulation, jackets, sealants, mastics, and adhesives) that have a flame spread rating of 25 or less and smoke developed rating of 50 or less, with the following exceptions:

Pipe insulation which is not located in an air plenum may have a flame spread rating not over 25 and a smoke developed rating no higher than 450 when tested in accordance with UL 723 and ASTM E84.

INSULATION TYPES

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.

FLEXIBLE FIBERGLASS INSULATION:

Minimum nominal density of 0.75 lbs. per cu. ft., and thermal conductivity of not more than 0.30 at 75 degrees F, rated for service to 250 degrees F.

RIGID FIBERGLASS INSULATION:

Minimum nominal density of 3 lbs. per cu. ft., and thermal conductivity of not more than 0.23 at 75 degrees F, 0.25 at 125 degrees F, 0.27 at 150 degrees F, 0.29 at 200 degrees F, 0.32 at 250 degrees F, minimum compressive strength of 25 PSF at 10% deformation, rated for service to 450 degrees F.

SEMI-RIGID FIBERGLASS INSULATION:

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% deformation, rated for service to 450 degrees F. Insulation fibers perpendicular to jacket and scored for wrapping cylindrical surfaces.

ELASTOMERIC INSULATION:

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% deformation, maximum water vapor permeability of 0.17 perm inch, maximum water absorption of 6% by weight, rated for service range of -20 degrees F to 220 degrees F on piping and 180 degrees F where adhered to equipment.

EXTRUDED POLYSTYRENE INSULATION:

Rigid closed cell, minimum nominal density of 1.6 lbs. per cu. ft., thermal conductivity of not more than 0.26 at 75 degrees F, minimum compressive strength of 20 psi, maximum water vapor permeability of 1.5 perm inch, maximum water absorption of .5 % by volume (ASTM C272), rated for service range of -290 degrees F to 165 degrees F.

ADHESIVES, MASTIC, SEALANTS, AND REINFORCING MATERIALS

Products shall be compatible with surfaces and materials on which they are applied, and shall be suitable for use at operating temperatures of systems to which they are applied.

FIBERGLASS INSULATION ADHESIVE:

Must comply with ASTM C916, Type II: Foster 85-60, Childers CP-127, Duro Dyne SSG.

INSULATION JOINT SEALANT: (cellular glass, polyisocyanurate, phenolic)

Used on all below ambient piping to prevent moisture ingress. Foster 95-50 Flextra, Childers CP-76 Chil-Byl, Pittsburgh Corning CW Sealant.

JACKETS

PVC FITTING COVERS AND JACKETS (PFJ):

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 minimum .02" indoors/.03" outdoors for piping 12" and smaller, .03" indoors/.04" outdoors for piping 15" and larger.

ALL SERVICE JACKETS (ASJ):

Heavy duty, fire retardant material with white kraft reinforced foil vapor retarding jacket, factory applied to insulation with a self-sealing pressure sensitive adhesive lap, maximum permeance of .02 perms and minimum beach puncture resistance of 50 units.

PROTECTIVE METAL JACKETS (PMJ):

0.024 inch thick aluminum or 0.016 inch thick stainless steel with safety edge for outdoor installations.

INSULATION INSERTS AND PIPE SHIELDS

Manufacturers: B-Line, Pipe Shields, Value Engineered Products.

Construct inserts with calcium silicate or polyisocyanurate (service temperatures below 300 degrees F only), minimum 140 psi compressive strength. Piping 12" and larger, supplement with high density 600 psi structural calcium silicate insert. Provide galvanized steel shield. Insert and shield to be minimum 180 degree coverage on bottom supported piping and full 360 degree coverage on clamped piping. On roller mounted piping and piping designed to slide on support, provide additional load distribution steel plate.

Where contractor proposes shop/site fabricated inserts and shields, submit schedule of materials, thicknesses, gauges and lengths for each pipe size to demonstrate equivalency to pre-engineered/premanufactured product described above. On low temperature systems, high density rigid polyisocyanurate may be substituted for calcium silicate provided insert and shield length and shield gauge are increased to compensate for lower insulation compressive strength.

Precompressed 20# density molded fiberglass blocks, Hamfab or equal, of the same thickness as adjacent insulation may be substituted for calcium silicate inserts with one 1"x6" block for piping through 2-1/2" and three 1"x6" blocks for piping through 4". Submit shield schedule to demonstrate equivalency to pre-engineered/premanufactured product described above.

Wood blocks will not be accepted.

ACCESSORIES

All products shall be compatible with surfaces and materials on which they are applied, and be suitable for use at operating temperatures of the systems to which they are applied.

Adhesives, sealants, and protective finishes shall be as recommended by insulation manufacturer for applications specified.

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.

Tack fasteners to be stainless steel ring grooved shank tacks.

Staples to be clinch style.

Insulating cement to be ANSI/ASTM C195, hydraulic setting mineral wool.

Finishing cement to be ASTM C449.

Fibrous glass or canvas fabric reinforcing used with lagging adhesive shall have a minimum untreated weight of 6 oz./sq. yd.

Joint sealants and metal jacketing sealants to be non-shrinking and permanently flexible.

Vapor retarding coatings to have maximum applied water vapor permeance of 0.03 perms or less at 45 °F, dry as tested by ASTM E96.

Fungicidal water base duct liner coating (Foster 40-20 or equal) to be compatible with vapor retarding coating. This product must be EPA registered to be used inside HVAC ducts. Coating must comply with ASTM D 5590 with 0 growth rating.

PART 3 - EXECUTION

EXAMINATION

Verify that all piping, equipment, and ductwork are tested and approved prior to installing insulation. Do not insulate systems until testing and inspection procedures are completed.

Verify that all surfaces are clean, dry and without foreign material before applying insulation materials.

INSTALLATION

All materials shall be installed by skilled labor regularly engaged in this type of work. All materials shall be installed in strict accordance with manufacturer's recommendations, building codes, and industry standards. Do not install products when the ambient temperature or conditions are not consistent with the manufacturer's recommendations. Surfaces to be insulated must be clean and dry.

Locate insulation and cover seams in the least visible location. All surface finishes shall be extended in such a manner as to protect all raw edges, ends and surfaces of insulation.

Install insulation with smooth and even surfaces. Poorly fitted joints or use of filler in voids will not be accepted. Provide neatly beveled and coated terminations at all nameplates, uninsulated fittings, or at other locations where insulation terminates.

Install fabric reinforcing without wrinkles. Overlap seams a minimum of 2 inches.

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.

All pipe and duct insulation shall be continuous through walls, ceiling or floor openings and through sleeves except where firestop or firesafing materials are required. Vapor retarding jacket shall be maintained continuous through all penetrations.

Provide a continuous unbroken moisture vapor retarding jacket on insulation applied to systems noted below. Attachments to cold surfaces shall be insulated and vapor sealed to prevent condensation.

Provide a complete vapor retarding jacket for insulation on the following systems:

- Insulated Duct
- Equipment, ductwork or piping with a surface temperature below 65 degrees F

PROTECTIVE JACKET INSTALLATION

PVC FITTING COVERS AND JACKETS (PFJ):

Lap seams and joints a minimum of 2 inches and continuously seal PVC with welding solvent recommended by jacket manufacturer. Lap slip joint ends 4" without fasteners where required to absorb expansion and contraction. For sections where vapor retarding jacket is not required and jacket requires routine removal, tack fasteners may be used. Secure PVC fitting covers with tack fasteners. For systems requiring a vapor retarding jacket, apply a 1-1/2" band of mastic over ends, throat, seams and penetrations.

ALL SERVICE JACKETS (ASJ) and FOIL SCRIM ALL SERVICE JACKETS (FSJ):

Install according to manufacturer's recommendations using factory supplied lap seals and butt strip seals.

PROTECTIVE METAL JACKET (PMJ):

Lap seams a minimum of 2 inches. Secure with metal bands for end to end joints, and rivets or sheet metal screws for longitudinal joints. Rivets, screws, and bands to be constructed of the same material as the jacket. Locate seams on bottom for exterior applications. Seal laps with 1/8" bead of metal jacketing sealant to prevent water entry.

PIPING, VALVE, AND FITTING INSULATION

GENERAL:

Install insulation with butt joints and longitudinal seams closed tightly. Provide minimum 2" lap on jacket seams and 2" tape on butt joints, firmly cemented with lap adhesive unless otherwise noted. Additionally secure with staples along seams and butt joints.

On systems requiring a vapor retarding jacket, seal off all raw ends of insulation and butt joints with vapor retarding mastic at intervals of not more than 20 feet on piping. Coat staples, longitudinal and transverse seams with vapor retarding mastic and on systems requiring vapor retarding jacket, coat insulated elbows, fittings, and valves with vapor retarding mastic.

Install insulation continuous through pipe hangers and supports with hangers and supports on the exterior of insulation. Where a vapor retarding jacket 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. Where riser clamps are required to be attached directly to piping requiring vapor retarding jacket, extend insulation and vapor retarding jacketing/coating around riser clamp.

Where insulated piping is installed on hangers and supports, the insulation shall be installed continuous through the hangers and supports. High density inserts shall be provided as required to prevent the weight of the piping from crushing the insulation. Pipe shields are required at all support locations. The insulation shall not be notched or cut to accommodate the supporting channels.

Fully insulate all reheat coil piping, fittings and valves (with the exception of unions) up to coil connection to prevent condensation when coil is inactive during cooling season. Provide a vapor proof seal between the pipe insulation and the insulated coil casing.

INSULATION INSERTS AND PIPE SHIELDS:

Provide pipe shields at all hanger and support locations. Rigid insulation inserts shall be installed between the pipe and the insulation shields. Quantity and placement of inserts shall be according to the manufacturer's installation instructions, however the inserts shall be no less than 12" in length. Inserts shall be of equal thickness to the adjacent insulation and shall be vapor sealed as required for system.

Provide insulation inserts and pipe shields at all hanger and support locations. Inserts may be omitted on 3/4" and smaller copper piping provided 12" long 22 gauge pipe shields are used.

FITTINGS AND VALVES:

Fittings, valves, unions, flanges, couplings and specialties may be insulated with factory molded or built up insulation of the same thickness as adjoining insulation. Where the ambient temperature exceeds 150 degrees F, cover insulation with fabric reinforcing and mastic. Where the ambient temperatures do not exceed 150 degrees, furnish and install PVC fitting covers.

PIPING PROTECTIVE JACKETS

In addition to the jackets specified in the pipe insulation schedule below the following protective jackets are required:

Provide a protective PVC jacket (PFJ) for the following insulated piping:

- All piping in all locations, other than mechanical rooms.

PIPE INSULATION SCHEDULE:

Provide insulation on new and existing remodeled piping as indicated in the following schedule:

SERVICE	INSULATION	JACKET	INSULATION THICKNESS BY PIPE SIZE				
			< 1"	1" to < 1-1/2"	1-1/2" to < 4"	4" to < 8"	8" and Larger
Heating Hot Water (including exposed Pex tubing)	Rigid Fiberglass	ASJ	1.5"	1.5"	2"	2"	2"

The following piping and fittings are not to be insulated:

- Hot water piping inside radiation, convector, or cabinet heater enclosures
- Piping unions for systems not requiring a vapor retarding Jacket

DUCT INSULATION

GENERAL:

Secure flexible duct insulation on sides and bottom of ductwork over 24" wide and all rigid duct insulation with weld pins. Space fasteners 18" on center or less as required to prevent sagging.

Secure rigid board insulation to ductwork with weld pins. Apply insulation with joints firmly butted as close as possible to the equipment surface. Pins shall be located a maximum of 3" from each edge and spaced no greater than 12" on center.

Install weld pins without damage to the interior galvanized surface of the duct. Clip pins back to washer and cover penetrations with tape of same material as jacket. Firmly butt seams and joints and cover with 4" tape of same material as jacket. Seal tape with plastic applicator and secure with staples. All joints, seams, edges and penetrations to be fully vapor sealed with vapor retarding mastic.

Stop and point insulation around access doors and damper operators to allow operation without disturbing insulation or jacket material.

External supply duct insulation is not required where ductwork contains continuous 1" acoustical liner. Provide 4" overlap of external insulation over ends of acoustically lined sections.

Where insulated ductwork is supported by trapeze hangers, the insulation shall be installed continuous through the hangers. Drop the supporting channels required to facilitate the installation of the insulation. Where rigid board or flexible insulation is specified, install high density inserts to prevent the weight of the ductwork from crushing the insulation.

Where insulated low temperature (below 45°F) ductwork is supported by steel metal straps or wire ropes that are secured directly to the duct, the straps or ropes shall be completely covered with insulation and sealed to provide a complete vapor retarding barrier.

Where insulated duct risers are supported by steel channels secured directly to the duct, extend the insulation and vapor retarding jacketing to encapsulate the support channels.

DUCT INSULATION SCHEDULE:

Provide duct insulation on new and existing remodeled ductwork in the following schedule:

SERVICE	INSULATION TYPE	JACKET	THICKNESS
Outside air ducts	Rigid Fiberglass	FSJ	2"
Mixed air ducts	Rigid Fiberglass	FSJ	2"
Exposed supply ducts*	Rigid Fiberglass	FSJ	3"
Concealed supply ducts	Flexible Fiberglass	FSJ	3"
Exhaust ducts downstream of motorized backdraft dampers	Rigid Fiberglass	FSJ	2"
Louver blank-off panels	Rigid Fiberglass	FSJ	2"

* Exposed supply branch ducts located in the space they are serving do not require insulation. Exposed supply main ducts running through spaces they serve shall be insulated as exposed supply ducts scheduled above.

*** Outside air ductwork between the isolation damper and the outside air intake does not require insulation where it is located in an unheated attic.

EQUIPMENT INSULATION

GENERAL:

Do not insulate over equipment access manholes, fittings, nameplates or ASME stamps. Bevel and seal insulation at these locations.

PROTECTIVE JACKETS:

Provide a protective metal jacket (PMJ) for the following:

- At existing heat exchanger (HX-1).

Provide a protective PVC jacket for the following:

- All supply and exhaust duct located in the new addition.

SEMI-RIGID FIBERGLASS:

Apply insulation to equipment shells using weld pins, bonding adhesive, banded and wired in place. Fill all joints, seams and depressions with insulating cement to a smooth, even surface. Cover with reinforcing fabric and 2 coats of mastic (FMJ). Use vapor retarding mastic on systems requiring a vapor retarding barrier.

ELASTOMERIC/POLYOLEFIN:

Apply full cover coat of adhesive to surface to be insulated, insulation and edge butt joints. Place insulation with edge joints firmly butted pressing to surface for full adhesion. Seal seams and joints vapor tight.

REMOVABLE COVERS:

Provide insulated easily removable elastomeric insulation sections for the following equipment:

- At equipment tag for existing heat exchanger (HX-1)

EQUIPMENT INSULATION SCHEDULE:

Provide equipment insulation as follows:

EQUIPMENT	INSULATION TYPE	JACKET	THICKNESS
Heat exchangers (Existing HX-1)	Semi-Rigid Fiberglass	ASJ/PMJ	2"

CONSTRUCTION VERIFICATION ITEMS

Contractor is responsible for utilizing the construction verification checklists in accordance with the procedures defined for construction verification in Section 01 91 00.

END OF SECTION

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SECTION 23 09 14

PNEUMATIC AND ELECTRIC INSTRUMENTATION AND CONTROL DEVICES FOR HVAC

PART 1 - GENERAL

SCOPE

This sections includes pneumatic control system specifications for all HVAC work as well as related pneumatic control for systems found in other specification sections. Included are the following topics:

PART 1 - GENERAL

- Scope
- Point List
- Related Work
- Reference
- Work Not Included
- Quality Assurance
- Reference Standards
- System Description
- Submittals
- Design Criteria
- Operation and Maintenance Data
- Material Delivery and Storage

PART 2 - PRODUCTS

- Air Piping
- Control Dampers
- Control Valves
- Control System Instrumentation
- Thermostat Guards
- Electric/Electronic Thermostats
- Pneumatic Transmitters
- Temperature Control Panels
- Temperature Sensors
- Differential Pressure Switches
- Air Pressure Safety Switches
- Current Status Switches
- Power Supplies

PART 3 - EXECUTION

- Installation
- Air Piping
- Wire and Air Piping Conduit and Tubing Installation Schedule
- Control Dampers
- Control Valves
- Control System Instrumentation
- Room Thermostats and Temperature Sensors
- Low Limit Thermostats (Freezestats)
- Temperature Control Panels
- Differential Pressure Switches
- Air Pressure Safety Switches
- Current Status Switches

POINT LIST (Section 23 09 15)

RELATED WORK

- Section 01 91 00 – Commissioning
- Section 23 05 93 - Testing, Adjusting, and Balancing for HVAC - Coordination
- Section 23 09 15 - Direct Digital Control Input/Output Point Summary Tables
- Section 23 09 23 - Direct Digital Control System for HVAC
- Section 23 09 93 - Sequence of Operation
- Section 23 33 00 - Ductwork Accessories (For control damper installation)

Division 23 - HVAC - Equipment provided to be controlled or monitored
Division 26 - Electrical - Installation requirements & Equipment provided to be controlled or monitored
Division 28 - Electronic Safety and Security

REFERENCE

Applicable provisions of Division 1 govern work under this section.

WORK NOT INCLUDED

Direct digital controls and energy management as specified in Section 23 09 23.

QUALITY ASSURANCE

Installing contractor must be a manufacturer's branch office or an authorized representative of a Direct Digital Control (DDC) equipment manufacturer that provides engineering and commissioning of the DDC equipment. Submit written confirmation of such authorization from the manufacturer. Indicate in letter of authorization that installing contractor has successfully completed all necessary training required for engineering, installation, and commissioning of equipment and systems and that such authorization has been in effect for a period of not less than three years. DDC equipment may or may not be required to be installed by this contractor as part of the project, but the intent of this quality assurance specification is to ensure that the installing contractor has the capabilities to engineer, install, and commission the field devices supplied under this section for temperature control.

REFERENCE STANDARDS

ANSI B16.22	Wrought Copper and Wrought Copper Alloy Solder Joint Pressure Fittings
ANSI/ASTM B32	Specification for Solder Metal
ASTM B75	Seamless Copper Tube
ASTM D1693	Environmental Stress-Cracking of Ethylene Plastics
ASTM D 635	Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position
UL 94	Tests for Flammability of Plastic Materials for Parts in Devices and Appliances
AMCA 500-D	Laboratory Method of Testing Dampers for Rating

SYSTEM DESCRIPTION

System is to use direct digital control with electronic actuation.

SUBMITTALS

Include the following information:

Manufacturer's data sheets indicating model number, pressure/temperature ratings, capacity, methods and materials of construction, installation instructions, and recommended maintenance. General catalog sheets showing a series of the same device is not acceptable unless the specific model is clearly marked.

Schematic flow diagrams of systems showing fans, pumps, coils, dampers, valves, and other control devices. Label each device with setting or adjustable range of control. Indicate all wiring, clearly, differentiating between factory and field installed wiring. Wiring should be shown in schematics that detail contact states, relay references, etc. Diagrammatic representations of devices alone are not acceptable.

Details of construction, layout, and location of each temperature control panel within the building, including instruments location in panel and labeling. Also include on drawings location of mechanical equipment controlled (room number), horsepower and flow of motorized equipment (when this data is available on plans), locations of all remote sensors and control devices (either by room number or column lines).

Schedule of control dampers indicating size, leakage rating, arrangement, pressure drop at design airflow, and number and size of operators required.

Schedule of control valves indicating system in which the 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.

A complete description of each control sequence for equipment that is not controlled by direct digital controls. Direct digital controlled equipment control sequences will be provided by the DDC control contractor.

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.

All submittals are to comply with submission and content requirements specified in specification Section 01 91 00.

DESIGN CRITERIA

Size all control apparatus to properly supply and/or operate and control the apparatus served.

Provide control devices subject to corrosive environments with corrosion protection or construct them so they are suitable for use in such an environment.

Provide devices exposed to outside ambient conditions with weather protection or construct them so they are suitable for outdoor installation.

Use only UL labeled products that comply with NEMA Standards. Electrical components and installation to meet all requirements of the electrical sections (Division 26) of project specifications.

OPERATION AND MAINTENANCE DATA

- Operation and maintenance instructions for the equipment and systems provided including:
 - Recommendations for frequency of service and preventative maintenance.
 - List indicating types/grades of oil/grease, packing materials, normal and abnormal tolerances for devices and method of equipment adjustment/calibration.
 - A description of recommended replacement parts and materials with the owner should stock.
 - A summary of equipment vendors or where replacement parts can be procured.
 - Manufacturers literature indicating features, materials of construction, and operating limits of installed equipment (equipment brochures are not acceptable).
 - A complete set of record control drawings.
 - Name, address and telephone number of the person or office to contact for service during the warranty period.
 - Name, address and telephone number of the person or service organization to be contacted for service after the warranty period.

MATERIAL DELIVERY AND STORAGE

Provide factory shipping cartons for each piece of equipment and control device. This contractor is responsible for storage of equipment and materials inside and protected from the weather.

PART 2 - PRODUCTS

AIR PIPING

ASTM B75 seamless, hard drawn or annealed copper tubing with ANSI B16.22 wrought copper fittings, except final connections to apparatus may be made with brass compression-type fittings. Use ANSI/ASTM B32, 95/5 tin antimony solder.

Virgin polyethylene plastic tubing classified as flame retardant under UL 94 and conforming to ASTM D1693 stress-crack test.

CONTROL DAMPERS

Provide control dampers shown on the plans and as required to perform the specified functions. Dampers shall be rated for velocities that will be encountered at maximum system design and rated for pressure equal or greater than the ductwork pressure class as specified in Section 23 31 00 of the ductwork where the damper is installed.

Use only factory fabricated dampers with mechanically captured replaceable resilient blade seals, stainless steel jamb seals and with entire assembly suitable for the maximum temperature and air velocities encountered in the system.

All dampers in stainless steel, PCD coated steel, PVC or PTFE ductwork shall be constructed of stainless steel.

All dampers in aluminum ductwork shall be constructed of stainless steel or aluminum.
Dampers in galvanized ductwork shall be constructed of galvanized steel and/or aluminum.

All dampers, unless otherwise specified, to be rated at a minimum of 180° F working temperature. Leakage testing shall be certified to be based on latest edition of AMCA Standard 500-D and all dampers, unless otherwise specified, shall have leakage ratings as follows:

Damper Class	Differential Pressure	Leakage
Class IA	1" w.g.	≤3 CFM/ft ²
Class I	4" w.g.	≤8 CFM/ft ²
Class I	8" w.g.	≤11 CFM/ft ²

Leakage rate dampers for differential pressures that they will encounter at maximum system design pressures.

Steel framed dampers: Nailor models 2010 & 2020; Greenheck models VCD-33 & VCD-42; Johnson Controls model V-1330; Ruskin Models CD60 & CD40; other approved equal.

Aluminum frame and blade dampers: Nailor models 2010EAF & 202EAF; Greenheck model VCD-43; Ruskin model CD50; Arrow model AFD-20; other approved equal.

Dampers used for directed mixing of airstreams, i.e. outside air and return air, to be parallel blade type and sized for an air velocity of 1800 to 2000 fpm with the damper blades shall be arranged so that the air streams are directed at one another to facilitate mixing. Dampers used for throttling or modulating applications other than air stream mixing to be opposed blade type. Two position dampers may be parallel or opposed blade type.

Dampers used for isolation on the discharge of centrifugal fans shall have damper blades perpendicular to the fan shaft to minimize system effect. Dampers mounted with blades vertically shall be designed for vertical blade orientation.

Dampers for applications other than fume exhaust to have frames of not less than 16 gauge galvanized steel or 12 gauge extruded aluminum. Blades to 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. Maximum allowable blade width is 8 inches. Use plated steel linkage hardware.

Maximum damper width is 48 inches; where required width exceeds 48 inches, use multiple damper sections. Inside frame free area shall be a minimum of 90% of total inside duct area.

Multiple width damper sections shall utilize jack shaft linkages unless noted below. Sections over 144 inches wide shall be actuated from two locations on the jack shaft. Double width damper sections for two-position operation may be actuated without jack shafts if each damper section is actuated separately. Dampers that have multiple width and multiple vertical sections shall have a jackshaft for each vertically stacked set of dampers and be provided with crossover linkages between jack shafts to transfer uneven loading.

Jack shafts shall be extended outside of the ductwork for external actuator mounting. Provide bearings on the point of exit for support of damper shafts to prevent wear on the shaft and the ductwork. If locating actuators out of the air stream is impossible, obtain mounting location approval from the designer unless the contract documents indicate in air stream mounting is acceptable. In no cases shall damper actuators for fume exhaust systems be located in the air stream or require entering the air stream to service an actuator.

Provide weatherproof NEMA 4 enclosures (Belimo N4 option or equal, Belimo ZS-100 or ZS-150 are not acceptable) that have removable covers that have clasps or machine screws (no sheet metal screws) and that do not require removing fasteners from the ductwork to prevent actuator failure or freeze-up when mounting in locations exposed to harsh environments or outdoor locations.

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. For pneumatic actuation, use rolling diaphragm, piston type operators with adjustable stops. For electric modulating actuation, use fully proportional actuators with zero and span adjustments. For two-position electric actuation use 24 VAC for DDC controlled actuators, 120 VAC actuators may be used for hardwire interlocking. See 23 09 15 for specific type of input signal required. Actuator stroke times shall match the requirements of the DDC controllers provided under 23 09 23 and/or the specific system requirements for proper operation. All electric actuators will be provided with overload protection to prevent motor from damage when stall condition is encountered.

Equip operators with spring return or stored energy fail-safe return for applications involving fire, freeze protection, moisture protection or specified normally open/closed operation. Face and bypass dampers for heating applications shall fail to the face position.

Provide independently mounted damper end switches (Kele TS-475, Ruskin SP-101/105, or equal) with form "C" contacts where control sequences require damper position indication or interlock. Damper end switches shall be independent of the damper actuators and be mounted directly to the damper shaft or auxiliary shaft that is mounted to a drive blade of the damper. End switches shall not contain mercury.

All power required for electric actuation shall be provided by this contractor if it is not able to be directly provided from the DDC controller.

Provide operators with linkages and brackets for mounting on device served.

CONTROL VALVES

Provide all control valves as shown on the plans/details and as required to perform functions specified. Spring ranges must be selected to prevent overlap of operation and simultaneous heating and cooling.

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. For pneumatic actuated systems, use rolling diaphragm, spring loaded, and piston type operators. For electric modulating actuation, use fully proportional actuators with 0-10VDC inputs and zero and span adjustments unless specified otherwise in the chart below. If TriState with feedback is specified, valve position shall be fed back to the controller and controller shall position valve based on this feedback. For two-position electric actuation use 24 VAC for DDC controlled actuators, 120 VAC actuators may be used for hardwire interlocking. Electric actuators, for applications other than terminal units, shall be provided with a manual override capability. All electric actuators shall be provided with a visible position indicator.

All power required for electric actuation shall be provided by this contractor if it is not able to be directly provided from the DDC controller.

Provide operators that are full proportioning or two-position, as required for specified sequence of operation. Provide spring-return for applications involving fire, freeze protection, moisture protection or specified normally open/closed operation. Valves shall move to their fail positions on loss of electrical power.

Two-position shut-off valves shall be sized for a maximum pressure drop of 2 PSI at design flow and shall be a minimum of line size.

Provide operators with linkages and brackets for mounting on device served.

All valves unless specifically noted on the plans or indicated below shall be globe style valves.

VALVE SERVING	TYPE	SIGNAL	SPRING RETURN REQUIRED	FAIL POSITION
	Globe Butterfly (BF) Ball Press Independent Ball (PI Ball)	0-10 VDC TriState (24VAC) 2-Position Elect Pneumatic (Pneu)	Yes No	Open (thru Coil) Closed (bypass Coil) Last Position
Radiation Floor Heating	Globe or Ball	0-10 VDC or TriState	No	Last Position
CUH and UH	Globe or Ball	TriState or 2-Pos Elect	Yes	Open
FCU Heating Coil	Globe	0-10 VDC	Yes	Open

See plan details, notes, and schedules for where two-way and three-way valves should be used.
 1. Equivalent Cv butterfly valves may be used where 3" and larger globe valves would be required.

WATER SYSTEMS:

Use equal percentage valves for two-way control valves; size for a pressure drop not less than 4 psi or more than 6 psi. Note: For low flows, the required minimum Cv size will result in lower pressure drop than 4 psi.

Use three-way valves sized for a maximum pressure drop of 5 psi and that have linear characteristics so that the valve pressure drop remains constant regardless of the valve position.

Globe valves 2" and smaller: 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° F. Seat leakage with actuator supplied will meet ANSI class IV leakage (0.01%). For globe valves that are specified to fail in place, valves shall be open when the stem is up. Only the following globe valve body styles will be acceptable for terminal unit control: Siemens Powermite 599 VF Series (599 VE Series Zone Valves are not acceptable), Invensys VB7200 Series, Johnson Controls VG7000 Series, and Honeywell V5011/V5013 Series. Minimum size for globe valves shall be 1.5 Cv.

Globe valves 2 1/2" and larger: 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° F.

Characterized Ball Valves: The following manufacturers are acceptable: Honeywell, Belimo, Johnson Controls, KMC Controls, Yamatake, Bray. For use on terminal units only where specified above. 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 ANSI Class IV (0.01%) leakage, suitable for use on water systems at 150 psig and 212° F. Minimum size for ball valves shall be 1.0 Cv.

CONTROL SYSTEM INSTRUMENTATION

Manufacturers: Averaging Type - Johnson Controls, or equal; Bulb Type - Johnson Controls, Ashcroft, Marshall, Weksler

DUCT THERMOMETERS:

3 inch or larger dial type with swivel mount. Maximum scale graduations of 2°F. Thermometers in ducts above 6 square feet to have averaging type, liquid or gas filled capillary sensing elements a minimum of 6 feet and supported across the width of the duct. Thermometer temperature range shall not be more than twice the expected temperature range at installed location.

REMOTE BULB THERMOMETERS:

3 inch or larger dial type with recalibration screw on face. Accuracy within 1% of scale range. Thermometers with sensing elements in air ducts with an area of above 6 square feet to have averaging liquid or gas filled capillary sensing elements. Provide separable wells for all pipeline applications. Thermometer temperature range shall not be more than twice the expected temperature range at installed location.

THERMOSTAT GUARDS

Provide clear plastic locking covers keyed the same. For locations that are subject to physical abuse, provide metal guard, Johnson Controls GRD10A-601, Shaw Perkins Series 16 or equal.

ELECTRIC/ELECTRONIC THERMOSTATS

LOW LIMIT THERMOSTATS (freezestats):

Electric two-position type with temperature sensing element and manual reset for all applications except integral face and bypass steam heating coils which shall have auto-reset freezestats and latching relays (see execution section for details). Unit to be capable of opening control circuit if any one-foot length of sensing element is subject to a temperature below the setpoint. Length of sensing element to be not less than one lineal foot per square foot of coil surface areas. Unless otherwise indicated, set low limit controls at 36°F.

AQUASTATS:

Line voltage type with single pole, double throw switch of adequate rating for the applied load.

REMOTE BULB THERMOSTATS:

Line voltage type with single pole, double throw switch of adequate rating for the applied load. Thermostat to have adjustable setpoint suitable for controlled load.

IMMERSION TYPE THERMOSTAT SENSORS:

Rod and tube type with linear output. Provide separable wells with heat conductive fluid for installation in pipeline. Units shall be factory calibrated.

FIRESTATS:

UL labeled, manual reset, line voltage type with 135°F setpoint.

TEMPERATURE TRANSMITTERS:

One pipe, with linearity within 1/2 percent of range for 200°F span and one percent of range for 50°F span and equipped with a compensated bulb, averaging capillary, or rod and tube sensing element. Range to be suitable for system. Pneumatic output signal to be directly proportional to measured variable.

TEMPERATURE CONTROL PANELS

Constructed of steel or extruded aluminum, with hinged door, keyed lock, and baked enamel finish. Install controls, relays, transducers and automatic switches inside panels. Label devices with permanent printed labels and provide asbuilt wiring/piping diagram within enclosure. Provide raceways for wiring and poly within panel for neat appearance. Provide termination blocks for all wiring terminations. Label outside of panel with panel number corresponding to plan tags and asbuilt control drawings as well as building system(s) served.

Control panels that have devices or terminations that are fed or switch 50V or higher shall enclose the devices, terminations, and wiring so that Personal Protective Equipment (PPE) is not required to service the under 50V devices and terminations within the control panel. As an alternative, a separate panel for only the 50V and higher devices may be provided and mounted adjacent to the under 50V control panel. For panels that have 120VAC power feeds provide a resettable circuit breaker. Provide label within the panel indicating circuit number of 120VAC serving panel

Provide a service shutdown toggle switch for each air handling unit system located inside the temperature control panel that will initiate a logical shutdown of the air handling unit system. Label the switch so it is clear which position is shutdown and which is auto.

Manual switches including damper "minimum-off" positioning switches, "summer-winter switches", "manual-automatic switches", dial thermometers, pressure gauges, and receiver indicating gauges shall be flush mounted in front door of panel. Clearly identify each item with engraved nameplates.

TEMPERATURE SENSORS

Thermistor temperature sensor manufacturers: PreCon, Badger Data Industrial, BAPI, and ACI

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. RTD's shall be of nickel or platinum construction and have a base resistance of 1000Ω at 70°F and 77°F respectively. 100Ω platinum RTD's are acceptable if used with temperature transmitters.

The temperature sensing device used must be compatible with the DDC controllers used on the project.

RTD

Accuracy (Room Sensor Only)	minimum \pm 1.0°F
Accuracy (Averaging)	minimum \pm 1.2°F
Accuracy (Other than Room Sensor or Averaging)	minimum \pm 0.65°F
Range	minimum -40 - 220°F

Thermistor

Accuracy (All)	minimum \pm 0.36°F
Range	minimum -30 - 230°F
Heat Dissipation Constant	minimum 2.7 mW/°C

Temperature Transmitter

Accuracy	minimum \pm 0.1°F or \pm 0.2% of span
Output	4-20 mA

Provide limited range or extended range sensors if required to sense the range expected for a respective point. Use RTD type sensors for extended ranges beyond -30 to 230°F. If RTD's are incompatible with DDC controller direct temperature input use temperature transmitters in conjunction with RTD's.

Use wire size appropriate to limit temperature offset due to wire resistance to 1.0°F. If offset is greater than 1.0°F due to wire resistance, use temperature transmitter. If feature is available in DDC controller, compensate for wire resistance in software input definition.

Terminal unit space sensors specified with overrides or adjustments shall be furnished under Section 23 09 23, 23 09 24, or 23 09 25. Terminal unit space sensors specified to be provided without overrides or adjustments shall be provided under this Section. Terminal unit discharge temperature sensors shall be provided under this Section.

Use averaging elements on duct sensors when the ductwork is ten square feet or larger. All mixed air and heating coil discharge sensors shall have averaging elements regardless of duct size.

In piping systems use temperature sensors with separable wells designed to be used with temperature element.

DIFFERENTIAL PRESSURE SWITCHES

Differential pressure switches shall sense both inlet and outlet of fans and pumps. Device shall be rated for 150% of maximum system pressures that may be encountered. Provide with pressure differential that will be required to meet specified operation and/or to prevent nuisance "togglng" of the device in the system served.

AIR PRESSURE SAFETY SWITCHES

Air pressure safety switches shall be a differential pressure switch that will sense differential, negative, or positive pressure as required by the sequence of operation specification. Device shall be rated for a minimum of 150% of maximum system pressures that may be encountered. Provide with pressure range that will be required to meet specified operation in the system served. Provide with a normally closed contact that will open above setpoint and will not close until the manual reset button is depressed. Setpoint shall be manually adjustable.

CURRENT STATUS SWITCHES

Provide a current sensor with adjustable threshold and digital output with LED display, equal to a Veris model H-708/H-904. Threshold adjustment must be by a multi-turn potentiometer or set by multiprocessor that will automatically compensate for frequency and amperage changes associated with variable frequency drives. When used on variable speed motor applications, use a current sensor that will not change state due to varying speeds.

POWER SUPPLIES

Provide all required power supplies for transducers, sensors, transmitters and relays. All low voltage transformers shall have a resettable secondary circuit breaker and be listed as class 2 power supplies.

PART 3 - EXECUTION

INSTALLATION

Install system with trained mechanics and electricians employed by the control equipment manufacturer or an authorized representative of the manufacturer. Where installing contractor is an authorized representative of the control manufacturer, such authorization shall have been in effect for a period of no less than three years.

Install all control equipment, accessories, wiring, and piping in a neat and workmanlike manner. All control devices must be installed in accessible locations. This contractor shall verify that all control devices furnished under this Section are functional and operating the mechanical equipment as specified in Section 23 09 93.

All cables to the electronic input/output devices, sensors, relays and interlocking wiring (all of which shall be supplied and installed under this section of specification) interfaced with the Direct Digital Control System shall be extended into the 23 09 24 DDC panel with a minimum of 5 ft. of cable to allow for termination by the 23 09 24 DDC Contractor. This contractor shall provide a technician to inspect and validate all tubing, wiring, and field devices associated with the DDC interface in coordination with and under direction of the 23 09 24 DDC Contractor to ensure that each device is operating per the control sequences as specified in Section 23 09 93.

Label all control devices with the exception of dampers, valves, and terminal unit devices with permanent printed labels that correspond to control drawings. Temperature control junction and pullboxes shall be identified utilizing spray painted green covers. Other electrical system identification shall follow the 26 05 53 specification.

All control devices and electrical boxes mounted on insulated ductwork shall be mounted over the insulation. Provide mounting stand-offs where necessary for adequate support. Cutting and removal of insulation to mount devices directly on ductwork is not acceptable. This contractor shall coordinate with the insulation contractor to provide for continuous insulation of ductwork.

Mounting of electrical or electronic devices shall be protected from weather if the building is not completely enclosed. This Contractor shall be solely responsible for replacing any equipment that is damaged by water that infiltrates the building if equipment is installed prior to the building being enclosed.

Provide all electrical relays and wiring, line and low voltage, for control systems, devices and components. Install all high voltage and low voltage wiring (includes 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 except above accessible ceilings as noted below. See Wire and Air Piping Conduit Installation Schedule below for specific conduit or tubing to be used. All raceways, enclosures, fittings and associated supports shall be provided and installed according to the requirements set forth in Division 16, NFPA 90 (NEC) and Chapter SPS 316 of the Wisconsin Administrative Code. All conduits shall be routed parallel and/or perpendicular to walls and adjacent piping. Raceways shall be located to maintain headroom and working clearance around equipment and devices that require inspection and service.

In general, support all raceways from the building structure. No component of a raceway system shall be secured to corrugated metal roof deck. Do not impose on the installations of other trades. Securing conduit, rods, straps, hangers, etc. to suspended ceiling components, electrical raceways, plumbing piping, fire protection sprinkler piping, HVAC piping or ductwork, or their associated support systems, will not be accepted.

Conduit shall be a minimum of 1/2 " for low voltage control provided the pipe fill does not exceed 40%.

Where HVAC equipment control panels, or devices, do not provide for the direct connection of conduits, exposed wiring may be extended to complete the final connections, providing it does not exceed 18 inches in length.

Minimum low voltage wiring gauge to be 18 AWG for outputs and 20 AWG for inputs. All low voltage wiring to be stranded.

Low voltage wiring can be run without conduit above accessible lay-in tile ceilings. All wiring in mechanical rooms, above inaccessible hard ceilings, exterior locations, and in any exposed areas, and in all other locations shall be in conduit. Wire for wall sensors shall be run in conduit. Wiring for radiation valves shall be run in conduit where routed through walls.

Where wiring is installed free-air, installation shall comply with the following:

- Wiring shall utilize the cable tray wherever possible.
- Wiring shall run at right angles and be kept clear of other trades work.
- Wiring shall be supported utilizing "J" or "Bridal-type" steel mounting rings anchored to ceiling concrete, piping supports, walls above ceiling or structural steel beams. Mounting rings shall be of open design (not a closed loop) to allow additional wire to be strung without being threaded through the ring. For mounting rings that do not completely surround the wire, attach the wire to the mounting ring with a strap.
- At HVAC terminal units only, where the wiring serves a specific device; e.g. controller, actuator, transmitter, etc. associated with the unit, the j-hooks or Bridal rings required to support the wiring, may be secured to the rods or straps that support the ductwork or piping that serves the unit. Wall penetrations shall be sleeved.
- Supports shall be spaced at a maximum 4-foot interval unless limited by building construction. If wiring "sag" at mid-span exceeds 6-inches; another support shall be used.
- Wall penetrations shall be sleeved, fire stopped and sealed air tight.
- Wiring shall not be supported from existing cabling, existing tubing, plumbing or steam piping, ductwork, any component of a suspended ceiling, or electrical or communications conduit.

Control panels serving equipment fed by emergency power shall also be served by emergency power. This contractor shall be responsible for all 120VAC power, not provided in the Division 26 specifications, required for equipment provided under this section. Power shown for temperature control panels on plans may be utilized by the 23 09 24 and/or 23 09 23, and 23 09 14 contractors.

Provide communication trunk wiring to integrated devices (i.e. VFD's, Flow Meters, Chillers, Lighting Panels, Electrical Meters, etc.) and terminal unit controllers that are specified to be connected to the building automation system. Communication trunk wiring shall be as required by the equipment specified under the 23 09 23, 23 09 24, or 23 09 25 Sections and shall be routed to the DDC panel designated for that equipment as shown on the plans or the closest DDC panel if not designated. If communication trunks require daisy chained style wiring, provide two communication cables to the DDC panel so that the communication trunk is not dead ended.

Install all terminal unit DDC controls and associated sensors furnished under Section 23 09 23. This contractor shall provide all 24VAC power transformers and wiring for DDC terminal unit controls. This contractor shall provide all communication wiring to the DDC supervisory controller provided under 23 09 24. Provide all power and communication wiring type and installation as required by the DDC controller manufacturer. Tag all terminal units with printed labels to match the terminal unit room schedules. This contractor shall terminate wiring for all terminal unit controllers and perform end to end point checkout of all inputs and outputs to the terminal unit controllers. This contractor shall verify the communication trunk and controller addressing.

Install "hand/off/auto" selector switches on systems where automatic interlock controls are specified and "hand/off/auto" selector switches are not supplied with the equipment controlled. Control panel power will not be required for "hand" switch to operate. When switch is in "hand" position, allow manual operation of the selected device without operating the interlocked motors but allowing all unit safety devices to stay in the circuit.

All wiring in control panels shall be terminated on a terminal strip. Wire nuts are not acceptable. A maximum of two wires shall be terminated under any one terminal.

All 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 the "Record Drawings".

After completion of installation, test and adjust control equipment. Submit data showing set points and final adjustments of controls.

AIR PIPING

Conceal piping whenever possible. Exposed piping may be run only in mechanical rooms, storage rooms, or other areas where mechanical systems piping is exposed.

Mechanically attach tubing to supporting surfaces. Sleeve through concrete surfaces in minimum one-inch sleeves, extended 6 inches above floors and one inch below bottom surface of slabs. Fire stop any open space in the sleeve after the air piping is installed if the sleeve is in a fire rated surface.

Install all polyethylene tubing in conduit as scheduled below unless specified otherwise hereafter. Exposed polyethylene tubing not exceeding 18 inches may be used for connection to an instrument or operator without being installed in conduit. All Conduit to be independently supported, all boxes must be supported, all conduit ends to have bushings for protection of tubing.

Conduit shall be a minimum of 1/2 " for poly tubing provided the pipe fill does not exceed 40%.

Minimum poly tubing size allowed is 1/4" OD. If an instrument has a barbed fitting that will only accept 5/32" tubing, connection to the device can be made with 5/32" tubing that is as short as is practical. Couplings are acceptable in this instance.

Install all exposed piping and conduit parallel to or at right angles to the building structure and support adequately at uniform intervals. Use only tool made bends in copper air pipe.

Tubing must be installed and supported in a manner as specified for exposed locations and acceptable to Dane County.

Where polyethylene tubing is installed free-air, installation shall consider the following:

- Tubing shall run at right angles and be kept clear of other trades work.
- Tubing shall be supported utilizing "J-" or "Bridal-type" mounting rings anchored to ceiling concrete, piping supports or structural steel beams. Rings shall be designed to maintain tubing bend to larger than the minimum bend radius (typically 4 x tubing diameter).
- Supports shall be spaced at a maximum 4-foot interval unless limited by building construction. If tubing "sag" at mid-span exceeds 6-inches, another support shall be used.
- Tubing shall never be laid directly on the ceiling grid or attached in any manner to the ceiling grid wires.
- Tubing shall be sleeved thru all interior wall penetrations. All interior wall penetrations shall be sealed air tight.

Tubing shall not be attached to existing cabling, existing tubing, plumbing or steam piping, ductwork, ceiling supports or electrical or communications conduit.

Tubing connected to air terminal unit devices shall be attached to the terminal unit device to prevent tubing from becoming kinked or becoming disconnected. Tubing serving air terminals may be routed on top of ductwork serving that terminal unit for a maximum distance of eight feet.

Number code all polyethylene tubing and install neatly with no concealed splices.

Piping material used shall be as follows:

- Use hard copper tubing for all main air lines, above 30 psi.
- All exposed copper to be hard drawn.
- Use only polyethylene tubing inside panels.

In concealed locations (other than noted below) hard copper, soft copper, or polyethylene tubing in conduit shall be used.

Polyethylene tubing in block, stud. or concrete walls must be in conduit and associated boxes to be of steel.

Where air piping is within concrete slab or under grade use only polyethylene tubing in conduit

For exposed outdoor locations, use hard copper or polyethylene tubing in conduit. Provide shielding for polyethylene tubing that is used for final device connection that will be exposed to direct sunlight.

For static sensing lines connected to ductwork located in exposed outdoor locations, slope piping from connection into building to a location that will be above freezing so any condensation will run into the building and not freeze in piping. Piping tap shall not be on the bottom of the ductwork.

Provide a drip leg of 3/8" tubing a minimum of one foot in length in an accessible location inside the building that will collect condensation from the sensing line.

Polyethylene tubing may be used in exposed areas if run in a fully enclosed rigid metal raceway or metal conduit and ambient temperature is less than 150°F.

Use copper tubing, where subject to temperatures in excess of 150°F or where adjacent to heating pipes passing through a common sleeve.

When polyethylene tubing is used above accessible lay-in acoustical panel ceilings it must be fire resistance "FR" rated pass the UL 94 vertical flame test with a rating of V2, be rated as self extinguishing under ASTM D 635, and may be run without conduit.

WIRE AND AIR PIPING CONDUIT AND TUBING INSTALLATION SCHEDULE

The following conduit schedule shall apply to both polyethylene tubing and wire in conduit where conduit is specified for air tubing or wiring. Conduit and tubing referenced below shall meet specifications in Section 26 05 33 and as defined below.

- Conduit other than that specified below for specific applications shall not be used.

- Underground Installations within Five Feet (1.5 m) of Foundation Wall: Rigid steel conduit.
- Underground Installations More than Five Feet (1.5 m) From Foundation Wall: Rigid steel conduit. Plastic-coated rigid steel conduit. Schedule 40 PVC conduit.
- Under Slab on Grade Installations: Schedule 40 PVC conduit.
- Exposed Outdoor Locations: Rigid steel conduit.
- Concealed in Concrete and Block Walls: Rigid steel conduit. Schedule 40 PVC conduit. Electrical Nonmetallic Tubing (ENT).
- Within Concrete Slab: Rigid steel conduit. Schedule 40 PVC conduit. Electrical Nonmetallic Tubing (ENT).
- Wet Interior Locations: Rigid steel conduit. Schedule 40 PVC conduit.
- Concealed Dry Interior Locations: Rigid steel conduit. Intermediate metal conduit. Electrical metallic tubing.
- Exposed Dry Interior Locations: Rigid steel conduit. Intermediate metal conduit. Electrical metallic tubing.

CONTROL DAMPERS

All control dampers furnished by the control manufacturer are to be installed by the Mechanical Contractor under the coordinating control and supervision of the Control Contractor in locations shown on plans or where required to provide specified sequence of control.

Damper end switches, where required, shall be independently mounted to the damper drive shaft or auxiliary shaft attached to a damper drive blade. End switches shall be adjusted to prove the damper the position opposite the fail position of the damper actuator unless the control sequence requires a different position to be proven to accomplish the specified control sequence.

Coordinate installation with the sheetmetal installer to obtain smooth duct transitions where damper size is different than duct size. Blank off plates will not be accepted.

Each operator shall serve a maximum damper area of 36 square feet. Where larger dampers are used, provide multiple operators.

CONTROL VALVES

All temperature control valves furnished by the control manufacturer are to be installed by the Mechanical Contractor under the coordinating control and supervision of the Control Contractor in locations shown on plans or where required to provide specified sequence of control.

All valves shall be mounted in the upright vertical position. If upright vertical mounting is not possible due to lack of space, obtain approval from the mechanical engineer of record on the project for alternate mounting that meet the manufacturers recommended installation.

CONTROL SYSTEM INSTRUMENTATION

Install thermometers at each point of temperature transmission (sensors) and control, except reheat coils, unless the drawings indicate a thermometer is to be installed by the piping or sheetmetal installer. Install thermometers to permit easy reading from the floor or operating platform. Provide remote mounting or swiveled mounting as required for easy reading. Flush mounting where not easily read is not acceptable.

ROOM THERMOSTATS AND TEMPERATURE SENSORS

Check and verify location of thermostats, humidistats, and other exposed control sensors with plans and room details before installation. Locate room thermostats and sensors 48 inches above floor. Align with light switches and humidistats. For drywall installations, thermostat mounting shall use a back-box attached to a wall stud, drywall anchors are not acceptable.

Any room thermostats or sensors mounted on an exterior wall shall be mounted on a thermally insulated sub-base. Subbase to provide a minimum of one half inch of insulation.

Where thermostats or sensors are mounted on exterior walls or in any location where air transfer will affect the measured temperature or humidity seal the conduit and any other opening that will effect the measurement.

Provide guards on thermostats and sensors in entrance hallways, other public areas, or in locations where thermostat is subject to physical damage.

LOW LIMIT THERMOSTATS (Freezestats)

Install low limit controls where indicated on the drawings or as specified. Unless otherwise indicated, install sensing element on the downstream side of heating coils.

Mount units using flanges and element holders. Provide duct collars or bushings where sensing capillary passes through sheetmetal housings or ductwork; seal this penetration to eliminate air leakage. Mount the units in an accessible location as to allow for resetting after low limit trips while still meeting manufacturer's installation requirements for proper function.

Distribute (serpentine) sensing element horizontally across the coil to cover every square foot of coil; on larger coils this may require more than one instrument. Install controls at accessible location with mounting brackets and element duct collars where required.

TEMPERATURE CONTROL PANELS

Mount control panels adjacent to associated equipment on vibration-free walls or freestanding angle iron supports. All control panel openings shall be plugged. Conduits and other penetrations on the top of the cabinets shall be sealed on the exterior of the cabinet with silicone caulk to resist water penetration. One cabinet may accommodate more than one system in same equipment room. Provide permanent printed labeling for instruments and controls inside cabinet and engraved plastic nameplates on cabinet face.

Provide as-built control drawings of all systems served by each local panel in a location adjacent to or inside of panel cover. Provide a protective cover or envelope for drawings.

DIFFERENTIAL PRESSURE SWITCHES

Provide for each fan or pump specified, or shown on point list. Provide shutoff valves at piping takeoff points. Readjust pressure and/or differential setpoints for proper operation after final balancing is completed.

CURRENT STATUS SWITCHES

Provide for each fan or pump specified, or shown on point list. Set threshold adjustment to indicate belt or coupling loss. Readjust threshold for proper operation after final balancing is completed. Use the variable frequency drive (VFD) integrated relay output for motor status, if provided on the VFD, in lieu of a discrete current switch. A separate current switch provided under this Section shall be wired in parallel with the VFD motor status relay when a bypass starter is provided on the VFD to prove motor status in the bypass mode.

END OF SECTION

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DDC INPUT / OUTPUT SUMMARY TABLE

PROJECT: Construction and Demolition Waste Recycling Facility LOCATION: Madison, WI	HARDWARE						SOFTWARE														Comments																
	OUTPUT			INPUT			ALARMS				ENERGY MANAGEMENT SYSTEM FUNCTIONS																										
	DIGITAL		ANALOG	DIGITAL		ANALOG	DIGITAL		DIGITAL	ANALOG		Day/Night Setback	Demand Limiting	Dial-up I/O	Duty Cycling	Optimum Start/Stop	Scheduled Start/Stop	Totalization	Trend	Equipment Integration		Lighting Integration	Fire Alarm Integration	Security/Access Integration	Elect P/QM Integration	Chiller Integration	Dry-bulb Economizer	HW/OA Reset	OA Lockout	Smoke Control	Fire Alarm Override						
	24VAC Contactor	2-Pos Actuator	Tri-State Actuator	Duration Adjust Actuator	4-20 mA	0-10 VDC	Current Sensing Switch	Control Relay Contact	Switch Closure	Auxiliary Contact	Diff Pressure Switch																					Flow Switch	Temperature	Relative Humidity	Differential Pressure	Gauge Pressure	Static Pressure
Control Relay																																					
POINT DESCRIPTION																																					
RADIANT FLOOR (HWP-6)																																					
Pump S/S	X																																				
Pump Status								X												X																	
3-Way Mixing Valve																																					
HWS Temp (To Radiant)												X															X	X									
HWR Temp (From Radiant)												X															X	X									
Floor Temperature												X															X	X									

SECTION 23 09 20

GAS DETECTION AND CONTROL SYSTEM

PART 1 - GENERAL

SCOPE

This section includes specifications for a system of gas detection and ventilation system control that monitors for the presence of some, or all of the following gasses; Nitrogen Dioxide (NO₂), Carbon Monoxide (CO) and Methane (CH₄). Included are the following topics:

PART 1 - GENERAL

- Scope
- Related Work
- Reference
- Reference Standards
- Quality Assurance
- Submittals
- Owner Training
- Warranty

PART 2 - PRODUCTS

- System
- System Electrical

PART 3 - EXECUTION

- Installation
- Start Up
- Control Sequences

RELATED WORK

Conditions of the Contract and portions of Division One of this Project Manual apply to this Section as though repeated herein.

Applicable provisions of Division 01 govern work under this Section.

- Section 01 91 00 – Commissioning
- Section 23 05 13 – Common Motor Requirements for HVAC
- Section 23 09 93 - Sequence of Operation for HVAC Controls

Division 26 - Electrical Specifications

REFERENCE

Applicable provisions of Division 1 govern work under this Section.

REFERENCE STANDARDS

- UL Underwriters Laboratory
- CSA Canadian Standards Association
- IPC-D-275 Standard for isolation from radio frequency and cellular transmissions

Sensors shall be capable of detecting the presence of gasoline fumes at a threshold of 5% of L.E.L. of gasoline.

QUALITY ASSURANCE

Substitution of Materials: Refer to Division 1 and the General Conditions of the Contract.

The gas detection system supplier shall maintain a service office within a 100-mile radius of the project location, and shall be staffed with trained technicians fully capable of providing instruction, routine maintenance and calibration service for all components of the gas detection system.

The manufacturer of the gas detection system shall have a minimum of five-years experience in the design and manufacturer of gas detection systems. The system shall ultimately provide the full functionality as outlined in these specifications.

SUBMITTALS

Product submittals shall include the following information:

Manufacturer's data sheets indicating model number, components, materials of construction, installation instructions and recommendations and recommended maintenance;

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;

Schedule of all sensors indicating sensor location and address (for microprocessor based systems).

The operation and maintenance instructions for the equipment and systems provided shall including the following items:

A description of recommended replacement parts and materials which the owner should stock;

A summary of equipment components and a parts list indicating replacement parts;

Manufacturer's literature indicating features, materials of construction, and operating limits of installed equipment.

OWNER TRAINING

Provide training to the Owner's Representative(s), concerning the proper operation and maintenance of the system and all sensing, monitoring, and control equipment. Conduct training during normal business hours, after system start-up and acceptance of the system by the Owner.

WARRANTY

The complete gas detection and control system shall be warranted for a minimum of (2) two years, with parts and labor provided free of charge to the Owner.

PART 2 – PRODUCTS

SYSTEM

Manufacturers:

The basis of design is Honeywell E3 Point networked remote gas detectors with central panel.

Base of design is Honeywell E3 Point panel networked remote gas detectors with a central panel. The Central panel shall be furnished with MODBus communications to BAS and relay connections for fire alarm panel.

Description:

The sensors shall be field adjustable and shall be able to be calibrated in the field.

Network Controller:

The network controller shall have the following capabilities and features:

- Green LED light for power on
- Red LED indicating first level of detection
- Red LED indicating second level of detection
- Yellow LED indicating system failure
- 4-20 mA Communications
- (2) RS-485 communication channels
- RS-232 data transmission port
- Alarm levels each with high and low set points
- Adjustable time delay before alarm
- Adjustable time delay after alarm
- DPDT relays
- BacNet or MODBus network compatible with building automation system.

LCD Display and Keypad:

The alphanumeric display will indicate precisely the status of the sensor, the type of gas or the location of the sensor as well as the value of the reading. The keypad shall facilitate cancellation of the alarm, as well as allowing for programming changes on the field.

Stand-Alone Monitor:

The unit shall have DPDT alarm relays, audible and visual alarms, programmable time delays, self-test capability and calibration status warning.

Sensors:

Sensor shall be similar to QEL Q5 series sensor.

The sensors shall be completely self-contained in a polycarbonate housing complete with control panel and indicating lights.

The sensor shall include a digital memory that continuously monitors the sensors calibration sequences to maintain sensor accuracy.

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.

The sensors shall be accurate in an operating environment of -10 degrees F to 104 degrees F and 10% to 90% R.H. (non-condensing).

The sensors must detect gas concentration for the following gases:

- Carbon Monoxide (CO)
- Nitrogen Dioxide (NO₂)
- Methane (CH₄)

System sensor relay module shall allow the operation of the auxiliary appliances. It shall contain relays of 1/16 HP, 5A, 24 VDC or 240 VAC and One (1) RS-485 Transmission Port.

SYSTEM ELECTRICAL

Network Controller:

Power supply shall be 120 VAC.

Furnish a 120 VAC to 24 VAC power transformers. Transformer shall be supplied by an independent primary feed circuit.

Sensors:

Power supply shall be 24 VAC.

Relays:

Furnish the system with all required relays and input/output signals to communicate with the building automation system.

Alarms:

Furnish the system with all required audible and non-audible alarms for proper system annunciation and control.

PART 3 - EXECUTION

INSTALLATION

Install all control equipment, accessories and wiring in a neat and workmanship like manner. All control devices must be installed in accessible locations.

Provide all electrical relays and wiring, line and low voltage for the control system including all devices and all components. Install all wiring in metal conduit, in accordance with electrical sections (Division 26) of these specifications.

All wiring shall be in accordance with the National Electrical Code.

Install in strict accordance with the manufacturer's recommendations and instructions.

Locate any control relays within 5 feet of the fan motor starter that it serves.

Carbon Monoxide (CO) sensors shall be installed between 3 to 5 feet above the floor.

Nitrogen Dioxide (NO₂) and Methane (CH₄) sensors shall be installed between 1 to 3 feet from the roof deck.

Provide quantity of sensors to cover the entire garage floor.

Provide quantity of audio and visual alarm devices to cover the entire garage floor.

Calibrate all sensors.

START UP

After completion of installation, test and adjust control equipment. A factory authorized service representative shall supervise the installation and test the system. Test the system and equipment by simulating a concentration of gas sufficient to initiate an alarm condition. Submit a final start-up report showing set points and final adjustments of controls, certifying that the system has been installed and is fully operational in accordance with the manufacturer's instructions and within the functional intent of these specifications.

Adjust and calibrate all sensors to assure proper operation of the system.

Control Sequences (See Also Section 23 09 93 – Sequence of Operation)

Automatic Operation:

If the sensor detects carbon monoxide in excess of 25 PPM and the ventilation system is disabled, the DDC system shall enable the ventilation system and it shall run continuously for a minimum of 20 minutes after levels drop below 25 PPM. If the ventilation system is enabled and the carbon monoxide sensor detects carbon monoxide in excess of 25 PPM, the DDC system shall generate an alarm.

If the CO level exceeds 100 PPM for an interval of 15 minutes or should the CO level remain at or above an average of 35 PPM for an (8) eight hour period, the sensor shall signal an audible alarm indicating high level. The alarm shall automatically reset should the CO level drop below 25 PPM.

Upon detection of a NO₂ level in excess of 1 PPM and the ventilation system is disabled, the DDC system shall enable the ventilation system and it shall run continuously for a minimum of 20 minutes after levels drop below 1 PPM.

If the NO₂ level reaches 2 PPM or remains at or above 1 PPM for an (8) hour period, the sensor shall signal an audible alarm indicating high level. The alarm shall automatically reset should the NO₂ level drop below 1 PPM.

Upon detection of a CH₄ level in excess of 25% LEL and the ventilation system is disabled, the DDC system shall enable the ventilation system and it shall run continuously for a minimum of 20 minutes after levels drop below 25% LEL.

If the CH₄ level reaches 50% LEL or remains at or above 25% LEL for an (8) hour period, the sensor shall signal an audible alarm indicating high level. The alarm shall automatically reset should the CH₄ level drop below 25% LEL.

END OF SECTION

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SECTION 23 09 23
DIRECT DIGITAL CONTROL SYSTEM FOR HVAC

PART 1 - GENERAL

SCOPE

Work in this section includes Direct Digital Control (DDC) panels, main communication trunk, software programming, and other equipment and accessories necessary to constitute a complete Direct Digital Control (DDC) system. This system interfaced with pneumatic/electric controls (Section 23 09 14) utilizing Direct Digital Control signals to operate actuated control devices will meet, in every respect, all operational and quality standards specified herein. All labor, material, equipment and software not specifically referred to herein or on the plans, that are required to meet the functional intent of this specification, shall be provided without additional cost to the Owner.

PART 1 - GENERAL

- Scope
- Related Work
- Reference
- Reference Standards
- Work Not Included
- Quality Assurance
- Submittals
- Operation and Maintenance Data
- Material Delivery and Storage

PART 2 - PRODUCTS

- General
- Open, Interoperable, Integrated Architecture
- Local Control Panels
- Direct Digital Controls (DDC)
- Networking/Communications
- BACnet Requirements
- Supervisory Controllers
- System Software Features
- Programmable Controllers
- Application Specific Controllers - HVAC
- Operator Interface Requirements
- Web Based HTML Browser Interface

PART 3 - EXECUTION

- General
- Installation
- County Training

RELATED WORK

Applicable provisions of Division 1 govern work under this Section.

- Section 01 91 00 - Commissioning Process
- Section 23 05 93 - Testing, Adjusting, and Balancing for HVAC – Coordination
- Section 23 09 14 - Pneumatic and Electric Instrumentation and Control Devices for HVAC
- Section 23 09 15 - Direct Digital Control Input/Output Point Summary Tables
- Section 23 09 93 - Control Sequences

Division 23 - HVAC - Equipment provided to be controlled or monitored

Division 26 - Electrical - Equipment provided to be controlled or monitored

REFERENCE

Applicable provisions of Division 1 govern work under this section.

REFERENCE STANDARDS

FCC Part 15, Subpart J, Class A - Digital Electronic Equipment to Radio Communication Interference

WORK NOT INCLUDED

Section 23 09 14 work includes furnishing and installing all field devices, including electronic sensors for the DDC of this section, equipment, and all related field wiring, interlocking control wiring between equipment, pneumatic tubing, sensor mounting, etc., that is covered in that section.

Motorized control dampers and actuators, thermowells (temperature sensing wells), automatic control valves and their actuators are also covered in Section 23 09 14.

QUALITY ASSURANCE

APPROVED MANUFACTURER

Approved Manufacturers: Honeywell

The existing building Honeywell direct digital control system to remain in operating order. Extend the existing direct digital control system to the new addition, for a complete and operating direct digital control system, encompassing the existing building and new addition.

INSTALLER

A firm specializing and experienced in DDC control system installation for no less than 3 years. All engineering and commissioning work shall be done by qualified employees of this manufacturer, or qualified employees of an Authorized Representative of that manufacturer that provides engineering and commissioning of the manufacturer's control equipment. Where installing contractor is an authorized representative of the control equipment manufacturer, submit written confirmation of such authorization. Indicate in letter of authorization that the installing contractor has successfully completed all necessary training required for the engineering, installation, and commissioning of equipment and systems to be provided for the project and that such authorization has been in effect for a period of not less than three years. The letter of authorization should also indicate that the installing contractor is authorized to install the manufacturer's DDC equipment at the project location at the time the project is bid. Installation of the equipment shall be done by qualified mechanics and/or electricians in the direct employ or be directly subcontracted and under the supervision of the manufacturer or Authorized Representative. The contractor providing and installing the equipment under this specification section shall be the same contractor providing and installing equipment under the 23 09 14 specification section.

All work shall follow current Dane County Building protocols and standards to provide County continuity in regards to controllers, thermostats, wiring and equipment.

RESPONSE TIME:

During warrantee period, four (4) hours or less, 24-hours/day, 7 days/week.

ELECTRICAL STANDARDS:

Provide electrical products, which have been tested, listed and labeled by Underwriters' Laboratories (UL) and comply with NEMA standards.

DDC Standards: DDC manufacturer shall provide written proof with shop drawings that the equipment being provided is in compliance with F.C.C. rules governing the control of interference caused by Digital Electronic Equipment to Radio Communications (Part 15, Subpart J, Class A).

SUBMITTALS

Include the following information:

Details of construction, layout, and location of each temperature control panel within the building, including instruments location in panel and labeling. Indicate which piece of mechanical equipment is associated with each controller and what area within the building is being served by that equipment. For terminal unit control, provide a room schedule that would list mechanical equipment tag, room number of space served, address of DDC controller, and any other pertinent information required for service.

PRODUCT DATA

Submit manufacturer's specifications for each control device furnished, including installation instructions and startup instructions. General catalog sheets showing a series of the same device is not acceptable unless the specific model is clearly marked. Annotated software program documentation shall be submitted for system sequences, along with descriptive narratives of the sequence of operation of the entire system involved. Submit wiring diagram for each electrical control device along with other details required to demonstrate that the system has been coordinated and will function as a system.

RECORD DRAWINGS

Prior to request for final payment provide complete composite record drawings to incorporate the DDC and Pneumatic/Electric field work. All software addressing for device communication shall be noted for all devices provided under this section and the communication addressing required for devices provided by others that are integrated into the direct digital control system provided under this section. Point to point routing of communication trunks and power wiring between DDC controllers, DDC communication devices, control panels, and Ethernet switches shall be documented. Coordinate with the supplier of the equipment specified to be interfaced through digital communications for communication addressing. Provide circuit number of 120VAC panel power circuit(s) feeding each control panel on record drawings. Label circuit number(s) inside the panel served.

OPERATION AND MAINTENANCE DATA

Provide three (3) hard copies and three (3) electronic copies (on compact disc) of the Operation and Maintenance Manuals to the Owners Representative upon the completion of the project. Operation and Maintenance Manuals shall include:

- Table of contents.
- As-built record drawings both in "hard copy" format and electronic format (Microsoft Word, AutoCAD and PDF). As-built drawings shall represent the current as-built condition AFTER the commissioning process has been completed.
- Manufacturer's product data sheets or catalog pages for all products including software.
- Archive copy of all site-specific data bases and sequences.
- BMS network diagrams.
- Interfaces to all third-party products and work by other trades.
- Name, address and telephone number of the person or office to contact for service during the warranty period.
- Name, address and telephone number of the person or service organization to be contacted for service after the warranty period.

The electronic copy of the Operation and Maintenance Manual shall be self-contained and include all necessary software required to access the product data sheets, etc. The manuals shall be logically organized, easy to use, easy to search and easy to print data from.

MATERIAL DELIVERY AND STORAGE

Provide factory shipping cartons for each piece of equipment and control device. This contractor is responsible for storage of equipment and materials inside and protected from the weather.

PART 2 - PRODUCTS

GENERAL

The Building Management System (BMS) shall be a complete system designed for use with the enterprise IT systems. This functionality shall extend into the equipment rooms. Devices residing on the automation network located in equipment rooms and similar shall be fully IT compatible devices that mount and communicate directly on the IT infrastructure in the facility. Contractor shall be responsible for coordination with the owner's IT staff to ensure that the BMS will perform in the owner's environment without disruption to any of the other activities taking place on that LAN.

All points of user interface shall be on standard PCs that do not require the purchase of any Special software from the BMS manufacturer for use as a building operations terminal. The primary point of interface on these PCs will be a standard Web Browser. The work of the single BMS Contractor shall be as defined individually and collectively in all Sections of this Division specifications together with the associated Point Sheets and Drawings and the associated interfacing work as referenced in the related documents. The BMS work shall consist of the provision of all labor, materials, tools, equipment, software, software licenses, software configurations and database entries, interfaces, wiring, tubing, installation, labeling, engineering, calibration, documentation, samples, submittals, testing, commissioning, training services, permits and licenses, transportation, shipping, handling, administration, supervision, management, insurance, temporary protection, cleaning, cutting and patching, warranties, services, and items, even though these may not be specifically mentioned in these Division documents which are required for the complete, fully functional and commissioned BMS.

Provide a complete, neat and workmanlike installation. Use only manufacturer employees who are skilled, experienced, trained, and familiar with the specific equipment, software, standards and configurations to be provided for this Project.

Manage and coordinate the BMS work in a timely manner in consideration of the Project schedules. Coordinate with the associated work of other trades so as to not impede or delay the work of associated trades.

The BMS as provided shall incorporate, at minimum, the following integrated features, functions and services:

- Operator information, alarm management and control functions.
- Enterprise-level information and control access.
- Information management including monitoring, transmission, archiving, retrieval, and reporting functions.
- Diagnostic monitoring and reporting of BMS functions.
- Offsite monitoring and management access.
- Energy management

OPEN, INTEROPERABLE, INTEGRATED ARCHITECTURES

The intent of this specification is to provide a peer-to-peer networked, stand-alone, distributed control system with the capability to integrate both the ANSI/ASHRAE Standard 135-1995 BACnet and LonWorks technology communication protocols in one operable integrated system.

The supplied computer software shall employ object-orientated technology for representation of all data and control devices within the system. In addition, adherence to industry standards including ANSI/ASHRAE Standard 135-1995, BACnet and LonMark to assure interoperability between all system components is required. For each LonWorks device that does not have LonMark certification, the device supplier must provide an XIF file for the device. For each BACnet device, the device supplier must provide a PICS document showing the installed device's compliance level. Minimum compliance is Level 3; with the ability to support data read and write functionality. Physical connection of BACnet devices shall be via Ethernet.

All components and controllers supplied under this contract shall be true peer-to-peer communicating devices. Components or controller requiring "polling" by a host to pass data shall not be acceptable.

The supplied system must incorporate the ability to access all data using Java enabled browsers without requiring proprietary operator interface and configuration programs. An Open DataBase Connectivity or Structural Query Language compliant server database is required for all system database parameter storage. This data shall reside on a supplier-installed server for all database access. Systems requiring proprietary database and user interface programs shall not be acceptable.

A hierarchical topology is required to assure reasonable system response times and to manage the flow and sharing of data without unduly burdening the customer's internal Intranet network. Systems employing a "flat" single tiered architecture shall not be acceptable.

Maximum acceptable response time from any alarm occurrence (at the point of origin to the point of annunciation shall not exceed 5 seconds for network connected user interfaces.

Maximum acceptable response time from any alarm occurrence (at the point of origin) to the point of annunciation shall not exceed 60seconds for remote or dual-up connected user interfaces.

LOCAL CONTROL PANELS

Use control panels with suitable mounting brackets for each supply fan system. Locate panel adjacent to system served.

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.

Provide UL listed cabinets for use with line voltage devices.

Control panels that have devices or terminations that are fed or switch 50V or higher shall enclose the devices, terminations, and wiring so that Personal Protective Equipment (PPE) is not required to service the under 50V devices and terminations within the control panel. As an alternative, a separate panel for only the 50V and higher devices may be provided and mounted adjacent to the under 50V control panel.

Plastic control enclosures will be approved provided all conduits are bonded and grounded.

Provide control panels for all DDC Controllers, ASC's and associated function modules. All controls to be in control panels provided under this Section except for the following:

- Terminal unit controllers mounted within the terminal unit equipment enclosure.
- or Above accessible lay-in tile ceilings where VAV box controllers designed to be directly mounted on air terminals.
- Above accessible lay-in tile ceilings where additional controllers are required for air terminal unit control. Where additional controllers are required, they shall not be mounted directly to the ductwork but be mounted on din rail or back panel in an accessible location as close as possible to the terminal unit(s) being controlled.
- Any devices other than DDC controllers, i.e. relays, pressure switches, etc. shall be installed in an enclosure.

Provide terminal unit equipment enclosures with removable cover for all terminal units located in exposed ceilings or in mechanical rooms that completely enclose the DDC controller and allow for conduit terminations.

All wiring for controllers shall be managed in a neat and workmanlike manner.

Permanently label all controls; tag all control wiring, and document both on control drawings.

DIRECT DIGITAL CONTROLS

System to be capable of integrating multiple building functions, including equipment supervision and control, alarm management, energy management, and trend data collection.

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.

The system shall be modular in nature, and shall permit expansion of both capacity and functionality through the addition of sensors, actuators, ASC's, and operator devices.

The failure of any single component or network connection shall not interrupt the execution of control strategies at other operational devices.

NETWORKING/COMMUNICATIONS

The design of the DDC shall be networked. The highest level networking shall use Ethernet and the sub-level networking shall use serial communications. Inherent in the system's design shall be the ability to expand or modify the highest network either via a local area network (LAN), wide area network (WAN), or a combination of the two schemes.

The highest-level DDC communications network shall be capable of direct connection to and communication with a high-speed LAN or WAN utilizing an Ethernet connection. Communication protocol used shall be BACnet/IP.

The supervisory controller shall directly oversee a local network such that communications may be executed directly to and between programmable controllers and ASC's. All operator devices, either network resident or connected via dial-up modems, shall have the ability to access all points and application reports on the network.

Provide serial communication ports on all ASC's for operator's terminal communications with the DDC Controller.

Access to system data shall not be restricted by the hardware configuration of the DDC system.

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.

Network design shall include the following provisions:

- Data transfer rates for alarm reporting and quick point status from multiple programmable controllers and ASC's. The minimum baud rate shall be 9600 baud.
- 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. The buss shall be addressable for up to 32 ASC's.
- Detection of single or multiple failures of ASC's or the network media.
- Error detection, correction, and re-transmission to guarantee data integrity.
- Use commonly available, multiple-sourced, networking components.
- Use of an industry standard communication transport, such as, ARCNET, Ethernet, and IEEE RS-485 communications interface.

Provide a temporary Ethernet network for communications between supervisory controllers and operator workstation until the building IT network is available for use by the DDC system. The temporary Ethernet network and all other communications required for the DDC system shall be installed as required for specified operation of mechanical equipment so check out and commissioning of the equipment can occur in a timely manner.

BACNET REQUIREMENTS

BACnet of highest level network communications will utilize BACnet/IP over Ethernet and field level communications shall utilize BACnet MSTP. No other communication protocol is acceptable.

All controllers shall provide a Protocol Implementation Conformance Statement (PICS) and BACnet Interoperability Building Blocks (BIBB'S) as required by the American National Standards Institute/American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ANSI/ASHRAE) Standard 135-2001, BACnet protocol.

In general all devices shall support the following:

- Segmentation Capability
- Segmentation requests supported
- Segmentation responses supported

Standard Object Types Supported:

- Analog input
- Analog output
- Analog value
- Binary input
- Binary output
- Binary value
- Calendar
- Device
- Event enrolment
- Group
- Multistate input
- Multistate output
- Multistate value
- Notification class
- Schedule

Character Sets supported

- ANSI X3.4
- ISO 10646 Universal Character Set-2

All highest level networked supervisory devices shall support the following:

- Data Link Layer Option
 - BACnet Internet Protocol (IP) (Annex J)

Networking Options:

- BACnet/IP Broadcast Management Device (BBDM)

BACnet object name and description shall match any existing naming conventions used by Dane County for their existing Building Automation System. Coordinate with Dane County facilities personnel to establish the naming conventions prior to programming of any controllers provided under this specification section. All controllers shall have object names, descriptions, and engineering units that are writable at the controller level and shall be programmed so that the object names, descriptions, and engineering units match the desired naming standards as specified above.

Ensure that the BACnet object attributes for object name, object description, engineering units and other required attributes will be transferred through to the Supervisory Controller when the auto-discovery function is executed.

Coordinate BACnet device instance numbering with Dane County facility personnel for controllers provided under this Section that are being connected to an existing building automation system. This contractor shall be responsible for correcting any conflicts with existing devices that may occur or changing the device instance numbers to comply to follow the agency BACnet device instance numbering scheme.

SUPERVISORY CONTROLLERS

Supervisory controllers shall be microprocessor-based, multi-tasking, multi-user and digital control processors.

Each supervisory controller shall have sufficient memory to support its own operating system and databases including:

- Control processes
- Energy management application
- Alarm management
- Trend data
- Maintenance support applications
- Operator I/O
- Dial-up communications
- Manual override monitoring

The system shall be modular in nature, and shall permit easy expansion through the addition of field controllers, sensors, and actuators.

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.

Supervisory controllers shall monitor the status of all overrides and include this information in the logs and summaries to inform the operator that automatic control has been inhibited.

Each supervisory controller shall continuously perform self-diagnostics, communications diagnostics, and diagnostics of all subsidiary equipment. Supervisory controllers shall provide both local and remote annunciation of any detected component failures, or repeated failure to establish communication. Indication of the diagnostic results shall be provided at each supervisory controller.

Isolation shall provided at all network terminations, as well as all field point terminations, to suppress induced voltage transients consistent with IEEE Standard 587-1980. Isolation levels shall be sufficiently high to allow all signal wiring to be run in the same conduit as high voltage wiring acceptable by electrical code.

In the event of the loss of normal power, there shall be an orderly shutdown of the supervisory controller to prevent the loss of data base or operating system software. Non-volatile memory shall be incorporated for all critical controller configuration data, and battery backup shall be provided to support the real-time clock and all volatile memory for a minimum of 72 hours.

Upon restoration of normal power, the supervisory controller shall automatically resume full operation without manual intervention.

Should supervisory controller memory be lost for any reason, the supervisory controller shall have the capability of reloading it's programming via high speed local area network from the control system archive workstation or server, the local RS-232C port, or telephone line dial-in.

SYSTEM SOFTWARE FEATURES

All necessary software to form a complete operating system, as described in this specification, shall be provided as an integral part of the supervisory controller, and shall not be dependent upon higher level computer for execution.

Control software shall include a provision for limiting the number of times that each piece of equipment may be cycled within any one-hour period.

The 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.

Supervisory controllers shall have the ability to perform any or all of the following energy management routines:

- Time of day scheduling
- Calendar based scheduling
- Holiday scheduling
- Optimal start
- Optimal stop
- Demand limiting
- Load rolling
- Heating/cooling interlock

All programs to be executed automatically without the need for operator intervention, and be flexible enough to allow user customization. Programs shall be applied to building equipment described in Section 23 09 93 of this specification.

Supervisory controllers shall be able to execute configured processes defined by the user to automatically perform calculations and control routines.

It shall be possible to use any of the following in a configured process:

- Any system-measured point data or status
- Any calculated data
- Any results from other processes
- Boolean logic operators (and, or)

Configured processes may be triggered based on any combination of the following:

- Time of day
- Calendar date
- Other processes
- Events (e.g., point alarms)

A single process shall be able to incorporate measured or calculated data from any and all other ASC's.

A single process shall be able to issue commands to points in any and all other programmable controllers and ASC's on the local network.

Alarm management shall be provided to monitor, buffer, and direct alarm reports to operator devices and memory files. Each supervisory controller shall perform distributed; independent alarm analysis and filtering to minimize network traffic and prevent alarms from being lost. At no time shall the ability of supervisory controllers to report alarms be affected by either operator activity at the local I/O device or communications with other ASC's on the network.

All alarm or point change reports shall include the English language description of each point and the time and date of the occurrence.

The user shall be able to define the specific system reaction for each point. Alarms shall be prioritized to minimize nuisance reporting and to speed operator response to critical alarms. A minimum of three priority levels shall be provided. Users shall have the ability to manually inhibit alarm reporting for each point.

The user shall also be able to define conditions under which point changes need to be acknowledged by an operator and/or logged for analysis at a later date.

Alarms reports and messages shall be directed to an operator device.

In addition to the point's descriptor and the time and date, the user shall be able to print, display or store a 60-character alarm message to more fully describe the alarm condition or direct operator response.

Each supervisory controller shall be capable of storing a library of at least 100 messages. Each message may be assignable to any number of points in the panel.

A data collection utility shall be provided to automatically sample, store, and display system data.

Measured and calculated analog and binary data shall be assignable to user definable trends for the purpose of collecting operator specified performance data over extended periods of time. Sample intervals of 1 minute to 24 hours, in one minute or one hour intervals, shall be provided. Each supervisory controller shall have a dedicated buffer for trend data and shall be capable of storing 16 trend logs. Each trend log shall have up to four points trended at 48 data samples each. Data shall be stored at the supervisory controller and up-loaded to the DDC system server when archiving is desired.

Supervisory controllers shall automatically accumulate and store runtime hours for binary input and output points specified in Section 23 09 14 of this specification.

Supervisory controllers shall automatically sample, calculate and store consumption totals on a daily, weekly, or monthly basis, user defined, for user-selected analog and binary pulse input type points.

Totalization shall provide calculation and storage accumulations of up to 9,999,999 units (e.g., KWH, gallons KBTU, tons, etc.).

The totalization routine shall have a sampling resolution of one minute.

The user shall have the ability to define a warning limit. Unique, user specified messages shall be generated when the limit is reached.

The information available from pulse totalization shall include, but not be limited to, the following:

- Peak demand, with date and time stamp
- 24-hour demand log
- Accumulated KWH for day
- Sunday through Saturday KWH usage
- Demand KW annual history for past 12 periods
- KWH annual history for past periods

Supervisory controllers shall have the ability to count events, such as the number of times a pump or fan system is cycled on and off.

The event totalization feature shall be able to store the records associated with a minimum of 9,999,999 events before reset.

PROGRAMMABLE CONTROLLERS

Programmable controllers shall be provided with a software program that shall allow the user to design flexible software algorithms for the control sequences as described in Sections 23 09 14 and 23 09 93 portions of this specification.

Programmable controllers shall support all necessary point inputs and outputs to perform the specified control sequence in a totally stand-alone fashion.

Each programmable controller shall perform its own limit and status monitoring and analysis to maximize network performance by reducing unnecessary communications.

Each programmable controller shall support the use of a locally mounted status and adjust panel interface to allow for the local adjustment of all setpoints, temporary override of any input or output points and status of all points directly at the controller. The capabilities of the locally mounted status and adjust panel shall include, but not be limited to, the following information for the programmable controllers to which:

- Display temperatures
- Display status
- Display setpoints
- Display control parameters
- Override binary output control
- Override analog output control
- Override analog setpoints
- Modification of gain and offset constants

All system setpoints, proportional bands, control algorithms, and any other programmable parameters shall be stored such that a power failure of any duration does not necessitate reprogramming the programmable controller.

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 and 23 09 93 portions of this specification, and for future expansion of air handling units:

- Boiler plants with pump logic
- Hot water heat exchangers
- Zone pressurization of labs
- Smoke control systems
- Generic system interlocking through hardware

APPLICATION SPECIFIC CONTROLLERS - HVAC APPLICATIONS

Each supervisory controller shall be able to extend its monitoring and control through the use of stand-alone application specific controllers (ASC's).

Each ASC shall operate as a stand-alone controller capable of performing its specified control responsibilities independently of other controllers in the network. Each ASC shall be a microprocessor based, multi-tasking, real-time digital control processor.

Each ASC shall have sufficient memory to support its own operating system and databases including:

- Control Processes
- Energy Management Applications
- Operator I/O (Portable Service Terminal)

The operator interface to any ASC point or program shall be through the supervisory controller connection to any ASC on the network.

ASC's shall directly support the temporary use of a portable service terminal that can be connected to the ASC via zone temperature or directly at the controller. The capabilities of the portable service terminal shall include, but not be limited to, the following information for the:

- Display temperatures
- Display status
- Display setpoints
- Display control parameters
- Override binary output control
- Override analog output control
- Override analog setpoints
- Modification of gain and offset constants

All system setpoints, proportional bands, control algorithms, and any other programmable parameters shall be stored such that a power failure of any duration does not necessitate reprogramming the ASC.

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 and 23 09 93 portions of this specification, and for future expansion of air handling units:

- Exhaust Valves.
- Reheat Terminals
- Fan Coils

Terminal unit space sensors shall be provided with digital displays with setpoint adjustments and manual occupancy override and indication of occupancy status. Provide information to the AE on sensor colors offered by the manufacturer and obtain approval on what color should be provided on the project. Provide setpoint adjustment as specified in the DDC Input/Output Summary Table and sequence of operation

All system setpoints, proportional bands, control algorithms, calibration constants, and any other programmable parameters shall be stored such that a power failure of any duration does not necessitate reprogramming the ASC.

All application specific controllers shall be fully programmable. Question and answer or template programming is not acceptable unless this is used to generate the initial application program and the result is able to be freely modified without restriction. Control sequences for terminal unit control that utilize devices wired directly to the terminal unit application controller shall be programmed in the application specific controller and shall be stand-alone in function, i.e. occupancy sensing, temperature setpoint setback, etc. Supervisory controllers shall not be involved in the control sequence logic unless it involves sharing data between or from individual terminal unit controllers to be utilized in a global sequence, i.e. trim and respond strategies, terminal unit grouping, etc.

OPERATOR INTERFACE REQUIREMENTS

COMMAND ENTRY/MENU SELECTION PROCESS:

Operator interface software shall minimize operator training through the use of English language prompting and English language point identification.

TEXT-BASED DISPLAYS:

The operator interface shall provide consistent text-based displays of all system point and application data described in this specification. Point identification, engineering units, status indication, and application naming conventions shall be the same at all operator devices.

GRAPHIC-BASED DISPLAYS:

The operator interface shall provide graphic based displays of each and all new building system. The point data associated with each system shall dynamically update at a minimum of every 30 seconds. Graphic displays shall be linked to each other to provide a "drill down" capability from main graphic displays to

more specific system based displays. Provide a building level graphic display that links to system graphics. For systems that have ASC controlled terminal unit controls, provide a building floor plan with dynamic temperatures shown on the graphic that can be drilled into for more specific terminal information. Points provided in the graphic shall have the override and adjust capability specified under operator commands. The contractor providing the DDC system under this Section shall provide all graphic displays for the project. Submit all graphic displays to the Agency control personnel for review and approval. Graphics shall be completed to provide enough time for approval and time for binding to be in place before control system commissioning is scheduled to occur.

PASSWORD PROTECTION:

Multiple-level password access protection shall be provided to allow the user/manager to limit control, display, and data base manipulation capabilities as he deems appropriate for each user, based upon an assigned password.

Passwords shall be exactly the same for all operator devices.

A minimum of three levels of access shall be supported:

- Level 1: Data access and display
- Level 2 = Level 1 + operator overrides and commands
- Level 3 = Level 2 + database generation and modification

A minimum of 4 passwords shall be supported at each supervisory controller.

Operators will be able to perform only those commands available for their respective passwords. Menu selections displayed at any operator device shall be limited to only those items defined for the access level of the password used to log-on.

Provide user definable, automatic log-off timers of from 1 to 60 minutes to prevent operators from inadvertently leaving devices on-line.

OPERATOR COMMANDS:

The operator interface shall allow the operator to perform commands including, but not limited to, the following:

- Start-up or shutdown selected equipment
- Adjust setpoints
- Override analog and binary outputs
- Add/modify/delete time programming
- Enable/disable process execution
- Lock/unlock alarm reporting for each point
- Enable/disable totalization for each point
- Enable/disable trending
- Enter temporary override schedules
- Define holiday schedules
- Change time/date
- Enter/modify analog alarm limits
- Enable/disable analog alarm limits
- Enable/disable demand limiting
- Enable/disable duty cycle

LOGS AND SUMMARIES:

Reports shall be generated manually, and directed to the displays. As a minimum, the system shall allow the user to easily obtain the following general listing of all points in the system that shall include, but not be limited to:

- Points currently in alarm
- Off-line points
- Points currently in override status
- Points in weekly schedules
- Holiday programming

Summaries shall be provided for specific points, for a logical point group, for a user-selected group of groups, or for the entire facility without restriction due to the hardware configuration on the facility management system. Under no conditions shall the operator need to specify the address of hardware controller to obtain system information.

SYSTEM CONFIGURATION AND DEFINITION:

All temperature and equipment control strategies and energy management routines shall be definable by the operator. System definition and modification procedures shall not interfere with normal system operation and control.

The system shall be provided complete with all equipment, software, and documentation necessary to allow an operator to independently perform the following functions:

- Add/delete/modify application specific controllers
- Add/delete/modify points of any type, and all associated point parameters, and tuning constants
- Add/delete/modify alarm reporting definition for each point
- Add/delete/modify energy management applications
- Add/delete/modify time and calendar-based programming
- Add/delete/modify totalization for every point
- Add/delete/modify historical data trending for every point
- Add/delete/modify configured control processes
- Add/delete/modify dial-up telecommunication definition
- Add/delete/modify all operator passwords
- Add/delete/modify alarm messages

PROGRAMMING DESCRIPTION:

Definition of operator device characteristics, ASC's, individual points, and shall be performed through fill-in-the-blank templates.

NETWORK-WIDE STRATEGY DEVELOPMENT:

Inputs and outputs for any process shall not be restricted to a single ASC, but shall be able to include data from any and all other ASC's to allow the development of network-wide control strategies.

SYSTEM DEFINITION/CONTROL SEQUENCE DOCUMENTATION:

All portions of system definition shall be self-documenting and be capable of providing hardcopy printouts of all configuration and application data.

DATA BASE SAVE/RESTORE/BACK-UP:

Backup copies of all programmable controller, ASC and supervisory controller databases shall be stored in at least one personal computer or laptop. Users shall have the ability to manually execute upload and downloading of a programmable controller, ASC and supervisory controller database.

WEB BASED HTML BROWSER INTERFACE

Provide a HTML based browser interface (Web Server) for accessing the DDC system. This shall include all hardware and software to provide an Ethernet twisted pair connection to the owners local or wide area network (LAN or WAN) that can be used to access the DDC system through a standard internet browser.

All information shall be provided to the owners IT staff to facilitate connection through the owners LAN/WAN.

At a minimum, this interface shall be capable of all functions described under the Operator Interface section, Password Protection, Operator Commands, and Logs and Summary subsections of this specification.

PART 3 - EXECUTION

GENERAL

All electronic work required as an integral part of the Direct Digital Control system work is the responsibility of this section unless specifically indicated otherwise in this section, Section 23 09 14, or in Division 26.

This contractor shall provide all labor, materials, engineering, software, permits, tools, checkout and certificates required to install a complete Direct Digital Control system as herein specified.

Any and all points added with this project shall be grouped for display purposes into the system such that all points associated with a new or existing DDC system can appear together on the flat panel display or printed log. Assignment of points to a group shall not be restricted by hardware configuration of the points of direct digital control. It shall be possible to assign a point to appear in more than one system. An English descriptor and an alpha/numeric identifier shall identify each system.

This Direct Digital Control system as herein specified shall be fully integrated and completely installed by this section. It shall include all required computer CPU software and hardware. Include the engineering, installation, supervision, calibration, software programming, and checkout necessary for a fully operational system.

INSTALLATION

All work and materials are to conform in every detail to the rules and requirements of the National Electrical Code and present manufacturing standards. All wiring and cable installation shall conform with the wiring installation as specified in the installation section of Section 23 09 14. All material shall be UL approved.

Install system and materials in accordance with manufacturer's instructions, rough-in drawings and details on drawings.

Line voltage wiring to power the DDC Controllers, not provided by the Division 26 contractor, to be by this contractor.

Control panels serving equipment fed by emergency power shall also be served by emergency power.

Provide uninterruptable power supplies where necessary to provide proper startup of equipment or to accomplish power restart control sequences specified.

Mount control panels adjacent to associated equipment on vibration-free walls or free-standing angle iron supports. One cabinet may accommodate more than one system in same equipment room. Provide engraved plastic nameplates for instruments and controls inside cabinet and on cabinet face.

Provide as-built control drawings of all systems served by each local panel in a location adjacent to or inside of panel cover. Provide a protective cover or envelope for drawings.

Cable tray routing of the communication trunks is acceptable.

Provide all necessary routers and or repeaters to accomplish connection to the BAN via the panel-mounted port provided.

Provide two data jacks in control panels housing supervisory controllers and allocate 6"x6" for each data jack in the panel. The first jack will be used for connecting the supervisory controller to the BAN. The second jack will be used as a spare for connecting to the BAN by service personnel.

Provide an input for a service shutdown toggle switch for each air handling unit system provided inside the temperature control panel that will initiate a logical shutdown of the air handling unit system.

All tubing, cable and individual wiring is to be permanently tagged, with numbers corresponding with "Record Drawings", spares are to be labelled as "Spare".

Provide technician to work with air balancing contractor and/or provide balancing contractor with necessary hardware to over-ride DDC controllers for air balancing.

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.

COUNTY TRAINING

All training provided for agency shall comply with the format, general content requirements and submission guidelines specified under Section 01 91 00.

Contractor to provide factory authorized representative and/or field personnel knowledgeable with the operations, maintenance and troubleshooting of the system and/or components defined within this section for a minimum period of 12 hours.

Provide two follow-up visits for troubleshooting and instruction, one six months after substantial completion and the other at the end of the warranty period. Length of each visit to be not less than 4 hours or the time necessary to provide required information and complete troubleshooting and inspection activity for all controls installed under 23 09 23, 23 09 14, and 23 09 93. Coordinate the visit with the owner/Agency and provide an inspection report to the owner of any deficiencies found.

END OF SECTION

SECTION 23 09 93

SEQUENCE OF OPERATION FOR HVAC CONTROLS

PART 1 - GENERAL

SCOPE

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 topics:

PART 1 - GENERAL

- Scope
- Related Work
- Description of Work
- Submittals
- Operation and Maintenance Data
- Design Criteria

PART 2 - PRODUCTS

Not Applicable

PART 3 - EXECUTION

- General Control
- Generator and Remote Radiator
- Boiler Plant and HW Pumps
- Radiant Floor Heating System (HWP-6)
- Fan Coil Unit (FCU-2)
- Exhaust Fans (EF-1(E)), (EF-4(E)), (EF-5(E)), and (EF-6(E))
- Exhaust Fan (EF-2) and (EF-3)
- Exhaust Fan (EF-7) and (EF-8)
- Exhaust Fan (EF-9)
- Exhaust Fan (EF-10) and (EF-11)
- Unit Heaters (UH-4) and (UH-5)

RELATED WORK

Conditions of the Contract and portions of Division One of this Project Manual apply to this Section as though repeated herein.

Applicable provisions of Division 1 govern work under this Section.

- Section 01 91 00 – Commissioning Process
- Section 23 05 93 - Testing, Adjusting, and Balancing for HVAC – Coordination
- Section 23 09 23 - Direct Digital Controls (DDC)

- Division 23 - HVAC - Equipment provided to be controlled or monitored
- Division 26 - Electrical - Equipment provided to be controlled or monitored

REFERENCE

Section 23 09 23 work includes furnishing and installing all field devices, including electronic sensors for the DDC of this section, equipment, and all related field wiring, interlocking control wiring between equipment, pneumatic tubing, sensor mounting, etc., that is covered in that section.

Motorized control dampers and actuators, thermowells (temperature sensing wells), automatic control valves and their actuators are also covered in Section 23 09 23.

DESCRIPTION OF WORK

Control sequences are hereby defined as the manner and method by which automatic controls function. Requirements for each type of operation are specified in this section.

Operation equipment, devices and system components required for automatic control systems are specified in other Division 23 control sections of these specifications.

Sequences for equipment controlled by Direct Digital Controls (DDC) as specified are accomplished by hardware and software provided under Section 23 09 23.

SUBMITTALS

Refer to Division 1, General Conditions, Submittals, Section 23 05 00 and Sections 23 09 23 for descriptions of what should be included in the submittals.

Shop drawings shall be provided by contractor(s) providing equipment under Sections 23 09 23. The contractor providing the DDC equipment shall provide a complete narrative of the sequence of operations for equipment that is controlled through the DDC system. The narrative of the sequence of operation shall not be a verbatim copy of the sequences contained herein, but shall reflect the actual operation as applied by the contractor.

DESIGN CRITERIA

Reference Section 23 09 23.

PART 2 - PRODUCTS

Not applicable to this Section – reference Sections 23 09 23 for product descriptions.

PART 3 - EXECUTION

CONTROL SEQUENCES

GENERAL:

SETPOINTS:

All setpoints indicated in the control specification are to be adjustable. The setpoints shall be readily available to be modified in the mechanical system software system summary (either textual or graphic based) and under the same software level as hardware points. The setpoints indicated herein are only specified as a 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 the building. The control contractor shall work with the balancing contractor and the Owner to provide the final system setpoint adjustments and control loop tuning after the system is in operation and building is in use. Document all final setpoints on the as-built control drawings. Any questions regarding the intended operation of the HVAC equipment and control systems shall be referred to the HVAC design engineer through the appropriate construction communication process. The following setpoints should be used as initial setpoints unless otherwise specified in the individual control sequences or instructed by the Owner. If the contractor fails to check with the user Owner for final setpoints, they shall adjust setpoints at no additional cost.

- Occupied Space Terminal Unit Heating: 60° F
- Unoccupied Space Terminal Unit Heating: 40° F

ANTI-CYCLING:

When HVAC equipment or a sequence is specified to be started and stopped by a temperature, humidity, pressure setpoint or any other controlled variable, there shall be an adjustable differential setpoint that shall be set to prevent short cycling of the systems and equipment due to minor changes in the controlled variable. Temperature differential setpoints shall be set at 2° F and non-temperature setpoints shall be set at 10% of the controlled range unless otherwise specified. Setpoints shall indicate at when the process should be turned on. Heating and cooling differentials shall be set for above setpoint and will be used to turn the process off. For example, an economizer sequence called to switch at 68° F, would turn on at 68° F and off at 70° F since it is a cooling function. A heating lockout setpoint of 50° F would turn on heating control at 50° F and off at 52° F. Non-temperature differentials shall be set above setpoint if the setpoint is indicating a minimum value or below setpoint if the setpoint is indicating a maximum value. Provide minimum runtime timers for loads that are cycled to prevent over-cycling. Timers shall be set as specified or as needed to prevent damage or excessive wear to the equipment. Unless otherwise specified in the individual control sequences, fans and pumps shall have a minimum runtime on timers of 15 minutes (adj.) and off timers of 5 minutes (adj.). Safeties shall override runtime timers.

DEADBANDS:

Provide deadbands for all DDC control loops to prevent constant hunting of output signals to controlled devices. Deadbands shall be set to provide adequate control around setpoint as follows unless otherwise specified in the individual control sequences:

- Temperature Control: $\pm 0.5^{\circ}$ F
- Humidity Control: $\pm 1\%$ RH
- Airflow Control: $\pm 2\%$ of total flow
- AHU Static Pressure Control: ± 0.01 in. w.c.

ALARMS:

Provide all alarmed points with adjustable time delays to prevent nuisance tripping under normal operation and on equipment start-up. For all commanded outputs that have status feedback, provide an alarm that will indicate the commanded output is not in its commanded state. Provide alarms on all points as indicated on point charts. For existing campus automations systems, add/delete what is called on the point charts for after consultation with user Agency to provide consistent alarming throughout the automation system.

For devices that have form "C" contacts available for alarm monitoring, use closed contacts for the Normal condition and open contacts on Alarm condition. This will provide a level of supervision by detecting a break in the wiring.

EQUIPMENT START/STOP FAILURE STATES:

All start/stop points for equipment shall utilize normally open contacts unless called out specifically in the individual control sequences.

LEAD/LAG SEQUENCING:

For sequences that call for lead/lag of equipment connected to building automation systems, the lead device shall be able to be chosen through a selectable day of the week and time of day through the building automation system. Coordinate with the user Agency for scheduling switchover and frequency. Unless otherwise directed, switchover shall occur at 10AM Tuesday and shall rotate the lead device on a weekly cycle rotating through all devices sequentially. For standalone lead/lag sequence controllers (non-DDC), the lead device shall be selected by a switch on the panel face.

CURRENT SWITCH SETUP:

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 the reduction in current draw on loss of coupled load. The current switch set up shall be redone by the 23 09 23 contractor after the balancer is complete.

FAN INTERLOCKING:

Provide interlocks between supply and return or exhaust fan systems as scheduled on the plans or called out in individual control sequences. If DDC controlled, interlocks shall be done through DDC start/stop points unless otherwise specified in individual control sequences. If not DDC controlled, interlocks shall be accomplished via hardwire interlocks between fan starters or VFD's.

THERMOSTATS AND SENSORS:

All devices and equipment including terminal units, specified to be controlled in a control sequence by a thermostat or sensor, shall be provided with a thermostat or sensor, whether or not the device is indicated on the plans. Consult the HVAC design engineer for the thermostat or sensor location.

ORIGINAL EQUIPMENT MANUFACTURER (OEM) CONTROLLER DDC INTEGRATION:

Provide DDC programming to define all equipment integral input/output points, setpoints, data points, calculations, etc. that are available through the manufacturers communication interface. Consult with the Agency DDC operations personnel to determine if some of the points should be omitted (for clarity or lack of value). The following equipment shall be integrated into the DDC system:

- Gas Detector Systems

WATCH DOG TIMER

Where the integrated system consists of programmable DDC controllers with BACnet objects mapped to an enterprise level Building Automation System (BAS) and it is shown that the BACnet objects do not indicate when they are offline on the enterprise level BAS when communication is lost between the two systems, software algorithms shall be provided to alarm when communication is lost. The integrated system shall program a binary data object that is toggled on and off at an adjustable rate (initially one minute) that shall be monitored by the enterprise level BAS which shall alarm if the toggling ceases.

DDC CONTROLLER COMMUNICATION BUS CONFIGURATION

The actively controlled primary mechanical equipment (AHU's, hot water, chilled water, boilers, etc.) DDC controllers shall be configured to be located on the same supervisory controller BACnet MSTP communication trunk unless the supervisory controller capacity prevents it. If this is the case, the primary mechanical equipment DDC controllers shall be separated onto supervisory controllers in such a way that the systems that need to share information for operation and interlocking shall reside on the same supervisory controllers. When AHU systems have associated exhaust fan systems that are interlocked and designed to operate together as a combined air system within a building, these must be on the same BACnet MSTP trunk. Peer to peer communication shall be used for interlocks and data sharing between the AHU and exhaust fans systems when possible to limit air system disruptions in the event of a supervisory controller failure. Other critical building systems that require communication between DDC controllers to operate shall be on the same BACnet MSTP communication trunk. Terminal unit controllers shall be located on a separate BACnet MSTP trunks if necessary to allow for primary equipment to reside on the same BACnet MSTP trunk. If the DDC controllers used for control of primary mechanical equipment and interlocks or point information is required for proper operation as described above do not use BACnet MSTP communication but use Ethernet communication, the DDC controllers shall be connected to the same Ethernet switch. If the controllers cannot be connected to the same switch, hardwired points between controllers shall be used to share information.

CONTROLLED VARIABLE REQUIREMENTS

All controlled variables, i.e. static pressure, differential pressure, temperature, humidity, etc., shall be wired directly to the DDC controller in which the software PID loop or other similar software loop resides unless the control sequence specifically allows the controlled variable to be routed over the network. Where a controlled variable is used for reset of a PID loop, the controlled variable shall be allowed to be shared over the network unless specified to be directly wired to the DDC controller.

OCCUPIED/UNOCCUPIED SCHEDULING

Facility occupied/unoccupied schedule shall be per the following:

Monday – Friday:	6:00 am – 5:00 pm - Occupied
Saturday:	6:00 am – 12:00 noon - Occupied
Sunday:	Unoccupied

GENERATOR AND REMOTE RADIATOR

The existing generator and remote radiator controls shall be modified as indicated on drawing M001, M002 and M003.

BOILER PLANT AND HW PUMPS

The existing hot water boiler plant, hot water pumps and building heating system to remain as currently controlled.

RADIANT FLOOR HEATING SYSTEM (HWP-6)

This system provides radiant floor heating to the Sorting Platform area.

This system consists of:

- Inline pump HWP-6.
- 3-way modulating mixing valve
- Temperature Sensors:
 - HWS (to radiant floor)
 - HWR (from radiant floor)
- Pump pressure switch.

The radiant pump shall be controlled by the BAS and shall operate on a call for heat by the radiant floor zone. The radiant floor system occupied/unoccupied schedule shall be controlled through the BAS. The radiant floor system shall be “off” during the unoccupied schedule.

Provide a pressure differential switch to prove pump operation. Should the pump fail to start within 60 seconds of being enabled by the building automation system, send an alarm.

The modulating 3-way mixing valve shall maintain 150°F (adjustable) glycol supply water temperature setpoint to the radiant floor.

If the outside air temperature is above 40 deg F, the radiant floor system shall not be allowed to operate.

FAN COIL UNIT (FCU-2)

Each system consists of:

- DDC space temperature sensor.
- 2-way, modulating hot water control valve.
- Outside air damper

Provide a DDC space temperature sensor to control a modulating electronic control hot water valve to maintain space temperature. Unit supply fan shall operate continuously during the occupied mode. The supply fan shall cycle as needed for heating during the unoccupied mode to maintain minimum 40°F space temperature.

When space temperature is below setpoint (50°F (adj.) +/- 2.0°F), modulate the hot water valve open to maintain temperature setpoint. The reverse shall occur when space temperature is above setpoint. Lock hot water valve closed whenever outside air is above 50° F (adj.).

Provide a discharge temperature for monitoring purposes. The heating control valve shall be commanded closed whenever the fan coil supply fan is off.

Minimum Outside Ventilation Air Flow Control: The duct mounted outside air damper shall open to maintain the scheduled outside air flow ventilation rate (see drawing M800 for airflow rates). The outside air damper shall be closed during unoccupied mode.

A supply fan failure alarm shall be sent to the BAS if the fan is commanded ON but a positive status signal is not received to verify fan operation. Fan failure is detected via a current switch mounted on the electrical power leads to the motor.

Monitor and Alarm: Monitor, through BAS, the following points associated with the system and generate the alarms indicated:

- Zone Temperature: Generate alarm if temperature exceeds setpoint by +/- 3°F (adj.) for 10 consecutive minutes (adj.)

EXHAUST FANS (EF-1(E)), (EF-4(E)), (EF-5(E)), AND (EF-6(E))

The existing exhaust fans shall remain as currently controlled.

- EF-1(E): Interlock and control through gas sensors and temperature sensor.
- EF-4(E): Interlock and control through gas sensors and temperature sensor.
- EF-5(E): Interlock and control through building occupied/unoccupied schedule.
- EF-6(E): Interlock and control through temperature sensor.

EXHAUST FAN (EF-2) and (EF-3)

This system serves the sorting platform.

System consists of:

- Roof mounted exhaust fan.
- Motorized damper (normally closed)
- Motorized outside air damper (normally closed).
- DDC Space Thermostat.

Fan shall be normally “off”, fan motorized damper closed and outside air damper closed.

These exhaust fans operate in a (lead/lag) arrangement and shall be controlled by the DDC system.

Start/Stop: The DDC system shall start the lead exhaust fan during occupied mode. The lag exhaust fan shall normally remain off. The exhaust fan start/stop relays shall utilize normally closed contacts so upon failure of the relay or DDC controller the exhaust fan will fail on.

Lead / Lag Control: Current status switches shall prove lead and lag exhaust fan operation. If the lead exhaust fan is called to run and the current status switch indicates that the lead exhaust fan is not operating for 30 seconds (adj.), an alarm shall be sent to the operator interface and the BAS shall start the lag exhaust fan. Upon sensing the lead exhaust fan is operating, the lag exhaust fan shall be stopped. The DDC system shall index the lag exhaust fan to become the lead exhaust fan through weekly scheduling feature of the building automation system. The BAS shall also allow for manual lead/lag selection between the two exhaust fans.

System consists of carbon monoxide (CO), nitrogen dioxide (NO₂) and methane (CH₄) gas sensors located at the Sorting Platform.

The gas detection and control system shall be capable of communicating with the building automation system (BAS) and energizing exhaust fan system when the presence of one of more of the network sensors detects gas levels that reach or exceed the field adjustable limits as specified herein.

Furnish the system with all required relays and input/output signals to communicate with the building automation system.

Furnish the system with all required audible and non-audible alarms for proper system annunciation and control.

Fan shall be interlocked thru the BAS to operate in the occupied mode.

When the fan is energized, the motorized exhaust damper shall open.

When the fan is turned "off", the motorized exhaust damper shall close.

When the space temperature rises above setpoint (85°F adj.), the motorized outside air damper interlocked with the (lag) exhaust fan (EF-2 or EF-3) shall open, the (lag) exhaust fan (EF-2 or EF-3) motorized damper shall open and the (lag) exhaust fan (EF-2 or EF-3) shall be energized. Both the lead and lag exhaust fans shall operate during this sequence of control.

On a drop in space setpoint temperature, the reverse shall occur until the (lag) exhaust fan (EF-2 or EF-3) is "off", interlocked exhaust fan motorized damper is closed and interlocked outside air damper is closed.

Automatic Operation:

Upon detection of a carbon monoxide (CO) level in excess of 25 PPM (adj.), the contactor controlling the ventilation system shall close, the interlocked motorized outside air damper and exhaust damper shall open and the (lead/lag) exhaust fans (EF-2 and EF-3) shall be enabled allowing the fan systems to operate for a minimum of 20 minutes (or longer if levels remain at or above 25 PPM (adj.). If the ventilation system is enabled and the carbon monoxide sensor detects carbon monoxide in excess of 25 PPM, the DDC system shall generate an alarm.

If the (CO) level exceeds 100 PPM for an interval of 15 minutes or should the (CO) level remain at or above an average of 35 PPM for an (8) eight hour period, the sensor shall signal an audible alarm indicating high level. The alarm shall automatically reset should the (CO) level drop below 25 PPM.

Once the (CO) level reaches below 25 PPM (adj.), the contactor controlling the ventilation system shall open, the exhaust fan shall be disabled and the motorized exhaust damper shall close.

Upon detection of a nitrogen dioxide (NO₂) level in excess of 1 PPM (adj.), the contactor controlling the ventilation system shall close, the interlocked motorized outside air damper and exhaust damper shall open and the (lead/lag) exhaust fans (EF-2 and EF-3) shall be enabled allowing the fan systems to operate for a minimum of 20 minutes (or longer if levels remain at or above 1 PPM (adj.). If the ventilation system is enabled and the nitrogen dioxide sensor detects nitrogen dioxide in excess of 1 PPM, the DDC system shall generate an alarm.

If the (NO₂) level exceeds 2 PPM for an interval of 15 minutes or should the (NO₂) level remain at or above an average of 1 PPM for an (8) eight hour period, the sensor shall signal an audible alarm indicating high level. The alarm shall automatically reset should the (NO₂) level drop below 1 PPM.

Once the (NO₂) level reaches below 1 PPM (adj.), the contactor controlling the ventilation system shall open, the exhaust fan shall be disabled and the motorized exhaust damper shall close.

Upon detection of a methane (CH₄) level in excess of 25% LEL (adj.), the contactor controlling the ventilation system shall close, the interlocked motorized outside air damper and exhaust damper shall open and the (lead/lag) exhaust fans (EF-2 and EF-3) shall be enabled allowing the fan systems to operate for a minimum of 20 minutes (or longer if levels remain at or above 25% LEL (adj.). If the ventilation system is enabled and the methane sensor detects methane in excess of 25% LEL, the DDC system shall generate an alarm.

If the (CH₄) level exceeds 50% LEL for an interval of 15 minutes or should the (CH₄) level remain at or above an average of 50% LEL for an (8) eight hour period, the sensor shall signal an audible alarm indicating high level. The alarm shall automatically reset should the (CH₄) level drop below 25% LEL.

Once the (CH₄) level reaches below 25% LEL (adj.), the contactor controlling the ventilation system shall open, the exhaust fan shall be disabled and the motorized exhaust damper shall close.

An exhaust fan failure alarm shall be sent to the BAS if the exhaust fan is commanded ON but a positive status signal is not received to verify fan operation. Fan failure is detected via a current switch mounted on the electrical power leads to the motor.

EXHAUST FAN (EF-7) and (EF-8)

System consists of:

- Roof mounted exhaust fan.
- Motorized exhaust damper (normally closed).
- Motorized outside air damper (normally closed).

Each fan shall be normally “off”, fan motorized damper closed and outside air damper closed.

These exhaust fans operate in a (lead/lag) arrangement and shall be controlled by the DDC system.

Start/Stop: The DDC system shall start the lead exhaust fan during occupied mode. The lag exhaust fan shall normally remain off. The exhaust fan start/stop relays shall utilize normally closed contacts so upon failure of the relay or DDC controller the exhaust fan will fail on.

Lead / Lag Control: Current status switches shall prove lead and lag exhaust fan operation. If the lead exhaust fan is called to run and the current status switch indicates that the lead exhaust fan is not operating for 30 seconds (adj.), an alarm shall be sent to the operator interface and the BAS shall start the lag exhaust fan. Upon sensing the lead exhaust fan is operating, the lag exhaust fan shall be stopped. The DDC system shall index the lag exhaust fan to become the lead exhaust fan through weekly scheduling feature of the building automation system. The BAS shall also allow for manual lead/lag selection between the two exhaust fans.

System consists of carbon monoxide (CO), nitrogen dioxide (NO₂) and methane (CH₄) gas sensors located at the New Tipping Floor.

The gas detection and control system shall be capable of communicating with the building automation system (BAS) and energizing exhaust fan system when the presence of one of more of the network sensors detects gas levels that reach or exceed the field adjustable limits as specified herein.

Furnish the system with all required relays and input/output signals to communicate with the building automation system.

Furnish the system with all required audible and non-audible alarms for proper system annunciation and control.

Fans shall be interlocked thru the BAS to operate in the occupied mode.

When the fans are energized, the interlocked motorized exhaust damper shall open.

When the fans are turned “off”, the interlocked motorized exhaust damper shall close.

When the space temperature rises above setpoint (85°F adj.), the motorized outside air damper interlocked with the (lag) exhaust fan (EF-7 or EF-8) shall open, the (lag) exhaust fan (EF-7 or EF-8) motorized damper shall open and the (lag) exhaust fan (EF-7 or EF-8) shall be energized. Both the lead and lag exhaust fans shall operate during this sequence of control.

On a drop in space setpoint temperature, the reverse shall occur until the (lag) exhaust fan (EF-7 or EF-8) is “off”, interlocked exhaust fan motorized damper is closed and interlocked outside air damper is closed.

Automatic Operation:

Upon detection of a carbon monoxide (CO) level in excess of 25 PPM (adj.), the contactor controlling the ventilation system shall close, the interlocked motorized outside air damper and exhaust damper shall open and the (lead/lag) exhaust fans (EF-7 and EF-8) shall be enabled allowing the fan systems to operate for a minimum of 20 minutes (or longer if levels remain at or above 25 PPM (adj.). If the ventilation system is enabled and the carbon monoxide sensor detects carbon monoxide in excess of 25 PPM, the DDC system shall generate an alarm.

If the (CO) level exceeds 100 PPM for an interval of 15 minutes or should the (CO) level remain at or above an average of 35 PPM for an (8) eight hour period, the sensor shall signal an audible alarm indicating high level. The alarm shall automatically reset should the (CO) level drop below 25 PPM.

Once the (CO) level reaches below 25 PPM (adj.), the contactor controlling the ventilation system shall open, the exhaust fans shall be disabled and the motorized outside air and exhaust dampers shall close.

Upon detection of a nitrogen dioxide (NO₂) level in excess of 1 PPM (adj.), the contactor controlling the ventilation system shall close, the interlocked motorized outside air damper and exhaust damper shall open and the (lead/lag) exhaust fans (EF-7 and EF-8) shall be enabled allowing the fan systems to operate for a minimum of 20 minutes (or longer if levels remain at or above 1 PPM (adj.). If the ventilation system is enabled and the nitrogen dioxide sensor detects nitrogen dioxide in excess of 1 PPM, the DDC system shall generate an alarm.

If the (NO₂) level exceeds 2 PPM for an interval of 15 minutes or should the (NO₂) level remain at or above an average of 1 PPM for an (8) eight hour period, the sensor shall signal an audible alarm indicating high level. The alarm shall automatically reset should the (NO₂) level drop below 1 PPM.

Once the (NO₂) level reaches below 1 PPM (adj.), the contactor controlling the ventilation system shall open, the exhaust fans shall be disabled and the motorized outside air and exhaust dampers shall close.

Upon detection of a methane (CH₄) level in excess of 25% LEL (adj.), the contactor controlling the ventilation system shall close, the interlocked motorized outside air damper and exhaust damper shall open and the (lead/lag) exhaust fans (EF-7 and EF-8) shall be enabled allowing the fan systems to operate for a minimum of 20 minutes (or longer if levels remain at or above 25% LEL (adj.). If the ventilation system is enabled and the methane sensor detects methane in excess of 25% LEL, the DDC system shall generate an alarm.

If the (CH₄) level exceeds 50% LEL for an interval of 15 minutes or should the (CH₄) level remain at or above an average of 50% LEL for an (8) eight hour period, the sensor shall signal an audible alarm indicating high level. The alarm shall automatically reset should the (CH₄) level drop below 25% LEL.

Once the (CH₄) level reaches below 25% LEL (adj.), the contactor controlling the ventilation system shall open, the exhaust fans shall be disabled and the motorized outside air and exhaust dampers shall close.

An exhaust fan failure alarm shall be sent to the BAS if the exhaust fan is commanded ON but a positive status signal is not received to verify fan operation. Fan failure is detected via a current switch mounted on the electrical power leads to the motor.

EXHAUST FAN (EF-9)

System consists of:

- Roof mounted exhaust fan.
- Motorized exhaust damper (normally closed).
- Motorized outside air damper (normally closed).

Fan shall be normally “off”, fan motorized damper closed and outside air damper closed.

System consists of carbon monoxide (CO) gas sensor located at the WTS Lower Level.

The gas detection and control system shall be capable of communicating with the building automation system (BAS) and energizing system EF-9 when the presence of one of more of the network sensors detects gas levels that reach or exceed the field adjustable limits as specified herein.

Furnish the system with all required relays and input/output signals to communicate with the building automation system.

Furnish the system with all required audible and non-audible alarms for proper system annunciation and control.

Fan shall be interlocked thru the BAS to operate in the occupied mode.

When the fan is energized, the motorized exhaust damper shall open.

When the fan is turned “off”, the motorized exhaust damper shall close.

Automatic Operation:

Upon detection of a carbon monoxide (CO) level in excess of 25 PPM (adj.), the contactor controlling the ventilation system shall close, the motorized exhaust damper shall open and the exhaust fan shall be enabled allowing the fan system to operate for a minimum of 20 minutes (or longer if levels remain at or above 25 PPM (adj.). If the ventilation system is enabled and the carbon monoxide sensor detects carbon monoxide in excess of 25 PPM, the DDC system shall generate an alarm.

If the (CO) level exceeds 100 PPM for an interval of 15 minutes or should the (CO) level remain at or above an average of 35 PPM for an (8) eight hour period, the sensor shall signal an audible alarm indicating high level. The alarm shall automatically reset should the (CO) level drop below 25 PPM.

Once the (CO) level reaches below 25 PPM (adj.), the contactor controlling the ventilation system shall open, the exhaust fan shall be disabled and the motorized exhaust damper shall close.

An exhaust fan failure alarm shall be sent to the BAS if the exhaust fan is commanded ON but a positive status signal is not received to verify fan operation. Fan failure is detected via a current switch mounted on the electrical power leads to the motor.

EXHAUST FAN (EF-10) and (EF-11)

System consists of:

- Roof mounted exhaust fan.
- Motorized exhaust damper (normally closed).
- Motorized outside air damper (normally closed).

Fan shall be normally “off”, fan motorized damper closed and outside air damper closed.

These exhaust fans operate in a (lead/lag) arrangement and shall be controlled by the DDC system.

Start/Stop: The DDC system shall start the lead exhaust fan during occupied mode. The lag exhaust fan shall normally remain off. The exhaust fan start/stop relays shall utilize normally closed contacts so upon failure of the relay or DDC controller the exhaust fan will fail on.

Lead / Lag Control: Current status switches shall prove lead and lag exhaust fan operation. If the lead exhaust fan is called to run and the current status switch indicates that the lead exhaust fan is not operating for 30 seconds (adj.), an alarm shall be sent to the operator interface and the BAS shall start the lag exhaust fan. Upon sensing the lead exhaust fan is operating, the lag exhaust fan shall be stopped. The DDC system shall index the lag exhaust fan to become the lead exhaust fan through weekly scheduling feature of the building automation system. The BAS shall also allow for manual lead/lag selection between the two exhaust fans.

System consists of carbon monoxide (CO), nitrogen dioxide (NO₂) and methane (CH₄) gas sensors located at the WTS Upper Level.

The gas detection and control system shall be capable of communicating with the building automation system (BAS) and energizing exhaust fan system when the presence of one of more of the network sensors detects gas levels that reach or exceed the field adjustable limits as specified herein.

Furnish the system with all required relays and input/output signals to communicate with the building automation system.

Furnish the system with all required audible and non-audible alarms for proper system annunciation and control.

Fan shall be interlocked thru the BAS to operate in the occupied mode.

When the fan is energized, the motorized exhaust damper shall open.

When the fan is turned "off", the motorized exhaust damper shall close.

When the space temperature rises above setpoint (85°F adj.), the motorized outside air damper interlocked with the (lag) exhaust fan (EF-10 or EF-11) shall open, the (lag) exhaust fan (EF-10 or EF-11) motorized damper shall open and the (lag) exhaust fan (EF-10 or EF-11) shall be energized. Both the lead and lag exhaust fans shall operate during this sequence of control.

On a drop in space setpoint temperature, the reverse shall occur until the (lag) exhaust fan (EF-10 or EF-11) is "off", interlocked exhaust fan motorized damper is closed and interlocked outside air damper is closed.

Automatic Operation:

Upon detection of a carbon monoxide (CO) level in excess of 25 PPM (adj.), the contactor controlling the ventilation system shall close, the interlocked motorized outside air damper and exhaust damper shall open and the (lead/lag) exhaust fans (EF-10 and EF-11) shall be enabled allowing the fan systems to operate for a minimum of 20 minutes (or longer if levels remain at or above 25 PPM (adj.). If the ventilation system is enabled and the carbon monoxide sensor detects carbon monoxide in excess of 25 PPM, the DDC system shall generate an alarm.

If the (CO) level exceeds 100 PPM for an interval of 15 minutes or should the (CO) level remain at or above an average of 35 PPM for an (8) eight hour period, the sensor shall signal an audible alarm indicating high level. The alarm shall automatically reset should the (CO) level drop below 25 PPM.

Once the (CO) level reaches below 25 PPM (adj.), the contactor controlling the ventilation system shall open, the exhaust fan shall be disabled and the motorized exhaust damper shall close.

Upon detection of a nitrogen dioxide (NO₂) level in excess of 1 PPM (adj.), the contactor controlling the ventilation system shall close, the interlocked motorized outside air damper and exhaust damper shall open and the (lead/lag) exhaust fans (EF-10 and EF-11) shall be enabled allowing the fan systems to operate for a minimum of 20 minutes (or longer if levels remain at or above 1 PPM (adj.). If the ventilation system is enabled and the nitrogen dioxide sensor detects nitrogen dioxide in excess of 1 PPM, the DDC system shall generate an alarm.

If the (NO₂) level exceeds 2 PPM for an interval of 15 minutes or should the (NO₂) level remain at or above an average of 1 PPM for an (8) eight hour period, the sensor shall signal an audible alarm indicating high level. The alarm shall automatically reset should the (NO₂) level drop below 1 PPM.

Once the (NO₂) level reaches below 1 PPM (adj.), the contactor controlling the ventilation system shall open, the exhaust fan shall be disabled and the motorized exhaust damper shall close.

Upon detection of a methane (CH₄) level in excess of 25% LEL (adj.), the contactor controlling the ventilation system shall close, the interlocked motorized outside air damper and exhaust damper shall open and the (lead/lag) exhaust fans (EF-10 and EF-11) shall be enabled allowing the fan systems to operate for a minimum of 20 minutes (or longer if levels remain at or above 25% LEL (adj.). If the ventilation system is enabled and the methane sensor detects methane in excess of 25% LEL, the DDC system shall generate an alarm.

If the (CH₄) level exceeds 50% LEL for an interval of 15 minutes or should the (CH₄) level remain at or above an average of 50% LEL for an (8) eight hour period, the sensor shall signal an audible alarm indicating high level. The alarm shall automatically reset should the (CH₄) level drop below 25% LEL.

Once the (CH₄) level reaches below 25% LEL (adj.), the contactor controlling the ventilation system shall open, the exhaust fan shall be disabled and the motorized exhaust damper shall close.

An exhaust fan failure alarm shall be sent to the BAS if the exhaust fan is commanded ON but a positive status signal is not received to verify fan operation. Fan failure is detected via a current switch mounted on the electrical power leads to the motor.

HOT WATER UNIT HEATERS (UH-4) and (UH-5)

Each system consists of:

- Hot water unit heater.
- DDC space thermostat by 23 09 14.
- 2-way, 2 position low voltage control valve by 23 09 14.
- Strap on pipe thermostat.

Unit heaters shall be controlled thru the BAS.

Unit heaters shall be controlled thru the BAS. The unit heater shall cycle as needed for heating during the unoccupied mode to maintain minimum 40°F space temperature.

On a drop below space temperature setpoint (60°F adj.), and hot water is available, the control valve shall open and the fan shall cycle on. The reverse shall occur on a rise in space temperature above setpoint. The strap on thermostat shall be mounted on the hot water return line, set at 100° F (adj.). The unit fan shall not be permitted to run unless the hot water temperature is above strap on thermostat setpoint.

Unit heaters shall be locked out and not operate at outside air temperatures above 60° F (adj.).

END OF SECTION

SECTION 23 21 13

HYDRONIC PIPING

PART 1 - GENERAL

SCOPE

This section contains specifications for all HVAC hydronic pipe and pipe fittings for this project. Included are the following topics:

PART 1 - GENERAL

- Scope
- Related Work
- Reference
- Reference Standards
- Shop Drawings
- Quality Assurance
- Delivery, Storage, and Handling
- Design Criteria
- Welder Qualifications

PART 2 - PRODUCTS

- Heating Hot Water
- Vents and Relief Valves
- Unions and Flanges

PART 3 - EXECUTION

- Erection
- Welded Pipe Joints
- Threaded Pipe Joints
- Copper Pipe Joints
- Water Systems
- Vents and Relief Valves
- Unions and Flanges
- Piping System Leak Tests
- Construction Verification Items
- Functional Performance Testing
- Piping System Leakage Test Report

RELATED WORK

- Section 01 91 00 - Commissioning
- Section 23 05 23 - General-Duty Valves for HVAC Piping
- Section 23 05 15 - Piping Specialties
- Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment
- Section 23 07 00 - HVAC Insulation
- Section 23 25 00 - HVAC Water Treatment.

REFERENCE

Applicable provisions of Division 1 govern work under this section.

REFERENCE STANDARDS

- ANSI B16.3 Malleable Iron Threaded Fittings
- ANSI B16.4 Cast Iron Threaded Fittings
- ANSI B16.5 Pipe Flanges and Flanged Fittings
- ANSI B16.22 Wrought Copper and Wrought Copper Alloy Solder Joint Pressure Fittings

ASTM A53	Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless
ASTM A74	Cast Iron Soil Pipe and Fittings
ASTM A105	Forgings, Carbon Steel, for Piping Components
ASTM A126	Gray Cast Iron Castings for Valves, Flanges, and Pipe Fittings
ASTM A181	Forgings, Carbon Steel for General Purpose Piping
ASTM A197	Cupola Malleable Iron
ASTM A234	Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures
ASTM A380	Practice for Cleaning and Descaling Stainless Steel Parts, Equipment, and Systems
ASTM B75	Seamless Copper Tube
ASTM B88	Seamless Copper Water Tube

SHOP DRAWINGS

Refer to division 1, General Conditions, Submittals.

Contractor shall submit schedule indicating the ASTM specification number of the pipe being proposed along with its type and grade and sufficient information to indicate the type and rating of fittings for each service.

TYPE F STEEL PIPE:

Statement from manufacturer on his letterhead that the pipe furnished meets the ASTM specification contained in this section.

TYPE E OR S STEEL PIPE:

Mill certification papers, also known as material test reports, for the pipe furnished for this project, in English. Heat numbers on these papers to match the heat numbers stenciled on the pipe. Chemical analysis indicated on the mill certification papers to meet or exceed the requirements of the referenced ASTM specification.

COPPER TUBE:

Statement from manufacturer on his letterhead that the pipe furnished meets the ASTM specification contained in this section.

QUALITY ASSURANCE

Order all Type E and Type S steel pipe with heat numbers rolled, stamped, or stenciled to each length or each bundle, depending on the size of the pipe, and in accordance with the appropriate ASTM specification.

Any installed material not meeting the specification requirements must be replaced with material that meets these specifications without additional cost to the Owner.

DELIVERY, STORAGE, AND HANDLING

Promptly inspect shipments to insure that the material is undamaged and complies with specifications.

Cover pipe to eliminate rust and corrosion 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 the caps remain in place. Protect fittings, flanges, and unions by storage inside or by durable, waterproof, above ground packaging.

Offsite storage agreements will not relieve the contractor from using proper storage techniques.

Storage and protection methods must allow inspection to verify products.

DESIGN CRITERIA

Use only new material, free of defects, rust and scale, and meeting the latest revision of ASTM specifications as listed in this specification.

Construct 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.

Where weld fittings or mechanical grooved fittings are used, use only long radius elbows having a centerline radius of 1.5 pipe diameters.

Where ASTM A53 type F pipe is specified, ASTM A53 grade A type E or S, or ASTM A53 grade B type E or S may be substituted at Contractor's option. Where ASTM A53 grade A pipe is specified, ASTM A53 grade B pipe may be substituted at Contractor's option. Where the grade or type is not specified, Contractor may choose from those commercially available.

Where ASTM B88, type L hard temper copper tubing is specified, ASTM B88, type K hard temper copper tubing may be substituted at Contractor's option.

PART 2 - PRODUCTS

HEATING HOT WATER

2" and Smaller: ASTM A53, type F, standard weight (schedule 40) black steel pipe with ASTM A126/ANSI B16.4, class 125, standard weight cast iron threaded fittings.

Contractor may use ASTM B88 seamless, type L, hard temper copper tube with ANSI 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) the diameter of the main.

VENTS AND RELIEF VALVES

Use pipe and pipe fittings as specified for the system to which the relief valve or vent is connected.

UNIONS AND FLANGES

2" and Smaller: ASTM A197/ANSI B16.3 malleable iron unions with brass seats. Use black malleable iron on black steel piping and galvanized malleable iron on galvanized steel piping. Use ANSI B16.18 cast copper alloy unions on copper piping. Use unions of a pressure class equal to or higher than that specified for the fittings of the respective piping service but not less than 250 psi.

PART 3 - EXECUTION

ERECTION

Carefully inspect all pipe, fittings, valves, equipment and accessories before installation. Any items that are unsuitable, cracked or otherwise defective shall be rejected and removed from the job site immediately. Excluding minor surface rust, piping that exhibits significant oxidation or corrosion will be rejected.

Exercise care at every stage of storage, handling, laying and erecting to prevent entry of foreign matter into piping, fittings, valves, equipment and accessories. Do not erect or install any item that is not clean.

Remove all loose dirt, scale, oil, chips, burrs and other foreign material from the internal and external surfaces of all pipe and piping components prior to assembly, including debris associated with cutting, threading and welding.

During fabrication and assembly, remove slag and weld spatter from internal pipe surfaces at all joints by peening, chipping and wire brushing.

During construction, until system is fully operational, keep all openings in piping and equipment closed except when actual work is being performed on that item of the system. Use plugs, caps, blind flanges or other items designed for this purpose.

Furnish and install all flanges, caps, bypasses, drains, valves, etc. required to facilitate flushing and draining all heating and cooling system piping.

Install all piping parallel to building walls and ceilings and at heights which do not obstruct any portion of a window, doorway, stairway, or passageway. Where interferences develop in the field, offset or reroute piping as required to clear such interferences. In all cases, consult drawings for exact location of pipe spaces, ceiling heights, door and window openings, or other architectural details before installing piping.

Mitered ells, notched tees, and orange peel reducers are not acceptable. On threaded piping, bushings are not acceptable.

"Weldolets" and "Threadolets" may be used for branch takeoffs up to one-half (1/2) the diameter of the main.

Install drains throughout the systems to permit complete drainage.

Do not route piping through transformer vaults or above transformers, panelboards, or switchboards, including the required service space for this equipment, unless the piping is serving this equipment

Install all valves, control valves, and piping specialties, including items furnished by others, as specified and/or detailed. Make connections to all equipment installed by others where that equipment requires the piping services indicated in this section.

THREADED PIPE JOINTS

Use a Teflon based thread lubricant or Teflon tape when making joints; no hard setting pipe thread cement or caulking will be allowed.

COPPER PIPE JOINTS

Remove all slivers and burrs remaining from the cutting operation by reaming and filing both pipe surfaces. Clean fitting and tube with emery cloth or sandpaper. Remove residue from the cleaning operation, apply flux, and assemble joint. Use 95-5 solder or brazing to secure joint as specified for the specific piping service.

Where mechanically formed tee fittings are allowed, form mechanically extracted collars in a continuous operation, consisting of drilling a pilot hole and drawing out the tube surface to form a collar having a height of not less than three times the thickness of the tube wall. Use an adjustable collaring device. Notch and dimple the branch tube. Remove all debris created by the forming process from the inside of the pipe. Braze the joint, applying heat properly so that pipe and tee do not distort; remove distorted connections.

WATER SYSTEM

Run water mains level or pitch horizontal mains up 1 inch in 40 feet in the direction of flow. Install manual air vents at all high points where air may collect. If vent is not in an accessible location, extend air vent piping to the nearest code acceptable drain location with vent valve located at the drain.

Main branches and runouts to terminal equipment may be made at the top, top 45 degree, side, and/or bottom 45 degree of the main provided that there are drain valves suitably located for complete system drainage and manual air vents are located at all top and top 45 degree connections. Bottom connections are not acceptable unless approved by the A/E.

Use top or top 45 degree connection to main for upfeed risers and bottom 45 degree connection to main for downfeed risers. Bottom connections are not acceptable unless approved by the A/E.

Use a minimum of two elbows in each pipe line to a piece of terminal equipment to provide flexibility for expansion and contraction of the piping systems. Offset pipe connections at equipment to allow for service, such as removal of the terminal device.

Use eccentric fittings for changes in horizontal pipe sizes with the fittings installed for proper air venting. Concentric fittings may be used for changes in vertical pipe sizes.

VENTS AND RELIEF VALVES

Install vent and relief valve discharge lines as indicated on the drawings, as detailed, and as specified for each specific valve or piping specialty item. In no event is a termination to occur less than six feet above a roof line.

UNIONS AND FLANGES

Install a 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. Where a valve is located at a piece of equipment, locate the flange or union connection on the equipment side of the valve. Concealed unions or flanges are not acceptable.

PIPING SYSTEM LEAK TESTS

Verify that the piping system being tested is fully connected to all components and that all equipment is properly installed, wired, and ready for operation. If required for the additional pressure load under test, provide temporary restraints at expansion joints or isolate them during the test. Verify that hangers can withstand any additional weight load that may be imposed by the test.

Provide all piping, fittings, blind flanges, and equipment to perform the testing.

Conduct pressure test with test medium of air or water unless specifically indicated. Minimum test time is indicated in the table below; additional time may be necessary to conduct an examination for leakage. Each test must be witnessed by the project representative. If leaks are found, repair the area with new materials and repeat the test; caulking will not be acceptable.

Do not insulate pipe until it has been successfully tested.

For hydrostatic tests, use clean water and remove all air from the piping being tested by means of air vents or loosening of flanges/unions. Measure and record test pressure at the high point in the system.

For air tests, gradually increase the pressure to not more than one half of the test pressure; then increase the pressure in steps of approximately one-tenth of the test pressure until the required test pressure is reached. Examine all joints and connections with a soap bubble solution or equivalent method. The piping system exclusive of possible localized instances at pump or valve packing shall show no evidence of leaking. After testing is complete, slowly release the pressure in a safe manner.

<u>System</u>	<u>Pressure</u>	<u>Medium</u>	<u>Duration</u>
Heating hot water	100 psig	Water	8 hr

All pressure tests are to be documented on form included in this specification.

On piping that cannot be tested because of connection to an active line, provide temporary blind flanges and hydrostatically test new section of piping. After completion of test, remove temporary flanges and make final connections to piping. Die penetrate test pass weld or x-ray the piping that was not hydrostatically tested up to the active system.

INITIAL FILL AND VENT

Fill hydronic systems with appropriate working fluids as specified. All system fluids shall be chemically treated as specified in Section 23 25 00 – HVAC WATER TREATMENT.

For closed piping systems, all air trapped at high points shall be relieved through the manual air vents prior to notifying A/E that the systems are ready to be tested and balanced.

CONSTRUCTION VERIFICATION ITEMS

Contractor is responsible for utilizing the construction verification checklists in accordance with the procedures defined for construction verification in Section 01 91 00.

FUNCTIONAL PERFORMANCE TESTING

Contractor is responsible for utilizing the functional performance test forms in accordance with the procedures defined for functional performance testing in Section 01 91 00.

END OF SECTION

PIPING SYSTEM LEAKAGE TEST REPORT

Date Submitted: _____

Project Name: _____

Location: _____ Project No: _____

Contractor: _____

- HVAC Refrigeration Controls
- Power Plant Plumbing Sprinkler

Test Medium: Air Water Other _____

Test performed per specification section No. _____

Specified Test Duration _____ Hours Specified Test Pressure _____ PSIG

System Identification: _____

Describe Location: _____

Test Date: _____	
Start Test Time: _____	Initial Pressure: _____ PSIG
Stop Test Time: _____	Final Pressure: _____ PSIG

Tested By: _____

Witnessed By: _____

Title: _____

Title: _____

Signed: _____

Signed: _____

Date: _____

Date: _____

Comments: _____

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SECTION 23 21 23

HYDRONIC PUMPS

PART 1 - GENERAL

SCOPE

This section includes specifications for water pumps used for HVAC applications. Included are the following topics:

PART 1 - GENERAL

- Scope
- Related Work
- Reference
- Quality Assurance
- Shop Drawings
- Operation and Maintenance Data
- Design Criteria

PART 2 - PRODUCTS

- In-line Booster Pumps

PART 3 - EXECUTION

- Installation
- Construction Verification Items
- Functional Performance Testing

RELATED WORK

- Section 01 91 00 - Commissioning
- Section 23 05 13 - Common Motor Requirements for HVAC Equipment

REFERENCE

Applicable provisions of Division 1 shall govern work under this section.

QUALITY ASSURANCE

Refer to division 1, General Conditions, Equals and Substitutions.

SHOP DRAWINGS

Refer to division 1, General Conditions, Submittals.

Include data concerning 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.

Pump curves shall identify design point of operation.

OPERATION AND MAINTENANCE DATA

All operations and maintenance data shall comply with the submission and content requirements specified under section GENERAL REQUIREMENTS.

DESIGN CRITERIA

Pump sizes, capacities, pressures and operating characteristics shall be as scheduled.

Pumps shall meet or exceed operating efficiencies scheduled.

Provide all pumps with motors, impellers, drive assemblies, bearings, coupling guard, and other accessories specified. Statically and dynamically balance all rotating parts. Provide flanged connections on all pumps unless specified otherwise. Service or repair of base mounted pumps shall not require breaking piping connections or removal of motor.

Where a pump is specified for parallel operation, the scheduled conditions are for that pump with both pumps operating; i.e., total system flow rate is twice that scheduled for a single pump. When only one of the parallel pumps is operating, the operating point of that pump must fall within the manufacturer's recommended operating range.

Provide pump with a motor sized for non-overloading over the entire pump curve. Motors to be 1750 rpm unless specified otherwise.

Furnish each pump and motor with a nameplate giving the 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.

Test all pumps, clean and paint before shipment. The manufacturer shall certify all pump ratings.

All pumps to operate without excessive noise or vibration.

After completion of balancing, provide replacement of impellers, or trim impellers to provide specified flow at actual pumping head, as installed.

Furnish one spare seal and casing gasket for each pump to user agency.

PART 2 - PRODUCTS

IN-LINE BOOSTER PUMPS

MANUFACTURERS:

Bell and Gossett, Taco, Grundfos, or approved equal.

Pumps to be horizontal, oil-lubricated or permanently lubricated with cast iron casing, steel or brass trim and flexible spring or sleeve type coupler. Casing shall be rated for 125 PSIG working pressure.

Seal: Mechanical, carbon on carbide.

Shaft: Heat treated carbon steel.

PART 3 - EXECUTION

INSTALLATION

Install all pumps in strict accordance with manufacturer's instructions. Access/service space around pumps shall not be less than minimum space recommended by pump manufacturer.

Support piping adjacent to pump such that no weight is carried on pump casings.

Decrease from line size at pump connections with suction diffusers where specified, long radius reducing elbows or concentric reducers/increasers in the vertical piping, and eccentric reducers/increasers for horizontal piping. Install eccentric reducers/increasers with the top of the pipe level

All valves and piping specialties must be full line size as indicated on the drawings

Install a full line size spring loaded check valve and balancing valve in the pump discharge piping. At contractor's option, combination shut-off, check, balancing valve may be substituted instead of separate valves. Reference section 23 05 23.

CONSTRUCTION VERIFICATION ITEMS

Contractor is responsible for utilizing the construction verification checklists in accordance with the procedures defined for construction verification in Section 01 91 00.

FUNCTIONAL PERFORMANCE TESTING

Contractor is responsible for utilizing the functional performance test forms in accordance with the procedures defined for functional performance testing in Section 01 91 00.

END OF SECTION

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SECTION 23 21 25

RADIANT FLOOR HEATING SYSTEMS

PART 1 - GENERAL

SCOPE

This section includes specifications for the radiant floor heating system, including piping, fittings, specialties, controls, etc. Included are the following topics:

PART 1- GENERAL

- Scope
- Related Work
- Reference
- Quality Assurance
- Shop Drawings
- Design Criteria

PART 2 - PRODUCTS

- Manufacturers
- Piping and Accessories
- Pipe
- Fittings
- Specialties
- Manifolds
- Fittings and Specialties
- Temperature Sensors
- Controls, Control Valves and Operators

PART 3 - EXECUTION

- Installation

RELATED WORK

- Section 23 05 15 – Piping Specialties
- Section 23 05 23 – General Duty Valves for HVAC
- Section 23 05 29 – Hangers and Supports for HVAC Piping and Equipment
- Section 23 07 00 – HVAC Insulation
- Section 23 21 13 – Hydronic Piping

REFERENCE

Applicable provisions of Division 1 govern work under this section.

QUALITY ASSURANCE

Substitution of Materials: Refer to Division 1 and the General Conditions of the Contract.

SHOP DRAWINGS

Complete system shop drawings shall be submitted which include the following items at a minimum:
Controls, piping, detailed in slab piping layouts, piping specialties and detailed installation instructions

The shop drawings shall be specifically prepared for this project. Incomplete or generic shop drawings will not be acceptable.

All control sensing element locations shall be identified on the shop drawings.

The control system shop drawings submitted shall include electrical interconnecting schematic diagrams.

DESIGN CRITERIA

All system electrical components shall be U.L. listed and shall bear the U.L. label.

Controls and control components shall be provided by the same manufacturer providing the in-floor heating piping system or shall be an approved manufacturer of radiant floor heating system controls as determined by the piping system manufacturer. The radiant floor heating system piping and controls shall have single source responsibility.

All transformers, relays, operators, thermostats, valves, etc. not specifically mentioned within the specifications but necessary to make the radiant 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, etc. as required to provide complete functionality.

All setpoints shall be adjustable and all controls shall allow manual override to select off, operating or idling modes.

PART 2 - PRODUCTS

MANUFACTURERS

PIPING AND ACCESSORIES

Wirsbo, Maxon, Heatlink, or approved equal.

PIPE

HePEX®, Cross-linked polyethylene, 1/2" 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 sections shall be continuous without any joints or fittings.

FITTINGS

Constructed of dezincification brass consisting of a barbed insert, compression ring and a compression nut.

SPECIALTIES

All piping specialties and supports as required for a complete installation.

MANIFOLDS

Cast brass construction, dezincification resistant in sizes and arrangements as indicated with integral, manual shut-off valves on return headers and integral manual balancing valves on supply headers.

FITTINGS AND SPECIALTIES

End caps with integral gasket, fill/drain valve and manual air vent as required, bushings, and manifold support brackets.

TEMPERATURE SENSORS

Temperature sensors, and piping water temperature sensors (as indicated and/or required for full system control). Piping temperature sensors shall be the immersion well type, mounted in the piping.

All control setpoints shall be adjustable.

CONTROLS, CONTROL VALVES AND OPERATORS

Section 23 09 23 shall provide all controls, controllers, etc.

Section 23 09 14 shall provide all automatic control valve(s) and valve operators as required.

PART 3 - EXECUTION

INSTALLATION

Horizontal piping shall be run level without pockets.

Vent all high points, at the manifold locations, and as indicated.

Mount valves and operators in location and position for ease of service.

The in-floor heating system piping shall be pressure tested with compressed air at a pressure of 60 PSIG for a period of not less than 24 hours. Isolate and protect all equipment not designed to withstand the test pressure.

During construction, a pressure of 60 PSIG shall be maintained on the radiant floor tubing system. The 60 PSIG pressure shall be maintained for a period of not less than 24 hours thereafter to ensure system integrity. Notify the Owner or Engineer at least 72 hours before pipe testing so that they can be present during the pipe testing process.

The entire radiant heat piping and control system shall be installed in strict accordance with the manufacturer's published instructions and recommendations.

The Contractor shall obtain from the manufacturer of the radiant 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.

The Contractor shall set and calibrate all automatic control system devices to achieve the required sequence of operation. All 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 23 25 00

HVAC WATER TREATMENT

PART 1 - GENERAL

SCOPE

This section includes specifications for chemical treatment of all water systems. Included are the following topics:

PART 1 - GENERAL

- Scope
- Reference
- Related Work
- Quality Assurance
- Shop Drawings
- Operation and Maintenance Data
- Design Criteria
- Maintenance Service

PART 2 - PRODUCTS

- Manufacturers
- System Cleaner
- System Inhibitor
- Glycol
- Closed Water System Treatment
- Treatment Equipment

PART 3 - EXECUTION

- Preparation
- Cleaning Sequence
- Glycol Water Systems
- Closed Water Systems
- Construction Verification

Appendix

- Pipe Cleaning and Treatment Report

REFERENCE

Applicable provisions of Division 1 shall govern work under this Section.

RELATED WORK

Section 23 05 15 - Piping Specialties

QUALITY ASSURANCE

Refer to division 1, General Conditions, Equals and Substitutions.

SHOP DRAWINGS

Refer to division 1, General Conditions, Submittals.

Required for all equipment and chemicals specified including data concerning dimensions, capacities, materials of construction, weights, operating sequence, composite wiring diagrams and appropriate identification. Chemical data to include the description of the chemical, its composition, its function, and the associated material safety data sheet.

OPERATION AND MAINTENANCE DATA

Provide for the services of the manufacturer's trained representative to approve the installation and instruct the user agency in the operation of each system.

Include data on chemical feed pumps, agitators, and other equipment including spare parts lists, procedures, and treatment programs. Include step by step instructions on test procedures including target concentrations.

DESIGN CRITERIA

Recommend a periodic test procedure and chemical treatment program for each system.

Treat the following systems:

- Hot water

Provide the initial chemical treatment for all systems based on a complete system fluid analysis prior to the equipment installation. The initial chemical treatment supply of chemicals for each system shall be adequate for the start-up and testing period, for the time the systems are being operated by the Contractor for temporary heating and cooling, and for one year after start-up of the system.

The chemicals used in the condenser water treatment system shall use only liquid chemicals and shall contain no phosphates or chromates.

Provide electrical devices, motors, wiring and conduit in accordance with the applicable sections of the Electrical Specifications.

MAINTENANCE SERVICE

Furnish service and maintenance of treatment systems for one year from date of substantial completion.

Provide technical service visits to perform field inspections and make water analysis on site. Detail findings in writing on proper practices, chemical treating requirements, and corrective actions needed. Submit two copies of field service report after each visit.

Provide laboratory and technical assistance services for the warranty period.

Provide site inspection of equipment during scheduled shutdown to evaluate success of the treatment program. Make recommendations in writing based on these inspections.

PART 2 - PRODUCTS

MANUFACTURERS

Betz Entac, Dearborn Div. - W. R. Grace & Co., Fremont Industries, Mitco Water Labs, Mogul Corporation, Nalco Chemical Co., Western Water Management, or approved equal.

SYSTEM CLEANER

Blend of organic alkaline penetrants, emulsifiers, surfactants and corrosion inhibitors that remove grease and petroleum products from the interior of piping systems. Cleaners that contain trisodium phosphate are specifically not acceptable.

SYSTEM INHIBITOR

Scale and corrosion inhibitor consisting of boron nitrite, benzol thiazol, benzotriazole, mercapto-benzothiazole, and tolyltrizole silicates.

GLYCOL

Inhibited ethylene glycol based material specifically designed for use in closed heat transfer systems. Dow Chemical Dowtherm SR-1, Union Carbide UCARTHERM, or approved equal.

CLOSED WATER SYSTEM TREATMENT

Sequestering agent to reduce deposits and adjust pH: polyphosphate.

Corrosion inhibitors: boron-nitrite, sodium nitrite and borax, sodium totyltriazole, low molecular weight polymers, phosphonates, sodium molybdate, or sulphites.

Conductivity enhancers: phosphates or phosphonates.

TREATMENT EQUIPMENT

BYPASS FEEDER:

Use existing by-pass feeder to feed chemical into the system.

PART 3 - EXECUTION

PREPARATION

Prior to cleaning, verify that systems are operational, filled, started, and vented. Use water meter to record capacity in each system.

Place terminal control valves in the full-open position

CLEANING SEQUENCE

GENERAL:

Systems are to be cleaned before they are used for any purpose except conduct pressure test before cleaning. Add cleaner to closed systems at concentrations as recommended by the manufacturer. Remove water filter elements from the system before starting circulation. For steam systems, fill boilers only, using the water and cleaner solution.

Use neutralizer agents on recommendation of the system cleaner supplier and approval of the Architect/Engineer.

Flush open systems with clean water for one hour minimum. Drain completely and refill.

Remove, clean, and replace strainer screens.

Inspect, remove sludge, and flush low points with clean water after cleaning process is completed. Include disassembly of components as required.

Use form at the end of this section to document system cleaning, flushing, and proper startup.

HOT WATER HEATING SYSTEMS:

Add cleaner to the system water until the M alkalinity value is 250 above that of the initial fill water. Verify the M alkalinity level before and after the addition of the cleaner by means of chemical tests that are observed by the Owner's construction representative; include results of all tests in the Operating and Maintenance manuals. Apply heat while circulating, slowly raising temperature to 160°F and maintain for 12 hours minimum; vent all high points to assure 100% system circulation. Remove heat and circulate to 100°F or less; drain system as quickly as possible and refill with clean water. Circulate for 6 hours at design temperature, vent air at all high points, then drain. Refill with clean water and repeat until the system cleaner is removed and the M alkalinity level returns to normal. Remove and clean all strainers. Re-vent the system and install clean filter elements in water filters. Treat with scale and corrosion inhibitors before using the system for building heating or cooling.

GLYCOL WATER SYSTEMS:

Clean and flush as indicated above for hot water heating systems. Verify complete drainage by measuring amount of water used for the initial fill versus the amount actually drained to assure complete removal of the cleaning solution. Remove all traces of chloride from the system; test to verify this removal and submit test results.

GLYCOL WATER SYSTEMS

The hot water system is a glycol water system.

Completely flush all traces of cleaning chemicals before adding the glycol water mixture to the system. Verify this by chemical test.

Premix the glycol water solution in a 30 gallon polyethylene drum to a concentration of 50% by volume. Use city water to make the solution. Use a hand pump to fill system from the mixing tank. Circulate fluid for several hours, vent all high points where air may collect, add more solution to the system if needed, and test the system for proper concentration of glycol; include copy of test report in the Operating and Maintenance manuals.

CLOSED WATER SYSTEMS

Install a separate bypass type feeder at the pumps for each closed hot water heating and chilled water cooling system. Provide a separate set of supply and return lines from each pump in the system and install ball valves in each of these lines. Locate the system connection that supplies the feeder upstream of the discharge shutoff valve for the pump. Locate the system connection that returns treatment back to the system at a convenient point downstream of the pump discharge shutoff valve. Provide a drain valve at the bottom of the feeder.

CONSTRUCTION VERIFICATION

Contractor is responsible for utilizing the construction verification checklists in accordance with the procedures defined for construction verification in Section 01 91 00.

PIPE CLEANING AND TREATMENT REPORT

Project Number: _____
Date Submitted: _____

Project Name: _____
Location: _____
Contractor: _____

System Tested: Hot Water ___ Glycol Water ___

System Volume: _____

Materials Used (Provide MSDS for each)

Cleaner: _____	Quantity Used: _____
Inhibitor: _____	Quantity Used: _____
Sequestering Agent: _____	Quantity Used: _____
Algaecide: _____	Quantity Used: _____
Neutralizer: _____	Quantity Used: _____
Glycol: _____	Quantity Used: _____
Glycol Solution Water Source: _____	Percent glycol by volume: _____

M Alkalinity

Prior to Cleaning: _____ During Cleaning: _____ After Flushing: _____

System Temperature

Prior to Cleaning: _____ During Cleaning: _____

Duration	Date/Time Start	Date/Time Stop
Initial Circulation	_____	_____
Draindown	_____	_____
System Refill	_____	_____
Final Circulation	_____	_____
Heating system Warmup	_____	_____

Component Checklist (Describe procedures performed at each)

Strainers: _____
Filters: _____
Vents: _____
Drains: _____
Branch Lines: _____
Terminal Units: _____

Comments: _____

END OF SECTION

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SECTION 23 31 00

HVAC DUCTS and CASINGS

PART 1 - GENERAL

SCOPE

This section includes specifications for all duct systems used on this project. Included are the following topics:

PART 1 - GENERAL

- Scope
- Related Work
- Reference
- Reference Standards
- Quality Assurance
- Shop Drawings
- Design Criteria

PART 2 - PRODUCTS

- General
- Materials
- Low Pressure Ductwork (Maximum 2 inch pressure class)
- Duct Sealant
- Gaskets

PART 3 - EXECUTION

- Installation
- Low Pressure Duct (Maximum 2 inch pressure class)
- Cleaning
- Leakage Test
- Construction Verification

APPENDIX

- Duct Leakage Test Report

RELATED WORK

- Section 23 05 93 - Testing, Adjusting, and Balancing for HVAC
- Section 23 33 00 – Air Duct Accessories

REFERENCE

Applicable provisions of Division 1 govern work under this Section.

REFERENCE STANDARDS

ANSI SS-EN 485-2	Aluminum and Aluminum Alloys-Sheet, Strip and Plate-Part 2: Mechanical Properties
ASTM B209	Specification for Aluminum and Aluminum-Alloy Sheet and Plate
ASTM A90	Test Method for Weight of Coating on Zinc-Coated (Galvanized) Iron or Steel Articles
ASTM A167	Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM A623	Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process

ASTM A527	Specification for General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Lock-Forming Quality
ASTM 924	Standard Specification for General Requirements for Sheet Steel, Metallic-coated by the Hot-dip Method
ASTM C 1071	Specification for Fibrous Glass Duct Lining Insulation
ASTM C 411	Test Method for Hot Surface Performance of High Temperature Thermal Insulation
ASTM E 84	Test Method for Surface Burning Characteristics of Building Materials
ASTM C 1338	Test Method for Determining Fungal Resistance of Insulation Materials and Facings
ASTM G 21	Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi
ASTM C 916	Standard Specification for Adhesives for Duct Thermal Insulation
UL 181	Standard for the Installation of Air Conditioning and Ventilating Systems
NAIMA	Standard for Safety for Factory Made Air Ducts and Air Connectors. Fibrous Glass Duct Liner Standard

QUALITY ASSURANCE

Refer to division 1, General Conditions, Equals and Substitutions.

SHOP DRAWINGS

Refer to division 1, General Conditions, Submittals.

Include manufacturer's data and/or Contractor data for the following:

- Schedule of duct systems including material of construction, gauge, pressure class, system class, method of reinforcement, joint construction, fitting construction, and support methods, all with details as appropriate.
- Duct sealant and gasket material.
- Duct liner including data on thermal conductivity, air friction correction factor, and limitation on temperature and velocity.

DESIGN CRITERIA

Construct all ductwork to be free from vibration, chatter, objectionable pulsations and leakage under specified operating conditions.

Use material, weight, thickness, gauge, construction and installation methods as outlined in the following SMACNA publications, unless noted otherwise:

- HVAC Duct Construction Standards, Metal and Flexible, 3rd Edition, 2005
- HVAC Air Duct Leakage Test Manual, 2nd Edition, 2012
- HVAC Systems - Duct Design, 4th Edition, 2006
- Rectangular Industrial Duct Construction Standard, 2nd Edition, 2004
- Round Industrial Duct Construction Standards, 2nd Edition, 1999
- Thermoplastic Duct (PVC) Construction Manual, 2nd Edition, 1995

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.

DELIVERY, STORAGE AND HANDLING

Promptly inspect shipments to ensure that Ductwork is undamaged and complies with the specification.

Protect Ductwork against damage.

Protect Ductwork by storing inside or by durable, waterproof, above ground packaging. Do not store material on grade. Protect Ductwork from dirt, dust, construction debris and foreign material. Where end caps/packaging are provided, take precautions so caps/packaging remain in place and free from damage.

Offsite storage agreements do not relieve the contractor from using proper storage techniques.

Storage and protection methods must allow inspection to verify products.

PART 2 - PRODUCTS

GENERAL

All 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" and below may be 26 gauge where allowed in SMACNA HVAC Duct Construction Standards, Metal and Flexible, 3rd Edition, 2005.

Duct sizes indicated on plans are net inside dimensions; where duct liner is specified, dimensions are net, inside of liner.

DUCTWORK PRESSURE CLASS

Minimum acceptable duct pressure class, for all ductwork except transfer ductwork, is 2 inch W.G. positive or negative, depending on the application. Transfer ductwork minimum acceptable duct pressure class is 1 inch W.G. positive or negative, depending on the application. Duct system pressure classes not indicated on the drawings to be as follows:

Supply duct	2 in. pressure class
Exhaust air ducts	2 in. pressure class
Return air ducts	2 in. pressure class
Outside air ducts	2 in. pressure class
Mixed air ducts	2 in. pressure class

MATERIALS

GALVANIZED STEEL SHEET:

Use ASTM A 653 galvanized steel sheet of lock forming quality. Galvanized coating to be 1.25 ounces per square foot, both sides of sheet, G90 in accordance with ASTM A90. Provide "Paint Grip" finish or galvalume sheetmetal for ductwork that will be painted.

LOW PRESSURE DUCTWORK (Maximum 2 inch pressure class)

Fabricate and install ductwork in sizes indicated on the drawings and in accordance with SMACNA recommendations, except as modified below.

Construct so that all interior surfaces are smooth. Use slip and drive or flanged and bolted construction when fabricating rectangular ductwork. Use spiral lock seam construction when fabricating round spiral ductwork. Sheet metal screws may be used on duct hangers, transverse joints and other SMACNA approved locations if the screw does not extend more than 1/2 inch into the duct.

Use elbows and tees with a center line radius to width or diameter ratio of 1.5 wherever space permits. When a shorter radius must be used due to limited space, install single wall sheet metal splitter vanes in accordance with SMACNA publications, Type RE 3. Where space will not allow and the C value of the radius elbow, as given in SMACNA publications, exceeds 0.31, use rectangular elbows with turning vanes as specified in Section 23 33 00. Square throat-radius heel elbows will not be acceptable. Straight taps or bullhead tees are not acceptable.

Where rectangular elbows are used, provide turning vanes in accordance with Section 23 33 00.

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 will not be accepted.

Button punch snaplock construction will not be accepted on aluminum ductwork.

Round ducts may be substituted 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 the Architect/Engineer.

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.

DUCT SEALANT

Manufacturer: 3M 800, 3M 900, H.B. Fuller/Foster, Hardcast, Hardcast Peal & Seal, Lockformer cold sealant, Mon-Eco Industries, United Sheet Metal, or approved equal. Silicone sealants are not allowed in any type of ductwork installation.

Install sealants in strict accordance with manufacturer's recommendations, paying special attention to temperature limitations. Allow sealant to fully cure before pressure testing of ductwork, or before startup of air handling systems.

GASKETS

2 INCH PRESSURE CLASS AND LOWER:

Soft neoprene or butyl gaskets in combination with duct sealant for flanged joints.

PART 3 - EXECUTION

INSTALLATION

Verify dimensions at the site, making field measurements and drawings necessary for fabrication and erection. Check plans showing work of other trades and consult with Architect in the event of any interference.

Make allowances for beams, pipes or other obstructions in building construction and for work of other contractors. Transform, divide or offset ducts as required, in accordance with SMACNA HVAC Duct Construction Standards, Figure 4-7, except do not reduce duct to less than six inches in any dimension and do not exceed an 8:1 aspect ratio. Where it is necessary to take pipes or similar obstructions through ducts, construct easement as indicated in SMACNA HVAC Duct Construction Standards, Figure 4-8, Fig. E. In all cases, seal to prevent air leakage. Pipes or similar obstructions may not pass through high pressure or fume exhaust ductwork.

Test openings for test and balance work will be provided under Section 23 05 93.

Provide frames constructed of angles or channels for coils, filters, dampers or other devices installed in duct systems, and make all connections to such equipment including equipment furnished by others. Secure frames with gaskets and screws or nut, bolts and washers.

Install duct to pitch toward outside air intakes and drain to outside of building. Solder or seal seams to form watertight joints.

Where two different metal ducts meet, the joint shall be installed in such a manner that metal ducts do not contact each other by using proper seal or compound.

Install all motor operated dampers and connect to or install all equipment furnished by others. Blank off all unused portions of louvers, as indicated on the drawings, with 1-1/2 inch board insulation with galvanized sheet metal backing on both sides.

Do not install ductwork through dedicated electrical rooms or spaces unless the ductwork is serving this room or space.

Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.

Provide adequate access to ductwork for cleaning purposes.

Provide temporary capping of ductwork openings to prevent entry of dirt, dust and foreign material.

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 the Ductwork.

Install prefabricated grease ductwork assemblies in accordance with manufacturer requirements and NFPA 96.

During construction provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.

DUCTWORK SUPPORT

Support ductwork in accordance with SMACNA HVAC Duct Construction Standards, Figure 5-5, except supporting ductwork with secure wire method is not allowed.

Support with 3/32 inch, 7 x 7, stainless steel air-craft cable, with matching serrated spring loaded wedge mechanism fasteners rated for actual load. Steel cable hanging systems will be allowed on round ductwork under 12 inches diameter if installed utilizing two fasteners with two cable loops. Comply with the manufacturer's installation instructions.

LOW PRESSURE DUCT (Maximum 2 inch pressure class)

Seal all duct, with the exception of transfer ducts, in accordance with SMACNA seal class "A"; all seams, joints, and penetrations shall be sealed.

Install a manual balancing damper in each branch duct and for each diffuser or grille. The use of splitter dampers, extractors, or grille face dampers will not be accepted for balancing dampers.

Hangers must be wrapped around bottom edge of duct and securely fastened to duct with sheetmetal screws or pop rivets. Trapeze hangers may be used at contractor's option.

CLEANING

Remove all dirt and foreign matter from the entire duct system and clean diffusers, registers, grilles and the inside of air-handling units before operating fans.

Clean duct systems with high power vacuum machines where systems have been used for ventilation purposes during construction. Protect equipment that may be harmed by excessive dirt with filters, or bypass during cleaning.

LEAKAGE TEST

Test all ductwork in accordance with test methods described in Section 5 of SMACNA HVAC Air Duct Leakage Test Manual. Do not insulate ductwork until it has been successfully tested. Test pressure shall be equal to the duct pressure class.

If excessive air leakage is found locate leaks, repair the duct in the area of the leak, seal the duct, and retest.

Leakage rate shall not exceed more than 5% of the system air quantity for low pressure ductwork, determined in accordance with Appendix C of the SMACNA HVAC Air Duct Leakage Test Manual.

Leakage rate shall not exceed more than 1% of the system air quantity for high pressure ductwork, determined in accordance with Appendix C of the SMACNA HVAC Air Duct Leakage Test Manual.

Leakage test for ductwork downstream of air terminal devices may be omitted but will not relieve the contractor from duct sealing requirements.

Submit a signed report to the A/E, indicating test apparatus used, results of the leakage test, and any remedial work required to bring duct systems into compliance with specified leakage rates.

CONSTRUCTION VERIFICATION

Contractor is responsible for utilizing the construction verification checklists in accordance with the procedures defined for construction verification in Section 01 91 00.

DUCT LEAKAGE TEST REPORT

Project Number: _____
Date Submitted: _____

<u>Project</u>	Name: _____		
	Location: _____		
	Contractor: _____		
<u>System</u>	Fan No: _____	Leakage Class (C _L): _____	
<u>Data</u>	Fan Design CFM: _____	Duct Pressure Class (P _C): _____	
		Test Pressure (P _T): _____	
<u>Test</u>			
<u>Equipment</u>	Manufacturer: _____	Model No: _____	Serial No: _____

For large systems, use the reverse side for a simple sketch of the entire duct system. Then use letter designations to indicate the various duct sections being tested at one time. Also use the reverse side for test comments.

Note that due to normal construction sequencing it is usually necessary to test risers separately prior to enclosing chases.

Design Data					Field Test Data							
Duct Section	Duct Shape	Duct Surface (Ft ²)	Allowable Leakage		Diameter		Pressure (in. wc.)		Date	Performed By	Observed By	Actual CFM
			Leakage Factor (P ⁶⁵ C _L)	CFM for Section	Tube (D ₁)	Orifice (D ₂)	In Duct (P)	Across Orifice (P _{drop})				
TOTAL												

END OF SECTION

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SECTION 23 33 00

AIR DUCT ACCESSORIES

PART 1 - GENERAL

SCOPE

This sections includes accessories used in the installation of duct systems. Included are the following topics:

PART 1 - GENERAL

- Related Work
- Reference
- Reference Standards
- Quality Assurance
- Shop Drawings
- Operation and Maintenance Data

PART 2 - PRODUCTS

- Manual Volume Dampers
- Turning Vanes
- Fire Dampers
- Control Dampers
- Access Doors
- Flexible Duct
- Duct Lining
- Flashings
- Duct Flexible Connections
- Louvers

PART 3 - EXECUTION

- Manual Volume Dampers
- Turning Vanes
- Fire Dampers
- Control Dampers
- Access Doors
- Flashings
- Duct Flexible Connections
- Louvers
- Construction Verification

RELATED WORK

Section 23 05 29 – Hanger and Supports for HVAC Piping and Equipment
Section 23 31 00 – HVAC Ducts and Casings

REFERENCE

Applicable provisions of Division 1 govern work under this Section.

REFERENCE STANDARDS

NFPA 90A	Standard for Installation of Air Conditioning and Ventilating Systems
SMACNA	HVAC Duct Construction Standards - Metal and Flexible, 2nd Edition, 1995
UL 214	
UL 555 (6 th edition)	Standard for Fire Dampers and Ceiling Dampers
UL 555S (4 th edition)	Leakage Rated Dampers for Use in Smoke Control Systems

QUALITY ASSURANCE

Refer to division 1, General Conditions, Equals and Substitutions

SHOP DRAWINGS

Refer to division 1, General Conditions, Submittals.

Submit for all accessories and include dimensions, capacities, ratings, installation instructions, and appropriate identification.

Include certified test data on dynamic insertion loss, self-noise power levels, and aerodynamic performance of sound attenuators.

Submit manufacturer's color charts where finish color is specified to be selected by the Architect/Engineer.

OPERATION AND MAINTENANCE DATA

All operations and maintenance data shall comply with the submission and content requirements specified under section GENERAL REQUIREMENTS.

PART 2 - PRODUCTS

MANUAL VOLUME DAMPERS

Manufacturers: Ruskin, Vent Products, Air Balance, or approved equal.

Dampers must be constructed in accordance with SMACNA Fig. 2-12, Fig. 2-13, and notes relating to these figures, except as modified below.

Reinforce all blades to prevent vibration, flutter, or other noise. Construct dampers in multiple sections with mullions where width is over 48 inches. Use rivets or tack welds to secure individual components; sheet metal screws will not be accepted. Provide operators with locking devices and damper position indicators for each damper; use an elevated platform on insulated ducts. Provide end bearings or bushings for all volume damper rods penetrating ductwork constructed to a 3" w.c. pressure class or above.

TURNING VANES

Manufacturers: Aero Dyne, Anemostat, Barber-Colman, Hart & Cooley, or approved equal.

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. Construct turning vanes for short radius elbows and elbows where one dimension changes in the turn in accordance with SMACNA Fig. 2-5 and Fig. 2-6.

FIRE DAMPERS

Manufacturers: Air Balance, Advanced Air, American Warming and Ventilating, Greenheck, Phillips-Aire, Prefco, Ruskin, Safe-Air or approved equal.

DYNAMIC FIRE DAMPERS

Dynamic fire damper assemblies must be UL 555 (6th edition) listed and labeled for dynamic applications (where air systems operate during a fire) and meet requirements of NFPA 90A. Dampers must be type B curtain type with curtain 100% out of air stream. Dampers larger than 30" by 30" or with velocity rating requirements of 3000 fpm or higher, may be multiblade type with blades located in the airstream. Velocity ratings and static pressure ratings as indicated on the drawings. Damper fire rating to be compatible with the rating of the building assembly in which the damper is used.

CONTROL DAMPERS

Control dampers are specified in section 23 09 14.

ACCESS DOORS

Access doors to be designed and constructed for the pressure class of the duct in which the door is to be installed. Doors in exposed areas shall be hinged type with cam sash lock. Hinges shall be aluminum or steel full length continuous piano type. Doors in concealed spaces shall be secured in place with cam sash latches. For both hinged and non-hinged doors provide sufficient number of cam sash latches to provide air tight seal when door is closed. Do not use hinged doors in concealed spaces if this will restrict access. Use minimum 1" deep 24 gauge galvanized steel double wall access doors with minimum 24 gauge galvanized steel frames. For non-galvanized ductwork, use minimum 1" deep double wall access door with frame that shall use materials of construction identical to adjacent ductwork. Provide double neoprene gasket that shall provide seals from the frame to the door and frame to the duct. 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. Access doors constructed with sheet metal screw fasteners will not be accepted.

Use insulated, 1-1/2 hour UL 1978 listed and labeled access doors in kitchen exhaust ducts.

FLEXIBLE DUCT

Manufacturers: Anco Products, Clevaflex, Thermaflex, Flexmaster or approved equal.

Factory fabricated, UL 181 listed as a class 1 duct, and having a flame spread of 25 or less and a smoke developed rating of 50 or under in accordance with NFPA 90A.

Suitable for pressures and temperatures involved but not less than a 180°F service temperature and ± 2 inch pressure class, depending on the application.

Duct to be composed of polyester film, aluminum laminate or woven and coated fiberglass fabric bonded permanently to corrosion resistant coated steel wire helix. Two-ply, laminated, and corrugated aluminum construction may also be used.

Where duct is specified to be insulated, provide a minimum 1 inch fiberglass insulation blanket with maximum thermal conductance of 0.23 K (75 degrees F.) and vapor barrier jacket of polyethylene or metalized reinforced film laminate. Maximum perm rating of vapor barrier jacket to be 0.1 perm.

DUCT LINING

Manufacturer: Manville, Owens-Corning, Knauf, or approved equal.

1 inch thick, flexible, mat faced insulation made from inorganic glass fibers bonded with a thermosetting resin with thermal conductivity of .25 Btu inch / hour sq.ft. deg F.

Meet erosion testing per UL 181 or ASTM C 1071 for 5000 fpm maximum air velocity. ASTM C 411 maximum operating temperature rating of 250 deg F. ASTM E84 flame spread less than 25 and smoke developed less than 50.

Meet requirements of ASTM C 1338 and ASTM G21 for fungi resistance.

Install liner using adhesive conforming to ASTM C 916.

FLASHINGS

Provide flashing to completely weatherproof connection of ductwork to louvers. Flashing to be constructed of material similar to louver material.

Flashing and counterflashing for roof curbs will be provided by others.

Flashing and curbs for duct and pipe penetrations of roof assemblies to be in accordance with details.

DUCT FLEXIBLE CONNECTIONS

Material to be fire retardant, be UL 214 listed, and meet the requirements of NFPA 90A.

Connections to be a minimum of 3 inches wide, crimped into metal edging strip, and air tight. Connections to have adequate flexibility and width to allow for thermal expansion/contraction, vibration of connected equipment, and other movement.

Use coated glass fiber fabric for all applications. Material for inside applications other than corrosive environments, fume exhaust, or kitchen exhaust to be double coated with neoprene, air and water tight, suitable for temperatures between -10°F and 200°F, and have a nominal weight of 30 ounces per square yard.

LOUVERS

Manufacturers: Greenheck ESD-635, Airolite K6776, Industrial Louvers 658, American Warming and Ventilating LE-31, Construction Specialties 6177, Ruskin ELF6375DX or approved equal.

Similar to Greenheck ESD-635, extruded aluminum alloy not less than 12 gauge (.081" thick), 6063 series frame and blades, all-welded assembly, 35 degree or 45 degree blades with water baffle, 6 inches thick. Provide with bird screen of 1/2" x 1/2" mesh aluminum in 12 gauge aluminum frame and an aluminum sill. Locate the bird screen inside of the louver unless noted otherwise.

Louver to bear the AMCA certified ratings seal for both air performance and water penetration, having a free area not less than 50% based on a 48" x 48" section, a water penetration less than 0.1 oz/square foot under AMCA test at 1000 feet per minute, and an intake pressure drop less than 0.20 inches of water at 1000 feet per minute.

Finish to be anodized or Kynar 500 in a custom color to be selected by the Architect. Furnish sufficient paint in the same color as the louver to paint the outer surface of panels over unused portions of louvers and to paint the interior portion of ductwork visible through the louvers.

PART 3 - EXECUTION

MANUAL VOLUME DAMPERS

Install manual volume dampers in each branch duct and for each grille, register, or diffuser as far away from the outlet as possible while still maintaining accessibility to the damper. Install so there is no flutter or vibration of the damper blade(s).

TURNING VANES

Install turning vanes in all rectangular, mitered elbows in accordance with SMACNA standards and/or manufacturer's recommendations.

Install double wall, airfoil, 2 inch radius vanes in ducts with vane runner length 18" or greater and air velocity less than 2000 fpm. Install double wall, airfoil, 4-1/2 inch radius vanes in ducts with vane runner length 18" or greater and air velocity 2000 fpm or greater.

If duct size changes in a mitered elbow, use single wall type vanes with a trailing edge extension. If duct size changes in a radius elbow or if short radius elbows must be used, install sheetmetal turning vanes in accordance with SMACNA Figure 2-5 and Figure 2-6.

FIRE DAMPERS

Install dampers in strict accordance with manufacturer's installation instructions. Install damper sleeves with retaining angles on both sides of rated partition. Connections of ductwork to fire damper assemblies to be as specified on the installation instructions. Where it is necessary to set dampers out from the rated wall, install a sleeve extension encased in two hour rated fire proofing insulation. Install an access door at each fire damper, located to permit resetting the damper replacing the fusible link.

Manually test each fire damper for proper operation by removing the fusible link. Repair or replace any fire damper that does not close completely. Re-install fusible link after test.

CONTROL DAMPERS

Install dampers in locations indicated on the drawings, as detailed, and according to the manufacturer's instructions. Install blank-off plates or transitions where required for proper mixing of airstreams in mixing plenums. Provide adequate operating clearance and access to the operator. Install an access door adjacent to each control damper for inspection and maintenance.

ACCESS DOORS

Install access doors where specified, indicated on the drawings, and in locations where maintenance, service, cleaning or inspection is required. 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.

Size and numbers of duct access doors to be sufficient to perform the intended service. 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. Install access doors on both inlet and outlet sides of reheat coils as well as other duct mounted coils.

Label fire, smoke and combination fire smoke dampers on the exterior surface of ductwork directly adjacent to access doors using a minimum of 0.5 inch height lettering reading, "FIRE DAMPER". The tags must be coordinated with the mechanical schedules. Utilize stencils or manufactured labels. All other forms of identification are unacceptable. All labels shall be clearly visible from the ceiling access point.

FLEXIBLE DUCT

Flexible duct may only be used for final connections of air inlets and outlets at diffuser, register, and grille locations. Where flexible duct is used, it shall be the minimum length required to make the final connections, but no greater than 5 feet in length, and have no more than one (1) 90 degree bend.

Secure inner jacket of flexible duct in place with stainless steel metal band clamp. Secure insulation vapor barrier jacket in place with steel or nylon draw band. Sheetmetal screws and/or duct tape will not be accepted.

Flexible duct used to compensate for misalignment of main duct or branch duct will not be accepted.

Individual sections of flexible ductwork shall be of one piece construction. Splicing of short sections will not be accepted.

Flexible ductwork used as transfer duct shall be sized for a maximum velocity of 300 fpm.

Penetration of any partition, wall, or floor with flexible duct will not be accepted.

DUCT LINING

Apply lining to the following ductwork:

- Return air ductwork at FCU-2

Do not apply lining to the following ductwork:

- Outside air ductwork.
- Exhaust air ductwork.

Install liner in compliance with the latest edition of NAIMA's Fibrous Glass Duct Liner Standard. Locate longitudinal joints at the 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 the liner manufacturer without compressing liner more than 1/8" with the fasteners.

FLASHINGS

Flashing for roof curbs, equipment supports or rails located on roof, will be installed by others.

DUCT FLEXIBLE CONNECTIONS

Install at all duct connections to rotating or vibrating equipment, including air handling units (unless unit is internally isolated), fans, or other motorized equipment in accordance with SMACNA Figure 2-19. Install thrust restraints to prevent excess strain on duct flexible connections at fan inlets and outlets; see Related Work.

For applications in corrosive environments or fume exhaust systems, use a double layer of the Teflon; coated fabric when making the connector.

LOUVERS

Connect outside air intake duct to the louver, sealing all connections air and water tight.

Provide bird screen on inside of active louver area where none is provided with louvers. Where louvers are equipped with inside birdscreen, remove screen at all locations where duct connections are not made.

Install insulated metal panel on unused portion of louver. Panels must be sealed weathertight to louver assembly with flashing as required for proper drainage to outside of building. Paint outside surface of panel to match louver prior to installation. Where ductwork is visible through louver when viewed from outside the building, paint inside of duct to match louver color.

CONSTRUCTION VERIFICATION

Contractor is responsible for utilizing the construction verification checklists in accordance with the procedures defined for construction verification in Section 01 91 00.

END OF SECTION

SECTION 23 34 00

HVAC FANS

PART 1 - GENERAL

SCOPE

This section includes specifications for fans that are not an integral part of a manufactured device. Included are the following topics:

PART 1 - GENERAL

- Scope
- Related Work
- Reference
- Reference Standards
- Quality Assurance
- Shop Drawings
- Operation and Maintenance Data
- Design Criteria

PART 2 - PRODUCTS

- General
- Power Roof Exhaust Fans

PART 3 - EXECUTION

- Installation
- Construction verification Items
- Functional performance Testing

RELATED WORK

- Section 01 91 00 - Commissioning
- Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment
- Section 23 05 13 - Common Motor Requirements for HVAC Equipment

REFERENCE

Applicable provisions of Division 1 govern work under this Section.

REFERENCE STANDARDS

AMCA 203	AMCA Fan Application Manual - Troubleshooting
AMCA 210	Laboratory Method of Testing Fans for Rating
AMCA 300	Reverberant Room Method for Sound Testing of Fans
NFPA 90A	Standard for the Installation of Air Conditioning and Ventilating Systems
NFPA 96	Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations
UL 762	Power Roof Ventilators For Restaurant Exhaust Appliances

QUALITY ASSURANCE

Refer to division 1, General Conditions, Equals and Substitutions.

SHOP DRAWINGS

Refer to division 1, General Conditions, Submittals.

Include dimensions, capacities, fan curves, materials of construction, ratings, weights, motors and drives, sound power levels, appropriate identification and vibration isolation for all equipment. Sound power levels to be based on tests performed in accordance with AMCA Standard 300.

Submit color selection charts for equipment where applicable.

Fan curves shall indicate the relationship of CFM to static or total pressure for various fan speeds. Brake horsepower, recommended selection range, and limits of operation are to also be indicated on the curves. Indicate operating point on the fan curves at design air quantity and indicate the manufacturer's recommended drive loss factor for the specific application. Tabular fan performance data is not acceptable.

For variable air volume application, include data which indicates the effect of capacity control devices, such as inlet vanes, on performance.

OPERATION AND MAINTENANCE DATA

All operations and maintenance data shall comply with the submission and content requirements specified under section GENERAL REQUIREMENTS.

DESIGN CRITERIA

Tested and certify all fans in accordance with the applicable AMCA test code.

Each fan and motor combination shall be capable of delivering 110% of air quantity scheduled at scheduled static pressure. The motor furnished with the fan shall not operate into the motor service factor when operating under these conditions.

Consider drive efficiency in motor selection according to manufacturer's published recommendation or according to AMCA Publication 203, Appendix L.

Where inlet and outlet ductwork at any fan is changed from that shown on the drawings, provide any motor, drive and/or wiring changes required due to increased static pressure or baffling necessary to prevent uneven airflow or improve mixing.

All internal insulation and other components exposed to the airstream are to meet the flame spread and smoke ratings contained in NFPA 90A.

All roof mounted equipment to be provided with curbs or equipment stands in accordance with specification in Section 23 05 29.

PART 2 - PRODUCTS

GENERAL

Use fan size, class, type, arrangement, and capacity as scheduled.

Furnish complete with motors, wheels, drive assemblies, bearings, vibration isolation devices, and accessories required for specified performance and proper operation. All single phase motors to have inherent thermal overload protection.

Provide variable pitch sheaves for drives 3 hp and smaller, fixed pitch sheaves for drives 5 hp and larger. Design all drives for 150% of motor rating.

Use OSHA approved belt guards that totally enclose the entire drive. Construct guards of expanded metal to allow for ventilation; provide tachometer openings at shaft locations.

Statically and dynamically balance all fans so they operate without objectionable noise or vibration.

Use AMCA Type A spark resistant construction for all fans handling flammable or explosive vapors.

All fans handling grease laden vapors shall meet the requirements of UL 762 and NFPA 96.

Provide a corrosion resistant coating on all surfaces exposed to fume and other corrosive exhaust air. Coating to be as scheduled.

POWER ROOF EXHAUST FANS

Manufacturers: Carnes, Greenheck, Penn, Jenn-Air, Cook, ACME, S&P or approved equal.

Provide upblast or downblast units, as scheduled, with aluminum housing, non-overloading type centrifugal aluminum wheel, inlet cone with aluminum rub ring, factory mounted and wired motor and disconnect switch, and bird screen.

Provide stainless steel shafts and stainless steel fasteners.

Electrical Contractor will provide disconnect switches and thermal overload protection for units with three phase motors.

Upblast units to have motor, bearings, and drives completely enclosed and isolated from the exhaust air stream with ventilation provided by outside air.

Provide explosion proof motors as scheduled.

PART 3 - EXECUTION

INSTALLATION

Install as shown on the drawings, as detailed, and according to manufacturer's installation instructions. On units provided with a drain connection, reduce drain connection down to ½" fitting and leave open.

CONSTRUCTION VERIFICATION

Contractor is responsible for utilizing the construction verification checklists in accordance with the procedures defined for construction verification in Section 01 91 00.

FUNCTIONAL PERFORMANCE TESTING

Contractor is responsible for utilizing the functional performance test forms in accordance with the procedures defined for functional performance testing in Section 01 91 00.

END OF SECTION

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SECTION 23 37 13

DIFFUSERS, REGISTERS & GRILLES

PART 1 - GENERAL

SCOPE

This section includes specifications for air terminal equipment. Included are the following topics:

PART 1 - GENERAL

- Scope
- Related Work
- Reference
- Reference Standards
- Quality Assurance
- Submittals
- Design Criteria

PART 2 - PRODUCTS

- Manufacturers
- Square Ceiling Diffusers - High Performance
- Square Ceiling Diffusers
- Side-Wall Registers and Grilles
- Construction Verification Items

PART 3 - EXECUTION

- Installation

RELATED WORK

- Section 01 91 00 - Commissioning
- Section 23 05 93 - Testing, Adjusting and Balancing for HVAC
- Section 23 31 00 - HVAC Ducts and Casings
- Section 23 33 00 - Air Duct Accessories

REFERENCE

Applicable provisions of Division 1 govern work under this section.

REFERENCE STANDARDS

- NFPA 90A - Installation of Air Conditioning and Ventilation Systems.
- UL 181 - Factory-Made Air Ducts and Connectors.
- ARI-ADC Standard 880

QUALITY ASSURANCE

Refer to division 1, General Conditions, Equals and Substitutions.

SUBMITTALS

Refer to division 1, General Conditions, Submittals.

Furnish submittal information including, but not limited to, the following:

- Manufacturer's name and model number
- Identification as referenced in the documents
- Capacities/ratings
- Materials of construction

Sound ratings
Dimensions
Finish
Color selection charts where applicable
Manufacturer's installation instructions
All other appropriate data

DESIGN CRITERIA

All performance data shall be based on tests conducted in accordance with Air Diffusion Council (ADC) Test Code 1062 GRD 84.

PART 2 - PRODUCTS

MANUFACTURERS

Manufacturers: Carnes, Krueger, Titus, Metal-Aire, and E.H. Price, and United Sheet Metal.

Acceptable manufacturers for specific products are listed under each item.

SQUARE CEILING DIFFUSERS - High Performance

High performance type diffuser incorporating short throws and low NC levels. Titus model TMS, Carne series SF, Price model SCD, Metal Aire series 5800, and Krueger series 1400.

Diffusers to be aluminum (Steel) unless otherwise indicated, louvered face furnished with frame type appropriate to installation.

Diffuser shall have throw characteristics of a round diffuser having a 360° horizontal blow pattern.

Louver cones shall be one-piece construction with no corner joints.

White, baked enamel finish or powder coat finish, unless otherwise indicated.

SQUARE CEILING DIFFUSERS

Titus model TDC/TDC-AA, Carnes series SK or SE, Price model SMD/AMD, Metal Aire series 5500 or 5500S, and Krueger series S.

Aluminum (Steel) unless otherwise indicated, louvered face furnished with frame type appropriate to installation.

Directional blow pattern as shown on the drawings and/or as scheduled.

One-piece construction louver cones with no corner joints.

White, baked enamel finish or powder coat finish, unless otherwise indicated.

SIDE-WALL REGISTERS AND GRILLES

Titus series 300 (supply) and series 350 (return/exhaust), Carnes model R series, Price model 520 (Supply) or 530 (return/exhaust), Metal Aire series V4000 or H4000, Krueger series 880.

Aluminum (Steel) unless otherwise indicated, with frame type appropriate to installation.

Double deflection type blade supply registers and supply grilles allow deflection adjustment in all direction.

Opposed blade volume control damper supply registers, operable from face.

Fixed blade (0 degree, 45 degree) core return and exhaust registers and grilles.

Opposed blade volume control damper return registers, operable from face.

Register and grille sizes as shown on drawings and/or as scheduled.

White, baked enamel finish or powder coat finish, unless otherwise indicated.

Screw holes on surface counter sunk to accept recessed type screws.

PART 3 - EXECUTION

INSTALLATION

Install grilles, registers and diffusers as shown on drawings and according to manufacturer's instructions.

Furnish diffusers with equalizing grids where it is not possible to maintain minimum 2 duct diameter straight duct into diffuser. Equalizing grids shall consist of individually adjustable vanes designed for equalizing airflow into diffuser neck and providing directional control of airflow.

Unless otherwise indicated, size ductwork drops to diffusers or grilles to match unit collar size.

Seal connections between ductwork drops and diffusers/grilles airtight.

Blank off unused portion of linear slot diffusers and linear bar diffusers and grilles.

Where diffusers, registers and grilles cannot be installed to avoid seeing inside duct, paint inside of duct with flat black paint to reduce visibility.

In clean rooms and animal holding rooms, caulk space between diffuser or grille and ceiling or wall to be air and watertight. Use clear, non-hardening silicone sealant compatible with ceiling or wall surfaces. Sealant shall be resistant to microbiological growth.

CONSTRUCTION VERIFICATION

Contractor is responsible for utilizing the construction verification checklists in accordance with the procedures defined for construction verification in Section 01 91 00.

END OF SECTION

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SECTION 23 82 00

HEATING AND COOLING TERMINAL UNITS

PART 1 - GENERAL

SCOPE

This section includes specification for heating and cooling terminal equipment using water as the source. Included are the following topics:

PART 1 - GENERAL

- Scope
- Related Work
- Reference
- Reference Standards
- Quality Assurance
- Shop Drawings
- Operation and Maintenance Data
- Design Criteria

PART 2 - PRODUCTS

- Unit Heaters
- Fan Coil Units

PART 3 - EXECUTION

- Installation
- Unit Heaters
- Fan Coil Units
- Construction Verification Items
- Functional Performance Testing

RELATED WORK

- Section 01 91 00 - Commissioning
- Section 23 05 13 - Common Motor Requirements for HVAC Equipment
- Section 23 05 23 - General-Duty Valves for HVAC Piping
- Section 23 36 00 - Air Duct Accessories

REFERENCE

Applicable provisions of Division 1 govern work under this Section.

REFERENCE STANDARDS

- ARI 210 Standard for Unitary Air-Conditioning Equipment
- ARI 410 Standard for Forced-Circulation Air-Cooling and Air-Heating Coils
- CS 140

QUALITY ASSURANCE

Refer to division 1, General Conditions, Equals and Substitutions

SHOP DRAWINGS

Refer to division 1, General Conditions, Submittals.

Include dimensions, capacities, materials of construction, ratings, weights, wiring diagrams, and appropriate identification for all equipment in this section. Include color selection chart where applicable.

OPERATION AND MAINTENANCE DATA

All operations and maintenance data shall comply with the submission and content requirements specified under section GENERAL REQUIREMENTS.

DESIGN CRITERIA

Forced Circulation Coils: Ratings certified in accordance with ARI 410.

Electrical Equipment and heaters shall be UL listed for the service specified.

Electrical components and work must be in accordance with National Electrical Code.

PART 2 - PRODUCTS

UNIT HEATERS

Manufacturers: Modine, McQuay, Trane, Airtherm, Sterling, Vulcan, Zehnder Rittling or approved equal.

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.

Furnish adjustable horizontal and vertical discharge louvers for units with horizontal discharge. Provide an adjustable cone diffuser for projection units with vertical discharge.

Furnish motors with characteristics as scheduled. Single phase, 120 volt motors to be permanently lubricated and provided with thermal overload protection.

FAN COIL UNITS

Manufacturers: Enviro-Tec, Carrier, Trane, McQuay, Modine, Zehnder Rittling.

Furnish with separate hot water coils, speed selector switch, condensate drain pan, and casing.

Use centrifugal type fans, statically and dynamically balanced for operation without objectionable noise and vibration. Mount fan assembly on rubber isolators.

Motors to be permanent split capacitor type with built-in thermal overload protection. Provide a manual disconnect switch inside cabinet.

Provide ducted units with air inlet and outlet duct collars.

Provide access doors in cabinet to allow maintenance of internal mechanical and electrical devices.

Provide concealed units with a galvanized steel cabinet.

Acoustically and thermally insulate all units with minimum 1/2" fiberglass insulation. Insulate drain pans with 1/2" fire retardant closed cell foam insulation.

Furnish each unit with filter rack and 1" MERV 8 panel filters.

PART 3 - EXECUTION

INSTALLATION

Install units in accordance with manufacturer's installation instructions.

Install branch water or steam/condensate piping to each unit with a minimum of three elbows to allow for expansion and contraction of the piping system.

Coordinate location of units with other trades to assure correct recess size for recessed units.

After installation, provide protective covers to prevent accumulation of dirt on units during balance of construction.

UNIT HEATERS

Suspend units from building structure and as high as possible to maintain headroom beneath units; supporting from piping systems will not be accepted.

Install a drain valve on the coil side of the shutoff valves for each hot water unit heater.

FAN COIL UNITS

Mount units in locations indicated on the drawings and as detailed. Support from roof structure with spring vibration isolators. Install a drain valve on the coil side of the shutoff valves for each hot and chilled water coil.

CONSTRUCTION VERIFICATION

Contractor is responsible for utilizing the construction verification checklists in accordance with the procedures defined for construction verification in Section 01 91 00.

FUNCTIONAL PERFORMANCE TESTING

Contractor is responsible for utilizing the functional performance test forms in accordance with the procedures defined for functional performance testing in Section 01 91 00.

END OF SECTION

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SECTION 26 05 00

COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

The electrical work included in all other divisions is the responsibility of the contractor performing the division 26 work unless noted otherwise.

SCOPE

The work under this section includes basic electrical requirements, which are applicable to all Division 26 sections. This section includes information common to two or more technical specification sections or items that are of a general nature, not conveniently fitting into other technical sections. Included are the following topics:

PART 1 - GENERAL

- Scope
- Related Work
- Reference Standards
- Regulatory Requirements
- Quality Assurance
- Continuity of Existing Services and Systems
- Protection of Finished Surfaces
- Approved Electrical Testing Laboratories
- Sleeves and Openings
- Sealing and Fire Stopping
- Intent
- Omissions
- Submittals
- Project/Site Conditions
- Work Sequence and Scheduling
- Work by Other Trades
- Offsite Storage
- Salvage Materials
- Certificates and Inspections
- Operating and Maintenance Data
- Record Drawings

PART 2 - PRODUCTS

- Identification
- Sealing and Fire Stopping

PART 3 - EXECUTION

- Concrete Work
- Cutting and Patching
- Building Access
- Equipment Access
- Coordination
- Sleeves and Openings
- Sealing and Fire Stopping
- Housekeeping and Clean Up
- Owner Training

RELATED WORK

Applicable provisions of Division 1 govern work under this Section.

Section 01 91 00 – Commissioning

Section 07 84 00 – Fire Stopping

REFERENCE STANDARDS

Abbreviations of standards organizations referenced in this and other sections are as follows:

ANSI	American National Standards Institute
ASTM	American Society for Testing and Materials
EPA	Environmental Protection Agency
ETL	Electrical Testing Laboratories, Inc.
IEEE	Institute of Electrical and Electronics Engineers
ISA	Instrument Society of America
NBS	National Bureau of Standards
NEC	National Electric Code
NEMA	National Electrical Manufacturers Association
NESC	National Electrical Safety Code
NFPA	National Fire Protection Association
UL	Underwriters Laboratories Inc.
DSPS	Wisconsin Department of Safety and Professional Services

REGULATORY REQUIREMENTS

All work and materials are to conform in every detail to applicable rules and requirements of the Wisconsin State Electrical Code (SPS 316), the National Electrical Code (NFPA 70), other applicable National Fire Protection Association codes, the National Electrical Safety Code, and present manufacturing standards (including NEMA).

All Division 26 work shall be done under the direction of a currently licensed State of Wisconsin Master Electrician.

QUALITY ASSURANCE

Where equipment or accessories are used which differ in arrangement, configuration, dimensions, ratings, or engineering parameters from those indicated on the contract documents, the contractor is responsible for all costs involved in integrating the equipment or accessories into the system and the assigned space, and for obtaining the performance from the system into which these items are placed.

Manufacturer references used herein are intended to establish a level of quality and performance requirements unless more explicit restrictions are stated to apply.

All materials shall be listed by and shall bear the label of an approved electrical testing laboratory. Where one of the approved electrical testing laboratories has an applicable system listing and label, the entire system shall be so labeled.

CONTINUITY OF EXISTING SERVICES AND SYSTEMS

No outages shall be permitted on existing systems except at the time and during the interval specified by the Owner. Any outage must be scheduled when the interruption causes the least interference with normal business routines. No extra costs will be paid to the Contractor for such outages which must occur outside of regular weekly working hours.

PROTECTION OF FINISHED SURFACES

Furnish one can of touch-up paint for each different color factory finish furnished by the Contractor. Deliver touch-up paint with other "loose and detachable parts" as covered in the General Requirements.

APPROVED ELECTRICAL TESTING LABORATORIES

The following laboratories are approved for providing electrical product safety testing and listing services as required in these specifications:

Underwriters Laboratories Inc.
Electrical Testing Laboratories, Inc.

SLEEVES AND OPENINGS

Refer to Division 1, General Requirements, Sleeves and Openings.

SEALING AND FIRE STOPPING

Sealing and fire stopping of sleeves/openings between conduits, cable trays, wireways, troughs, cablebus, busduct, etc. and the sleeve, structural or partition opening shall be the responsibility of the contractor whose work penetrates the opening. Provide all fire stopping of fire rated penetrations and sealing of smoke rated penetrations in compliance with section 07 84 00 Fire Stopping.

INTENT

The Contractor shall furnish and install all the necessary materials, apparatus, and devices to complete the electrical equipment and systems installation herein specified, except such parts as are specifically exempted herein.

If an item is either called for in the specifications or shown on the plans, it shall be considered sufficient for the inclusion of said item in this contract. If a conflict exists within the Specifications or exists within the Drawings, the Contractor shall furnish the item, system, or workmanship, which is the highest quality, largest, or most closely fits the project intent. Refer to the General Conditions of the Contract for further clarification.

It must be understood that the details and drawings are diagrammatic. The Contractor shall verify all dimensions at the site and be responsible for their accuracy.

All sizes as given are minimum except as noted.

Materials and labor shall be new (unless noted or stated otherwise), first class, and workmanlike, and shall be subject at all times to the A/E's inspections, tests and approval from the commencement until the acceptance of the completed work.

Whenever a particular manufacturer's product is named, it is intended to establish a level of quality and performance requirements unless more explicit restrictions are stated to apply.

OMISSIONS

No later than ten (10) days before bid opening, the Contractor shall call the attention of the A/E to any materials or apparatus the Contractor believes to be inadequate and to any necessary items of work omitted.

SUBMITTALS

Submit for all equipment and systems as indicated in the respective specification sections, marking each submittal with that specification section number. 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 the contract documents. Failure to do this may result in the submittal(s) being returned to the Contractor for correction and resubmission. Failing to follow these instructions does not relieve the Contractor from the requirement of meeting the project schedule.

On request from the A/E, the successful bidder shall furnish additional drawings, illustrations, catalog data, performance characteristics, etc.

Submittals shall be grouped to include complete submittals of related systems, products, and accessories in a single submittal. Mark dimensions and values in units to match those specified. Include wiring diagrams of electrically powered equipment.

The submittals must be approved before fabrication is authorized.

PROJECT/SITE CONDITIONS

Install Work in locations shown on drawings, unless prevented by project conditions.

Prepare drawings showing proposed rearrangement of work to meet project conditions, including changes to work specified in other sections. Obtain permission of Owner before proceeding.

Tools, materials and equipment shall be confined to areas designated by the Owner.

WORK SEQUENCE AND SCHEDULING

Install work in phases to accommodate user agency's occupancy requirements. During the construction period coordinate electrical schedule and operations with Owner's Construction Representative.

WORK BY OTHER TRADES

Every attempt has been made to indicate in this trade's specifications and drawings all work required of this Contractor. However, there may be additional specific paragraphs in other trade specifications and addenda, and additional notes on drawings for other trades which pertain to this trade's work, and thus those additional requirements are hereby made a part of these specifications and drawings.

Electrical details on drawings for equipment to be provided by others are based on preliminary design data only. This Contractor shall lay out the electrical work and shall be responsible for its correctness to match equipment actually provided by others.

SALVAGE MATERIALS

No materials removed from this project shall be reused unless specifically noted. All materials removed shall become the property of and shall be disposed of by the Contractor.

CERTIFICATES AND INSPECTIONS

Obtain and pay for all required State installation inspections in accordance with the Wisconsin Administrative Code. Deliver originals of these certificates to the Owner's Project Representative.

This contractor is responsible for coordination of electrical inspection.

OPERATION AND MAINTENANCE DATA

All operations and maintenance data shall comply with the submission and content requirements specified under section GENERAL REQUIREMENTS.

In addition to the general content specified under GENERAL REQUIREMENTS supply the following additional documentation:

1. Manufacturer's wiring diagrams for electrically powered equipment.

RECORD DRAWINGS

The Contractor shall maintain at least one copy each of the specifications and drawings on the job site at all times.

Daily records of changes and deviations from contract shall be recorded. Dimensions and elevations on the record drawings shall locate all buried or concealed piping, conduit, or similar items.

The daily record of changes shall be the responsibility of Contractor's field superintendent. No arbitrary mark-ups will be permitted.

At completion of the project, the Contractor shall submit the marked-up record drawings to the Architect/Engineer prior to final payment.

PART 2 - PRODUCTS

IDENTIFICATION

See Electrical section 26 05 53 – Identification for Electrical Systems.

SEALING AND FIRE STOPPING

FIRE AND/OR SMOKE RATED PENETRATIONS:

Provide all fire stopping of fire rated penetrations and sealing of smoke rated penetrations in compliance with section 07 84 00 “Fire Stopping”.

NON-RATED PENETRATIONS:

Conduit Penetrations:

At conduit and cable tray penetrations of non-rated interior partitions, floors and exterior walls above grade, use urethane caulk in annular space between conduit and sleeve, or the core drilled opening.

PART 3 - EXECUTION

CONCRETE WORK

The Division 3 Contractor will perform all cast-in-place concrete unless noted otherwise elsewhere. Provide all layout drawings, anchor bolts, metal shapes, and/or templates required to be cast into concrete or used to form concrete for the support of electrical equipment.

CUTTING AND PATCHING

Refer to Division 1, General Requirements, Cutting and Patching.

BUILDING ACCESS

Arrange for the necessary openings in the building to allow for admittance of all apparatus. When the building access was not previously arranged and must be provided by this contractor, restore any opening to its original condition after the apparatus has been brought into the building.

EQUIPMENT ACCESS

Install all piping, conduit, ductwork, and accessories to permit access to equipment for maintenance. Coordinate the exact location of wall and ceiling access panels and doors with the General Contractor, making sure that access is available for all equipment and specialties. Where access is required in plaster or drywall walls or ceilings, furnish the access doors to the General Contractor and reimburse the General Contractor for installation of those access doors.

COORDINATION

The Contractor shall cooperate with other trades and DFD in locating work in a proper manner. Should it be necessary to raise or lower or move longitudinally any part of the electrical work to better fit the general installation, such work shall be done at no extra cost to the DFD, provided such decision is reached prior to actual installation. The Contractor shall check location of electrical outlets with respect to other installations before installing.

The Contractor shall verify that all devices are compatible for the surfaces on which they will be used. This includes, but is not limited to light fixtures, panelboards, devices, etc. and recessed or semi-recessed heating units installed in/on architectural surfaces.

Coordinate all work with other contractors prior to installation. Any installed work that is not coordinated and that interferes with other contractor's work shall be removed or relocated at the installing contractor's expense.

SLEEVES AND OPENINGS

Conduit penetrations in new poured concrete horizontal construction requiring F and T rating: Form opening using hole form or core drill opening. Alternatively provide cast in place fire stopping devices/sleeves.

Conduit penetrations in new poured concrete horizontal construction requiring F rating but no T rating: Same as conduit penetrations in new poured concrete construction requiring F and T ratings except that schedule 40 steel pipe sleeves may also be used.

Conduit penetrations in new poured concrete horizontal construction that do not require F or T ratings: Provide schedule 40 steel pipe sleeve, form opening using hole form or core drill opening.

Conduit penetrations in existing concrete floors: Core drill openings.

Where penetrating conduit weight is supported by floor, provide manufactured product or structural bearing collar designed to carry load.

SEALING AND FIRE STOPPING

FIRE AND/OR SMOKE RATED PENETRATIONS:

Provide all fire stopping of fire rated penetrations and sealing of smoke rated penetrations in compliance with section 07 84 00 Fire Stopping.

NON-RATED PENETRATIONS:

At all interior walls and exterior walls, conduit penetrations are required to be sealed. Apply sealant to both sides of the penetration in such a manner that the annular space between the sleeve or cored opening and the conduit is completely blocked.

PENETRATIONS SUBJECT TO WATER INTRUSION:

For penetrations (both rated and non-rated) in floors subject to water intrusion or in rooms housing electrical equipment (but not within walls) provide one of the following:

- Conduit penetration where steel pipe sleeve is used extend steel sleeve 2" above the floor.
- Conduit penetration where cast in place fire stopping device/sleeve is used, extend device/sleeve 2" above the floor (provided it meets the device's UL listing).
- Conduit penetration where there is no steel sleeve or cast in place fire stopping device/sleeve, provide 2"x 2" x 1/8" galvanized steel angles fastened to floor surrounding the penetration or group of penetrations to prevent water from getting to penetration. Provide urethane caulk between angles and floor and fasten angles to floor minimum 8" on center. Seal corners water tight with urethane caulk.

Floors subject to water intrusion or rooms housing electrical equipment include the following locations:

- Mechanical/Plumbing Equipment Rooms
- Chemical/Hazardous Waste Storage
- Maintenance/Industrial Shops
- Electrical Equipment Rooms

Provide waterproof caulk sealant top coating on fire stopping system (or other approved means to protect the fire stopping system from water) in areas subject to wash down such as Food Service and Dish Washing Areas.

HOUSEKEEPING AND CLEAN UP

The Contractor shall clean up and remove from the premises, on a daily basis, all debris and rubbish resulting from its work and shall repair all damage to new and existing equipment resulting from its work. When job is complete, this Contractor shall remove all tools, excess material and equipment, etc., from the site.

OWNER TRAINING

All training provided for agency shall comply with the format, general content requirements and submission guidelines specified under Section 01 91 00.

Contractor to provide factory authorized representative and/or field personnel knowledgeable with the operations, maintenance and troubleshooting of the system and/or components defined within this section for a minimum period of 10 hours.

END OF SECTION

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SECTION 26 05 02

ELECTRICAL DEMOLITION FOR REMODELING

PART 1 - GENERAL

SCOPE

The project also includes disconnect and removal of selected existing power distribution equipment designated to be replaced. Included are the following topics:

PART 1 - GENERAL

Scope

Related Work

PART 2 - PRODUCTS

Materials and Equipment

PART 3 - EXECUTION

Examination

Preparation

Demolition and Extension of the Existing Electrical Work

RELATED WORK

Applicable provisions of Division 1 govern work under this Section.

PART 2 - PRODUCTS

MATERIALS AND EQUIPMENT

Materials and equipment for patching and extending work as specified in the individual Sections.

PART 3 - EXECUTION

EXAMINATION

Verify field measurements and circuiting arrangements as shown on Drawings.

Verify that abandoned wiring and equipment serve only abandoned facilities.

Demolition Drawings are based on casual field observation and/or existing record documents. Report discrepancies to the Architect/Engineer and Owner Field Representative before disturbing existing installation.

Beginning of demolition means installer accepts existing conditions.

PREPARATION

Disconnect electrical systems in walls, floors, and ceilings scheduled for removal.

Coordinate utility service outages with the Owner's Field Representative, and Architect/Engineer. Also, if applicable, coordinate utility service outages with the local Utility Company.

Provide temporary wiring and connections to maintain existing systems in service during construction. When work must be performed on energized equipment or circuits, use personnel experienced in such operations and follow the safe working practice requirements of NFPA 70E.

Existing Electrical Service: Maintain existing system in service until new system is complete and ready for service. Disable system only to make switchovers and connections. Obtain permission from the Owner's Representative at least 48 hours before partially or completely disabling system. Minimize outage duration. If required, make temporary connections to maintain service in areas adjacent to work area.

DEMOLITION AND EXTENSION OF EXISTING ELECTRICAL WORK

Demolish and extend existing electrical work to meet all requirements of these specifications.

If certain raceways and boxes are abandoned but not scheduled for removal, those items must be shown on the "As Built Drawings".

Remove, relocate, and extend existing installations to accommodate new construction.

Remove abandoned wiring to source of supply.

Provide revised typed circuit directory in panelboards that have circuits removed.

Remove exposed abandoned conduit. Cut conduit flush with walls and floors, and patch surfaces.

Disconnect abandoned outlets and remove devices. Remove abandoned outlets if conduit and wiring servicing them is abandoned and removed. Provide blank cover for abandoned outlets which are not removed.

Disconnect and remove abandoned distribution equipment.

Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.

Repair adjacent construction and finishes damaged during demolition and extension work.

Maintain access to existing electrical installations which remain active. Modify installation or provide access panel as appropriate.

Extend existing installations using materials and methods compatible with existing electrical installations, or as specified. This includes the extension of the circuit from the last active device to the next device in the system to be activated.

END OF SECTION

SECTION 26 05 04

CLEANING, INSPECTION, AND TESTING OF ELECTRICAL EQUIPMENT

PART 1 - GENERAL

SCOPE

The work under this section includes the required cleaning, repair, adjustment, calibration, maintenance and testing of electrical equipment, as specified herein. This applies only to new electrical and existing electrical equipment being furnished, modified, worked on or serviced by this contractor for this project. Included are the following topics:

PART 1 - GENERAL

Scope
Related Work

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

General Inspection and Cleaning of All Equipment
Grounding Systems
Ground Fault Systems
Switchboards (Low voltage)
Panelboards
Motor Starters and Motor Control Centers
Cables
Manholes
Light Fixtures
Occupancy Sensors
Battery Pack Emergency Lighting

RELATED WORK

Applicable provisions of Division 1 govern work under this Section.

Section 01 91 00 – Commissioning Process

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

GENERAL INSPECTION AND CLEANING OF ALL ELECTRICAL EQUIPMENT

Inspect for physical damage and abnormal mechanical and electrical conditions.

Any item found to be out of tolerance, or in any other way defective as a result of the required inspection or testing, shall be reported to the Owner. Procedure for repair and/or replacement will be outlined. After appropriate corrective action is completed the item shall be re-tested.

Compare equipment nameplate information with the latest single line diagram and report any discrepancies.

Verify proper auxiliary device operation and indicators.

Check tightness of accessible bolted electrical joints. Use torque wrench method.

Make a close examination of equipment and remove any shipping brackets, insulation, packing, etc. that may not have been removed during original installation.

Make a close examination of equipment and remove any dirt or other forms of debris that may have collected in existing equipment or in new equipment during installation.

Clean All Equipment:

Vacuum inside of panelboards, switchboards, switchgear, transformer core and coils, bus ducts, MCC's, fire alarm panels, communication/data panels, security panels, etc.

Loosen attached particles and vacuum them away.

Wipe all insulators with a clean, dry, lint free rag.

Clean insulator grooves.

Inspect equipment anchorage.

Inspect equipment and bus alignment.

Check all heater elements for operation and control.

Lubricate nonelectrical equipment per manufacturer's recommendations.

GROUNDING SYSTEMS

Inspect the ground system for adequate termination at all devices.

GROUND FAULT SYSTEMS

Inspect for physical damage.

Inspect the neutral main bonding connection to assure:

Zero sequence system is grounded upstream of sensor.

Ground strap systems are grounded downstream from the sensing device.

Ground connection is made ahead of the neutral disconnect link.

SWITCHBOARDS (LOW VOLTAGE)

Visual and Mechanical Inspection:

Inspect for physical, electrical and mechanical conditions. Re-torque all bolted connections.

Compare equipment nameplate information with latest single line diagram and report discrepancies.

Inspect for proper alignment, anchorage and grounding

All doors, panels and sections shall be inspected for paint, dents, scratches, and fit.

Inspect cleanliness

Clean switchboard enclosure using the following methods:

Loosen attached particles and vacuum them away.

Wipe all porcelain with a clean, dry, lint-free rag.

Clean all insulator grooves.

Vacuum inside of switchgear enclosure

Lubricate per manufacturer's recommendations.

All active components shall be exercised and cleaned where possible.

All indicating devices shall be inspected for proper operation.

PANELBOARDS

Torque all the connections per the manufacturers spec. Verify phase wires, color coding, separate neutral and mechanical bonding. Verify circuit breaker operation. Verify the directory.

MOTOR STARTERS AND MOTOR CONTROL CENTERS

Verify the control circuits. Confirm the fusing and the grounding of the control transformers. Torque all of the connections. Confirm the overload elements and the circuit breakers (fuse) for proper sizing. Verify all grounding. Operate and test each motor starter for proper operation.

CABLES

600 Volt cable:

Visually inspect cables, lugs, connectors and all other components for physical damage and proper connections.

Check all cable connectors for tightness (with a torque wrench) and clearances. Torque test conductor terminations to manufacturer's recommendations.

Perform a 1000 Vdc megger test on all secondary cables from the substation transformers to the secondary switchboards and on all switchboard feeders.

LIGHT FIXTURES

Check the bonding and proper lamping. Verify that recessed fixtures are installed with hold down clips. Confirm operation of the fixture with the proper switch or sensor.

OCCUPANCY SENSORS

Confirm operation of the sensor per the manufacturers spec.

BATTERY PACK EMERGENCY LIGHTING

Verify the operation per the manufacturers spec and run all of the diagnostic steps. Confirm proper grounding and location.

END OF SECTION

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SECTION 26 05 19

LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLE

PART 1 - GENERAL

SCOPE

The work under this section includes furnishing and installing required wiring and cabling systems including pulling, terminating and splicing. Included are the following topics:

PART 1 - GENERAL

- Scope
- Related Work
- References
- Submittals
- Project Conditions

PART 2 - PRODUCTS

- General
- Building Wire
- Service Entrance Conductors
- Aboveground Wire for Exterior Work
- Underground Wire for Exterior Work
- Wiring Connectors

PART 3 - EXECUTION

- General Wiring Methods
- Wiring Installation in Raceways
- Wiring Connections and Terminations
- Field Quality Control
- Wire Color
- Branch Circuits
- Construction Verification Items

RELATED WORK

Applicable provisions of Division 1 govern work under this Section.

Section 26 05 33 – Raceway and Boxes for Electrical Systems.

Section 26 05 53 – Identification for Electrical Systems.

Section 01 91 00 – Commissioning Process

REFERENCES

Wisconsin Administrative Code SPS 316 - Electrical

SUBMITTALS

Submit product data: Provide for each cable assembly type.

Submit factory test reports: Indicate procedures and values obtained.

Submit shop drawings for modular wiring system including layout of distribution devices, branch circuit conduit and cables, circuiting arrangement, and outlet devices.

Submit manufacturer's installation instructions. Indicate application conditions and limitations of use stipulated by product testing agency specified under Regulatory Requirements.

PROJECT CONDITIONS

Verify that field measurements are as shown on Drawings.

Conductor sizes are based on copper.

Wire and cable routing shown on Drawings is approximate unless dimensioned. Route wire and cable as required to meet project conditions.

Where wire and cable routing is not shown, and destination only is indicated, determine exact routing and lengths required.

PART 2 - PRODUCTS

GENERAL

All wire shall be new, delivered to the site in unbroken cartons and shall be less than one year old out of manufacturer's stock.

All conductors shall be copper. Aluminum conductors size #1/0 and larger may be substituted for copper and used for phase and neutral conductors for transformer feeders, switchboard feeders, and panelboard feeders. All ground conductors shall be copper.

Aluminum conductors shall not be used for serving individual motors, chillers, VFD's and motor controllers.

The following requirements shall be met when aluminum conductors are used:

Aluminum alloy conductors shall be compact stranded conductors of a recognized Aluminum Association 8000 Series aluminum alloy conductor material (AA-8000 series alloy).

It is the responsibility of the contractor to increase the size of the conduit, wire gutter, or enclosure, if necessary, to accommodate the aluminum conductors and meet allowable code requirements.

It is the responsibility of the contractor to increase the size of the aluminum conductor and associated termination lugs to match the ampacity of the copper conductor circuit shown on the Drawings.

The contractor shall submit a feeder schedule to the Engineer for all conductor substitutions indicating the aluminum conductor wire size and the conduit size. The contractor shall not begin the installation until written approval is granted by the Engineer.

All aluminum conductors shall terminate on a mechanical screw-type connector or mechanical compression-type connector. Connector shall be dual rated (AL7CU or AL9CU) and Listed by UL for use with aluminum and copper conductors, and sized to accept aluminum conductors of the required ampacity. When using compression-type connectors, the lugs shall be marked with wire size, die index, number and location of crimps and shall be suitably color-coded. Using a suitable stripping tool, remove insulation from the required length of the conductor. Wire brush the conductor and apply a Listed joint compound. Tighten or crimp the connection per the connector manufacturer's recommendation. Wipe off any excess joint compound.

When terminating aluminum conductors to aluminum bus, prepare a mechanical screw-type or compression-type connection. Bolts shall be anodized alloy and conform to current ANSI and ASTM chemical and mechanical property limits. Nuts shall be aluminum alloy and conform to current ANSI standards. Washers shall be flat aluminum alloy, Type A plain, standard wide series conforming to current ANSI standards. Lubricate and tighten the hardware per manufacturer's recommendations.

When terminating aluminum conductors to copper bus, prepare a mechanical screw-type or compression-type connection. Bolts shall be plated or galvanized medium carbon steel; heat treated, quenched and tempered equal to current ASTM standard or SAE grade 5. Nuts shall conform to current ANSI standards. Washers shall be steel, Type A plain, standard wide series conforming to current ANSI standards. Belleville conical spring washers shall be of hardened steel, cadmium plated or silicone bronze. Lubricate and tighten the hardware per manufacturer's recommendations.

The final tightening torque shall be recorded for all aluminum conductor mechanical screw-type connections and provided in report form, in the completed O&M manuals.

The contractor shall perform an infrared survey of all aluminum conductor connections after the installation is complete and in normal service. Infrared surveys shall be performed during periods of maximum possible loading with at least 30% of rated load of the equipment being inspected. All connections with elevated temperatures shall be corrected by the contractor. The infrared survey results shall be provided in report form, in the completed O&M manuals.

No copper-to-aluminum transitions permitted when splicing onto existing copper feeders.

Insulation shall have a 600 volt rating.

All conductors shall be stranded.

Stranded conductors may only be terminated with UL OR ETL Listed type terminations or methods: e.g. stranded conductors may not be wrapped around a terminal screw but must be terminated with a crimp type device or must be terminated in an approved back wired method.

BUILDING WIRE

Description: Single conductor insulated wire 90 degree C.

Insulation: Type THHN/THWN-2, XHHW-2 insulation.

SERVICE ENTRANCE CONDUCTORS

Description: Single conductor or multi-conductor insulated wire. 90 degree C sized at the 75 degree C table.

Insulation: Type USE-2, XHHW-2 insulation for service entrance conductors routed from exterior source to exterior termination location.

Type XHHW-2 insulation for services entrance conductors routed from exterior source to interior termination location.

ABOVE GROUND WIRE FOR EXTERIOR WORK

Description: Single conductor insulated wire, 90 degree C.

Insulation: Type THHN/THWN-2, XHHW-2 insulation.

UNDERGROUND WIRE FOR EXTERIOR WORK

Description: Stranded single or multiple conductor insulated wire, 90 degree C.

Insulation: Type USE-2, XHHW-2, RHW-2 insulation.

This wiring shall be used in all underground feeder and branch circuit applications, except THHN/THWN-2 is permitted when run in a concrete-encased ductbank.

WIRING CONNECTORS

Split Bolt Connectors: Not acceptable.

Solderless Pressure Connectors: High copper alloy terminal. May be used only for cable termination to equipment terminals. Not approved for splicing.

Twist Type Wire Connectors: Solderless twist type spring connector (wire-nut) with insulating cover for copper wire splices and taps. Use for conductor sizes 10 AWG and smaller. The manufacturer's wire fill capacity must be followed.

All wire connectors used in underground or exterior pull boxes or hand holes shall be gel filled twist connectors or a connector designed for damp and wet locations. Gel filled twist type connectors can be used for copper conductor sizes 6 AWG and smaller for site lighting applications. The manufacturer's wire fill capacity must be followed.

Mechanical Connectors: Bolted type tin-plated; high conductivity copper alloy; spacer between conductors; beveled cable entrances.

Compression (crimp) Connectors: Long barrel; seamless, tin-plated electrolytic copper tubing; internally beveled barrel ends. Connector shall be clearly marked with the wire size and type and proper number and location of crimps. Connector must be installed with a crimper tool listed for use with the manufacturer and type of compression connector.

Insulation Piercing Connectors: Molded insulated body, copper teeth, wrench tightened, UL 486B Listed. May be used only for connection of a tap conductor in run and tap type applications when main conductor is 8 AWG and larger.

PART 3 - EXECUTION

GENERAL WIRING METHODS

All wire and cable shall be installed in conduit.

Do not use wire smaller than 12 AWG for power and lighting circuits.

All phase, neutral and ground conductors shall be sized to prevent excessive voltage drop at rated circuit ampacity. As a minimum use 10 AWG conductors for 20 ampere, 120 volt branch circuit home runs longer than 100 feet (30 m), and for 20 ampere, 277 volt branch circuit home runs longer than 200 feet (61 m).

Make conductor lengths for parallel conductors equal.

Splice only in junction or outlet boxes.

No conductor less than 10 AWG shall be installed in exterior underground conduit.

Identify ALL low voltage wire, 600V and lower, per section 26 05 53.

Neatly train and lace wiring inside boxes, equipment, and panelboards.

WIRING INSTALLATION IN RACEWAYS

Pull all conductors into a raceway at the same time. Use Listed water or silicone based wire pulling lubricant for pulling 4 AWG and larger wires and for other conditions when necessary. Wax based lubricants are not allowed. Pulling lubricant is not required for low friction type products where the cable manufacturer recommends that cables be pulled without lube.

Install wire in raceway after interior of building has been physically protected from the weather and all mechanical work likely to injure conductors has been completed.

Completely and thoroughly swab raceway system before installing conductors.

Place all conductors of a given circuit (this includes phase wires, neutral (if any), and ground conductor) in the same raceway. If parallel phase and/or neutral wires are used, then place an equal number of phase and neutral conductors in same raceway or cable.

In high ambient spaces, mechanical rooms, utility rooms and exterior exposed conduit, 90 degree C conductors shall be utilized.

WIRING CONNECTIONS AND TERMINATIONS

Splice only in accessible junction boxes.

Wire splices and taps shall be made firm, and adequate to carry the full current rating of the respective wire without soldering and without perceptible temperature rise.

All splices shall be so made that they have an electrical resistance not in excess of two feet (600 mm) of the conductor.

Use solderless twist type spring connectors (wire nuts) with insulating covers for wire splices and taps, 10 AWG and smaller.

Use mechanical or compression connectors for wire splices and taps, 8 AWG and larger. Tape uninsulated conductors and connectors with electrical tape to 150 percent of the insulation value of the wiring.

Thoroughly clean wires before installing lugs and connectors.

At all splices and terminations, leave tails long enough to cut splice out and completely re-splice.

FIELD QUALITY CONTROL

Field inspection and testing will be performed under provisions of Section 26 05 04.

Additional testing as follows shall be performed if aluminum conductors are used:

Feeders terminated with aluminum conductors shall be tested with a thermal imager and recorded.

Conductors shall be closely checked for loose or poor connections, and for signs of overheating or corrosion.

Test procedures shall meet NETA guidelines.

Test results and report shall be provided to the engineer and included in O&M manual under AL conductors/ tests.

Contractor shall correct all deficiencies reported in the test report.

WIRE COLOR

General:

Solid colored insulation is required for all THHN/THWN-2 wire. For other wire types use colored wire or identify wire with colored tape at all terminals, splices and boxes. Wire shall be colored as indicated below.

In existing facilities, use existing color scheme.

In new facilities, use black and red for single phase circuits at 120/240 volts, use Phase A black, Phase B red and Phase C blue for circuits at 120/208 volts single or three phase, and use Phase A

brown, Phase B orange and Phase C yellow for circuits at 277/480 volts single or three phase. Note: This includes fixture whips except for Listed whips mounted by the fixture manufacturer on the fixture and Listed as a System.

Switch legs shall be the same color as their associated circuit, except for the second switch leg used for dual-level switching. The second switch leg shall be the next phase color, e.g. if the first switch leg is brown (277/480V phase A), the second switch leg shall be orange (277/480V phase B).

Traveler conductors run between 3 and 4 way switches shall be colored pink or purple.

Neutral Conductors: White for 120/208V and 120/240V systems, Gray for 277/480V systems. Where there are two or more neutrals in one conduit, each shall be individually identified with a different stripe.

Branch Circuit Conductors: Three or four wire home runs shall have each phase uniquely color coded.

Feeder Circuit Conductors: Each phase shall be uniquely color coded.

Ground Conductors: Green colored insulation for THHN/THWN-2 wire. For other wire types use green colored wire or identify wire with green tape at both ends and at all access points, such as panelboards, motor starters, disconnects and junction boxes. When isolated grounds are required, contractor shall provide green with yellow tracer.

BRANCH CIRCUITS

The use of single-phase, multi-wire branch circuits with a common neutral is not permitted. All single-phase branch circuits shall be furnished and installed with an individual accompanying neutral, sized the same as the phase conductors.

CONSTRUCTION VERIFICATION

Contractor is responsible for utilizing the construction verification checklists supplied under specification Section 26 08 00 in accordance with the procedures defined for construction verification in Section 01 91 00.

END OF SECTION

SECTION 26 05 26

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

SCOPE

The work under this section includes grounding electrodes and conductors, equipment grounding conductors, and bonding. Included are the following topics:

PART 1 - GENERAL

- Scope
- Related Work
- References
- Performance Requirements
- Submittals
- Project Record Documents
- Regulatory Requirements

PART 2 - PRODUCTS

- Rod Electrode
- Concrete-Encased Grounding Electrode
- Mechanical Connectors
- Compression Connectors
- Exothermic Connections
- Conductors

PART 3 - EXECUTION

- Examination
- General
- Less Than 600 Volt System Grounding
- Field Quality Control
- Identification and Labeling

All hardware, cables and related termination and support hardware shall be furnished, installed, wired, tested, labeled, and documented by the Contractor, as detailed in this and related sections.

RELATED WORK

Applicable provisions of Division 1 govern work under this Section.

Section 26 08 00 - Commissioning of Electrical.

Section 01 91 00 - Commissioning Process

REFERENCES

Wisconsin Administrative Code SPS 316 - Electrical

ANSI/IEEE 142 (Latest edition) - Recommended Practice for Grounding of Industrial and Commercial Power Systems

UL 467 Electrical Grounding and Bonding Equipment

IEEE 837 - IEEE Standard for Qualifying Permanent Connections Used in Substation Grounding

ANSI J-STD-607-B - Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications

TIA/EIA-606-A - Administration Standard for Commercial Telecommunications Infrastructure

PERFORMANCE REQUIREMENTS

Grounding System Resistance:

- Equipment Rated 500 KVA and Less: 10 ohms maximum at building service entrance.
- Equipment Rated 500 to 1000 KVA: 5 ohms maximum at building service entrance.
- Equipment Rated more than 1000 KVA: 3 ohms building service entrance.
- Communications Busbars: 5 ohms maximum.

Testing of grounding system resistance is to be witnessed by the Owner's Field Representative. Provide test report of grounding system resistance in final O&M manuals.

SUBMITTALS

Product Data: Provide data for grounding electrodes and connections.

Test Reports: Indicate overall resistance to ground.

Manufacturer's Instructions: Include instructions for preparation, installation and examination of exothermic connectors.

PROJECT RECORD DOCUMENTS

Accurately record locations of all ground rods and other grounding electrodes.

REGULATORY REQUIREMENTS

Conform to requirements of NFPA 70.

Furnish products listed and classified by Underwriters Laboratories, Inc. or testing firm acceptable to authority having jurisdiction as suitable for purpose specified and shown.

PART 2 - PRODUCTS

ROD ELECTRODE

Material: Copper-clad steel.

Diameter: 3/4 inch (19 mm) minimum.

Length: 10 feet (3.5 m) minimum. Rod shall be driven at least 9' 6" deep.

CONCRETE-ENCASED GROUNDING ELECTRODE FOR POLE BASES

Fabricate per NFPA 70, Article 250.52 (A)(3) using 20 feet (6m) of bare copper wire not smaller than #4 AWG. If concrete foundation is less than 20 feet (6m) long, coil excess conductor within the base of the foundation. Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts.

MECHANICAL CONNECTORS

The mechanical connector bodies shall be manufactured from high strength, high conductivity cast copper alloy material. Bolts, nuts, washers and lock washers shall be made of Silicon Bronze and supplied as a part of the connector body and shall be of the two bolt type.

Split bolt connector types are NOT allowed. Exception: the use of split bolts is acceptable for grounding of wire-basket type cable tray, and for cable shields/straps of medium voltage cable.

The connectors shall meet or exceed UL 467 and be clearly marked with the catalog number, conductor size and manufacturer.

COMPRESSION CONNECTORS

The compression connectors shall be manufactured from pure wrought copper. The conductivity of this material shall be no less than 99% by IACS standards.

Each connector shall be factory filled with an oxide-inhibiting compound.

The connectors shall meet or exceed the performance requirements of IEEE 837, latest revision.

The connectors shall be clearly marked with the manufacturer, catalog number, conductor size and the required compression tool settings.

The installation of the connectors shall be made with a compression tool and die system, as recommended by the manufacturer of the connectors, and shall be irreversible.

Pre-crimping of the ground rod is required for all irreversible compression connections to a ground rod.

Terminal lug for communication system grounding shall be compression type and conform to the following:

Material: Tin Plated Copper (aluminum not permitted).

Wire Size: to match conductor

Number of Stud Holes: 2

Stud Hole Size: 3/8"

Bolt Hole Spacing: per ANSI Joint Standard J-STD-607-A

Tongue Angle: Straight

EXOTHERMIC CONNECTIONS

As manufactured by Cadweld or similar.

CONDUCTORS

Material: Stranded copper (aluminum not permitted).

Grounding Electrode Conductor: Size as shown on drawings, specifications or as required by NFPA 70, whichever is larger.

Feeder and Branch Circuit Equipment Ground: Size as shown on drawings, specifications or as required by NFPA 70, whichever is larger. Differentiate between the normal ground and the isolated ground when both are used at the same facility.

Branch Circuit Equipment Grounds shall be increased in size when routed with phase conductors increased in size due to voltage drop calculations.

BUS/BUSBAR

Material: Copper (aluminum not permitted).

Size:

All Power systems: 1/4" X 2", length as needed (24" minimum).

Telecommunications Main Ground Busbar (TMGB): 1/4" x 4" x 20" long (minimum).

Telecommunications Grounding Busbar (TGB): 1/4" x 2" x 12" long (minimum).

PART 3 - EXECUTION

EXAMINATION

Verify that final backfill and compaction has been completed before driving rod electrodes.

GENERAL

Install Products in accordance with manufacturer's instructions.

Mechanical connections shall be accessible for inspection and checking. No insulation shall be installed over mechanical ground connections.

Ground connection surfaces shall be cleaned and all connections shall be made so that it is impossible to move them.

Attach grounds permanently before permanent building service is energized.

Terminate each grounding conductor on its own terminal lug. Sharing a single lug by multiple conductors is not allowed.

All grounding electrode conductors and individual grounding conductors shall be installed in PVC conduit, in exposed locations.

LESS THAN 600 VOLT ELECTRICAL SYSTEM GROUNDING

Supplementary Grounding Electrode: Use effectively grounded metal frame of the building.

Provide code sized copper grounding electrode conductor from electrical room ground bus to secondary switchboard ground bus, each separately derived system neutral, secondary service system neutral to street side of water meter, building steel, ground rod, and any concrete encased electrodes. Provide bonding jumper around water meter.

Equipment Grounding Conductor: Provide separate, insulated equipment grounding conductor within each raceway. Terminate each end on suitable lug, bus, enclosure or bushing. Provide a ground wire from each device to the respective enclosure.

Bond together system neutrals, service equipment enclosures, exposed non-current carrying metal parts of electrical equipment, metal raceway systems, grounding conductor in raceways and cables, receptacle ground connectors, and plumbing systems.

FIELD QUALITY CONTROL

Inspect grounding and bonding system conductors and connections for tightness and proper installation.

Testing of grounding system resistance is to be witnessed by the DSF electrical inspector or Field Representative. Provide test report of grounding system resistance in final O&M manuals.

IDENTIFICATION AND LABELING

Label Grounds at point of termination.

CONSTRUCTION VERIFICATION

Contractor is responsible for utilizing the construction verification checklists supplied under specification Section 26 08 00 in accordance with the procedures defined for construction verification in Section 01 91 00.

END OF SECTION

SECTION 26 05 29

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

SCOPE

The work under this sections includes conduit and equipment supports, straps, clamps, steel channel, etc., and fastening hardware for supporting electrical work. Included are the following topics:

PART 1 - GENERAL

- Scope
- Related Work
- Submittals
- Quality Assurance

PART 2 - PRODUCTS

- Material

PART 3 - EXECUTION

- Installation

RELATED WORK

Applicable provisions of Division 1 govern work under this Section.

Section 01 91 00 – Commissioning Process

Section 26 05 53 – Identification for Electrical Systems

SUBMITTALS

Product Data: Provide data for support channel.

QUALITY ASSURANCE

Support systems shall be adequate for weight of equipment and conduit, including wiring, which they carry.

PART 2 - PRODUCTS

MATERIAL

Support Channel: Steel, Galvanized, Enameled or other corrosion resistant.

Hardware: Corrosion resistant.

Minimum sized threaded rod for supports shall be 3/8" for trapezes and single conduits 1-1/4" and larger, and 1/4" for single conduits 1" and smaller.

Conduit clamps, straps, supports, etc., shall be steel or malleable iron. One-hole straps shall be heavy duty type. All straps shall have steel or malleable backing plates when rigid steel conduit is installed on the interior or exterior surface of any exterior building wall.

PART 3 - EXECUTION

INSTALLATION

Fasten hanger rods, conduit clamps, outlet, junction and pull boxes to building structure using pre-cast insert system, preset inserts, beam clamps, expansion anchors, or spring steel clips (interior metal stud walls only).

Use toggle bolts or hollow wall fasteners in hollow masonry, plaster, or gypsum board partitions and walls; expansion anchors or preset inserts in solid masonry walls; self-drilling anchors or expansion anchors on concrete surfaces; sheet metal screws in sheet metal studs and wood screws in wood construction. If nail-in anchors are used, they must be removable type anchors.

Powder-actuated fasteners are not permitted. Compressed-air power-actuated fasteners may ONLY be used for the installation of separate ceiling wires required for support of conduits and aircraft cable hung light fixtures.

File and de-bur cut ends of support channel and spray paint with cold galvanized paint to prevent rusting.

Do not fasten supports to piping, ductwork, mechanical equipment, cable tray or conduit. Do not fasten to suspended ceiling grid system.

Support wires that are installed in addition to the ceiling grid support wires to provide secure support for raceways, cables assemblies, boxes, cabinets, and fittings shall be secured at both ends (e.g. the ceiling structure at the top and the ceiling grid at the bottom) per NEC 300.11(A).

Support wires shall be identified per specification section 26 05 53.

Do not drill structural steel members unless approved by A/E.

Fabricate supports from galvanized structural steel or steel channel, rigidly welded or bolted to present a neat appearance. Use hexagon head bolts with spring lock washers under all nuts.

In wet locations, mechanical rooms, and electrical rooms, install free-standing electrical equipment on 3.5-inch (89 mm) concrete pads.

Install surface-mounted cabinets and panelboards with a minimum of four anchors. At all cabinet and panelboard locations on concrete or concrete block walls, and at ALL locations below grade, provide steel channel supports to stand cabinet one inch (25 mm) off wall (7/8" Uni-strut or 3/4" painted fire-retardant plywood is acceptable). In above-grade equipment rooms that have drywall walls, the cabinets and panelboards may be mounted to the drywall if backing is provided in the stud walls behind the equipment.

Bridge studs top and bottom with channels to support flush-mounted cabinets and panelboards in stud walls.

Furnish and install all supports as required to fasten all electrical components required for the project, including free standing supports required for those items remotely mounted from the building structure, catwalks, walkways etc.

END OF SECTION

SECTION 26 05 33

RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

SCOPE

This section describes the products and execution requirements relating to furnishing and installing raceways and boxes and related systems as part of a raceway system for electrical, communications, and other low-voltage systems for the project. Included are the following topics:

PART 1 - GENERAL

- Scope
- Related Work
- References
- Submittals

PART 2 - PRODUCTS

- General
 - Rigid Metal Conduit (RMC) and Fittings
 - Intermediate Metal Conduit (IMC) and Fittings
 - Electrical Metallic Tubing (EMT) and Fittings
 - Flexible Metal Conduit (FMC) and Fittings
 - Liquidtight Flexible Metal Conduit (LFMC) and Fittings
 - Rigid Polyvinyl Chloride Conduit (PVC) and Fittings
 - Conduit Supports
 - Conduit Water Sealant
 - Pull and Junction Boxes
 - In Grade Handholes and Boxes
 - Outlet Boxes
 - Outlet Box Extenders
 - Boxes for Fire Alarm Audio-Visual Notification Appliances

PART 3 - EXECUTION

- Conduit Sizing, Arrangement, and Support
- Conduit Installation
- Conduit Installation Schedule
- PVC Coated Rigid Metal Conduit Installation
- Coordination of Box Locations
- Pull and Junction Box Installation
- In Grade Handholes and Boxes
- Outlet Box Installation
- Construction Verification Items

RELATED WORK

Applicable provisions of Division 1 govern work under this section.

- Section 01 91 00 – Commissioning Process
- Section 26 05 26 – Grounding and Bonding for Electrical Systems
- Section 26 05 29 – Hangers and Supports for Electrical Systems.
- Section 26 27 02 – Equipment Wiring Systems.
- Section 26 27 26 – Wiring Devices.

REFERENCES

Wisconsin Administrative Code SPS 316 - Electrical

SUBMITTALS

Surface Raceway System - submit product data and catalog sheets for all components.

Boxes - provide product data showing configurations, finishes, dimensions, and manufacturer's instructions.

Conduits in Concrete Slabs Above Grade - provide proposed conduit routing and sizing to Structural Engineer prior to approval of installation to verify structural integrity and fire rating of concrete slab.

PART 2 - PRODUCTS

GENERAL

All steel fittings and conduit bodies shall be galvanized.

No cast metal or split-gland type fittings permitted.

Mogul-type condulets larger than 2 inch (50 mm) not permitted except as approved or detailed.

All conduit covers must be fastened to the conduit body with screws and be of the same manufacture.

C-condulets shall not be used in lieu of pull boxes.

All boxes shall be of sufficient size to provide free space for all conductors enclosed in the box and shall comply with NEC requirements.

RIGID METAL CONDUIT (RMC) AND FITTINGS

Conduit: Heavy wall threaded, galvanized steel, schedule 40.

Fittings and Conduit Bodies: Use all steel threaded fittings and conduit bodies.

Expansion Fittings/Expansion Joints: Expansion Fittings shall be Internal Grounding type and shall not rely on external bonding jumpers to maintain grounding continuity between raceway components.

INTERMEDIATE METAL CONDUIT (IMC) AND FITTINGS

Conduit: Galvanized steel, threaded.

Fittings and Conduit Bodies: Use all steel threaded fittings and conduit bodies.

Expansion Fittings/Expansion Joints: Expansion Fittings shall be Internal Grounding type and shall not rely on external bonding jumpers to maintain grounding continuity between raceway components.

ELECTRICAL METALLIC TUBING (EMT) AND FITTINGS

Conduit: Steel, galvanized tubing.

Fittings: All steel, set screw type. No push-on or indenter types permitted.

Conduit Bodies: All steel threaded conduit bodies.

FLEXIBLE METAL CONDUIT (FMC) AND FITTINGS

Conduit: steel, galvanized, spiral strip.

Fittings and Conduit Bodies: All steel, galvanized, or malleable iron (except as allowed in specification 26 51 13).

LIQUIDTIGHT FLEXIBLE METAL CONDUIT (LFMC) AND FITTINGS

Conduit: flexible, steel, galvanized, spiral strip with an outer Liquidtight, nonmetallic, sunlight-resistant jacket.

Fittings and Conduit Bodies: ANSI/NEMA FB 1, compression type. There shall be a metallic cover/insert on the end of the conduit inside the connector housing to seal the cut conduit end.

RIGID POLYVINYL CHLORIDE CONDUIT (PVC) AND FITTINGS

Conduit: Rigid non-metallic conduit, Schedule 40 PVC minimum, Listed, sunlight resistant, rated for 90° C conductors. Schedule 80 for locations exposed to physical damage or as required.

Fittings and Conduit Bodies: NEMA TC 2, Listed.

CONDUIT SUPPORTS

See section 26 05 29.

CONDUIT WATER SEALANT

Description: Conduit sealant used to prevent water from entering buildings via conduits.

Sealant shall seal conduits against water and gas intrusion, such as Polywater® FST™-250 Foam Duct Sealant, Raychem RDSS Rayflute Duct Sealing System, or approved alternate. Sealant shall be re-enterable, shall be compatible with the conduit and conductor types being used, and shall comply with NEC 225.27, 230.8, and 300.5(G).

Manufacturer names and catalog numbers are used to develop quality and performance requirements only. Products manufactured by others may be acceptable provided they meet or exceed the specifications.

PULL AND JUNCTION BOXES

Interior Sheet Metal Boxes: code gauge galvanized steel, screw covers, flanged and spot welded joints and corners.

Interior Sheet Metal Boxes larger than 12 inches (300 mm) in any dimension shall have a hinged cover or a chain installed between box and cover.

Exterior Boxes and Wet Location Installations: Type 4 and Type 6, flat-flanged, surface-mounted junction box, UL listed as rain-tight. Galvanized cast iron] box and cover with ground flange, neoprene gasket, and stainless steel cover screws.

Box extensions and adjacent boxes within 48 inches of each other are not allowed for the purpose of creating more wire capacity.

Junction boxes 6 inch-by-6 inch or larger size shall be without stamped knock-outs.

Wireways shall not be used in lieu of junction boxes.

IN GRADE HANDHOLES AND BOXES

Handholes and boxes for use in underground systems shall be designed and identified as defined in NFPA 70, for intended location and application.

Handholes and covers shall be listed for the structural load at the identified installation location.

Covers: Weatherproof, secured by tamper-resistant locking devices with non-skid finish and labeled "ELECTRIC", "SIGNAL", "CATV" OR "TELEPHONE" dependent on system served.

Units shall be designed to prevent frost heaving.

OUTLET BOXES

Sheet Metal Outlet Boxes: galvanized steel, with stamped knockouts.

Luminaire and Equipment Supporting Boxes: Rated for weight of equipment supported; include 3/8 inch male fixture studs where required.

Concrete Ceiling Boxes: Concrete type.

Cast Boxes: Cast ferroalloy or aluminum, deep type, gasketed cover, threaded hubs.

OUTLET BOX EXTENDERS

Outlet Box Extenders: Non Metallic, adjustable depth.

BOXES FOR FIRE ALARM AUDIO-VISUAL NOTIFICATION APPLIANCES

Recessed boxes for Fire Alarm audio, visual, and audio-visual notification appliances shall be galvanized steel sheet metal with stamped knockouts. Boxes shall be 4 inches square (100 mm) by 2 1/8 inches (54 mm) deep, and shall be painted red.

For surface mounting, use manufacturer supplied back boxes and trim plates, painted red or off white, and shall contain no visible conduit knock-outs. Mark each device with its circuit number.

PART 3 - EXECUTION

CONDUIT SIZING, ARRANGEMENT, AND SUPPORT

EMT is permitted to be used in sizes 4 inch (100 mm) and smaller for power and low-voltage systems. See CONDUIT INSTALLATION SCHEDULE below for other limitations for EMT and other types of conduit.

Size power conductor raceways for conductor type installed. Conduit size shall be 1/2 inch (16 mm) minimum except all homerun conduits shall be 3/4 inch (21 mm), or as specified elsewhere. Caution: Per the NEC, the allowable conductor ampacity is reduced when more than three current-carrying conductors are installed in a raceway. Contractor must take the NEC ampacity adjustment factors into account when sizing the raceway and wiring system.

Size communications and other low-voltage systems raceways as follows:

Communications, including Outlet Box: 1 inch minimum. Conduit used for single device locations (e.g. Wireless Access Point, Video Surveillance Camera, and Wall mounted telephone) may be 3/4 inch minimum.

Control, security, signal, video, and other low-voltage applications: 3/4 inch minimum.

Fire Alarm: 1/2 inch minimum.

Arrange conduit to maintain 6'-8" clear headroom and present a neat appearance.

Route exposed conduit and conduit above accessible ceilings parallel and perpendicular to walls and adjacent piping.

Maintain minimum 6 inch (150 mm) clearance between conduit and piping. Maintain 12 inch (300 mm) clearance between conduit and heat sources such as flues, steam pipes, and heating appliances.

Arrange conduit supports to prevent distortion of alignment by wire pulling operations. Fasten conduit using galvanized pipe straps, conduit racks (lay-in adjustable hangers), clevis hangers, or bolted split stamped galvanized hangers.

Group conduit in parallel runs where practical and use conduit rack (lay-in adjustable hangers) constructed of steel channel with conduit straps or clamps. Provide space for 25 percent additional conduit.

Do not fasten conduit with wire or perforated pipe straps. Before conductors are pulled, remove all wire used for temporary conduit support during construction.

Support and fasten metal conduit at a maximum of 8 feet (2.4 m) on center.

Supports shall be independent of the installations of other trades, e.g. ceiling support wires, HVAC pipes, other conduits, etc., unless so approved or detailed.

Conceal all conduits except where noted on the drawings or approved by the Architect/Engineer. Contractor shall verify with Architect/Engineer all surface conduit installations except in mechanical rooms.

Changes in direction shall be made with symmetrical bends, cast steel boxes, stamped metal boxes or cast steel conduit bodies.

For indoor conduits, no continuous conduit run shall exceed 100 feet (30 meters) without a junction box.

All conduits installed in exposed areas shall be installed with a box offset before entering box.

CONDUIT INSTALLATION

Cut conduit square; de-burr cut ends.

Conduit shall not be fastened to the corrugated metal roof deck.

Bring conduit to the shoulder of fittings and couplings and fasten securely.

Use conduit hubs for fastening conduit to cast boxes. Use sealing locknuts or conduit hubs for fastening conduit to sheet metal boxes in damp or wet locations.

Terminate all conduit (except for terminations into conduit bodies) using conduit hubs, or connectors with one locknut, or utilize double locknuts (one each side of box wall).

Provide bushings for the ends of all conduit not terminated in box walls. Refer to Section 26 05 26 – Grounding and Bonding for Electrical Systems for grounding bushing requirements.

Provide insulated bushings where raceways contain 4 AWG or larger conductors.

Install no more than the equivalent of:

Three 90 degree bends between boxes for electrical systems.

Two 90 degree bends between boxes for communications and other low voltage systems.

No single bend may exceed 90 degrees.

Use hydraulic one-shot conduit bender or factory elbows for bends in conduit larger than 2 inch (50 mm) size unless sweep elbows are required.

Bend conduit according to manufacturer's recommendations. Torches or open flame shall not be used to aid in bending of PVC conduit.

Use suitable conduit caps or other approved seals to protect installed conduit against entrance of dirt and moisture.

Provide 1/8 inch (3 mm) nylon pull string in empty conduit, except sleeves and nipples.

Install expansion-deflection joints where conduit crosses building expansion joints. Note: expansion-deflection joints are not required where conduit crosses building control joints if the control joint does not act as an expansion joint.

Install expansion joints where direct-buried conduit is subject to Earth Movement by settlement or frost per NEC 300.5(J), especially where conduit exits the ground exposed and enters a box, cabinet, or enclosure attached to a building or structure.

Install expansion fitting in exterior PVC conduit runs per NEC table 352.44 utilizing a minimum temperature change of 120 degree F.

Avoid moisture traps where possible. Where moisture traps are unavoidable, provide junction boxes with drain fittings at conduit low points.

Where conduit passes between areas of differing temperatures such as into or out of cool rooms, freezers, unheated and heated spaces, buildings, etc., provide conduit or box with duct seal or other means to prevent the passage of moisture and water vapor through the conduit.

Route conduit through roof openings for piping and ductwork where possible.

Where communication cabling is to be installed in conduit to the wiring hub (e.g. Telecom Room), multiple conduits may be consolidated into fewer, larger conduits. Capacity of shared conduits shall equal the capacity of the individual conduits unless otherwise noted.

Ground and bond conduit under provisions of Section 26 05 26.

Conduit is not permitted in any slab topping of two inches (50 mm) or less.

Conduits in Concrete Slab Above Grade: Provide proposed conduit routing and sizing to Structural Engineer for approval prior to installation to verify structural integrity and fire rating of concrete slab.

Maximum Size Conduit in Concrete Slabs Above Grade: 1 inch (25 mm). Do not route conduits to cross each other in slabs above grade. Minimum conduit spacing shall be 6 inches on center.

PVC conduit in concrete pole bases shall transition to galvanized rigid metal conduit 12 inches before it enters a concrete pole base. Inside the pole base, the elbow shall be galvanized rigid metal conduit. From the elbow, the conduit shall transition back to PVC as it continues up and out the top of the concrete pole base.

PVC conduit shall transition to galvanized rigid metal conduit before it enters a foundation wall or up through a concrete floor.

Identify conduit under provisions of Section 26 05 53.

All conduit installed underground (exterior to building) shall be buried a minimum of 24 inches below finished grade, whether or not the conduit is concrete encased. Install warning tape 12" below finish grade over all buried conduits. Underground warning tape shall be detectable, 2" wide minimum, 5 mil thickness, containing a foil core. Tape color shall be red and labeled with the words "CAUTION-BURIED ELECTRIC LINE BELOW" as manufactured by Presco or similar.

Conduits penetrating underground foundation walls: Individual conduits or each conduit as part of a ductbank penetrating underground foundation walls (excluding manholes) shall be sealed against water intrusion into the building.

Clean PVC conduit with solvent, and dry before application of glue. The temperature rating of glue/cement shall match weather conditions. Apply full even coat of cement/glue to entire area that will be inserted into fitting. The entire installation shall meet manufacturer's recommendations.

CONDUIT INSTALLATION SCHEDULE

Conduit other than that specified below for specific applications shall not be used.

- Underground Installations That Penetrate Foundation Walls: Rigid metal conduit within five feet (1.5 m) of the foundation wall. Conduit may transition to PVC conduit five feet (1.5 m) from the foundation walls.
- Underground Installations That Do Not Penetrate Foundation Walls: Rigid metal conduit, or PVC conduit.
- Underground Installations Emerging from Grade: Buried conduit emerging from grade shall be Rigid metal conduit extending from the minimum cover distance of 24 inches below grade to the conduit termination point above grade.
- Underground Installations Under Concrete Slab: Rigid metal conduit or Schedule 40 PVC conduit.
- Underground Installations Emerging through Concrete Slab: Rigid metal conduit.
- Concealed in Poured Concrete Walls: Rigid Metal Conduit, PVC conduit.
- Concealed in Concrete Block Walls: Electrical metallic tubing, PVC conduit.
- Within Concrete Slab: Rigid Metal conduit or PVC conduit.
- Emerging from Within Concrete Slab: Rigid metal conduit.
- Exposed Outdoor Locations: Rigid metal conduit, IMC.
- Wet Interior Locations: Exposed: Rigid metal conduit, Schedule 80 PVC conduit.
- Concealed Dry Interior Locations: Rigid metal conduit, Intermediate metal conduit, Electrical metallic tubing, and PVC conduit (Ground conductor).
- Interior Building Grounding Electrode Conductor: Schedule 80 PVC.
- Exposed Dry Interior Locations: Rigid metal conduit, Intermediate metal conduit, Electrical metallic tubing.
- Motor and equipment connections: Liquidtight flexible metal conduit (LFMC) (all locations). Minimum length shall be one foot (300 mm); maximum length shall be three feet (900 mm). Conduit must be installed perpendicular to direction of equipment vibration to allow conduit to freely flex.
- Light fixtures: Refer to specification section 26 51 13.

COORDINATION OF BOX LOCATIONS

Provide electrical boxes as shown on Drawings, and as required for splices, taps, wire pulling, equipment connections, and code compliance.

Electrical box locations shown on Contract Drawings are approximate unless dimensioned. Verify location of floor boxes and outlets in offices and work areas prior to rough-in.

No outlet, junction, or pull boxes shall be located where it will be obstructed by other equipment, piping, lockers, benches, counters, etc.

Conduit and boxes shall not be fastened to the metal roof deck. If conduit and boxes are required to be located and installed on roof decks, the conduit and boxes are required to be spaced minimum 1-5/8 inch off the lowest part of the metal roof decking material, per NEC 300.4 (E).

It shall be the Contractor's responsibility to study drawings pertaining to other trades, to discuss location of outlets with workmen installing other piping and equipment and to fit all electrical outlets to job conditions.

In case of any question or argument over the location of an outlet, the Contractor shall refer the matter to the Architect/Engineer and install outlet as instructed by the Architect/Engineer.

The proper location of each outlet is considered a part of this contract and no additional compensation will be paid to the Contractor for moving outlets which were improperly located.

Locate and install boxes to allow access to them. Where installation is inaccessible, coordinate locations and provide 18 inch (450 mm) by 24 inch (600 mm) access doors. Boxes must be installed within 12" from edge of the access door.

Locate and install to maintain headroom and to present a neat appearance.

Install boxes to preserve fire resistance rating of partitions and other elements, using approved materials and methods.

PULL AND JUNCTION BOX INSTALLATION

Pull boxes and junction boxes shall be minimum 4 inches square (100 mm) by 2 1/8 inches (54 mm) deep for use with 1 inch (25 mm) conduit and smaller. On conduit systems using 1 1/4 inch (31.75 mm) conduit, minimum junction box size shall be 4 11/16 inches square by 2 1/8 inches deep.

Where used with raceway(s) containing conductors of 4 AWG or larger, pull box shall be sized as required unless otherwise noted on the drawings.

Where used with raceway(s) containing conductors on systems over 600V, pull box shall be sized per NEC 314 Part IV unless otherwise noted as larger on the drawings.

Locate pull boxes and junction boxes above accessible ceilings, in unfinished areas or furnish and install access panels in non-accessible ceilings where boxes are installed. All boxes are to be readily-accessible.

Provide Pull and Junction boxes for communications and other low voltage applications (a) in any section of conduit longer than 100 feet, (b) where there are bends totaling more than 180 degrees between pull points or pull boxes and (c) wherever there is a reverse bend in run. Locate boxes on straight section of raceway (e.g. do not use boxes in place of raceway bends).

Support pull and junction boxes independent of conduit.

IN GRADE HANDHOLES AND BOXES

Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.

Unless otherwise indicated and detailed, support units on a level bed of crushed stone or gravel, graded from 1/2 inch (12.5 mm) sieve to No. 4 (4.25 mm) sieve and compacted to same density as adjacent undisturbed earth.

Elevation: In finished areas, set so cover surface will be flush with finished grade.

Unless approved by A/E, handholes and boxes shall NOT be installed in paved or concrete drives or walks.

Units shall be selected with depth sufficient to allow for conductor bending/ wire management and allow sufficient conduit elevation above compacted bed to prevent water infiltration in conduit.

Provide conduit sealant to seal conduits against water and gas intrusion, such as Polywater® FST™-250 Foam Duct Sealant, Raychem RDSS Rayplate Duct Sealing System, or approved alternate. Sealant shall be re-enterable, shall be compatible with the conduit and conductor types being used, and shall comply with NEC 225.27, 230.8, and 300.5(G).

OUTLET BOX INSTALLATION

Do not install boxes back-to-back in walls. Provide minimum 6 inch (150 mm) separation, except provide minimum 24 inch (600 mm) separation in acoustic-rated walls.

Power:

Recessed (1/4 inch maximum) outlet boxes in masonry, concrete, tile construction, or drywall shall be minimum 4 inch square, with device rings. Device covers shall be square-cut except rounded corner plaster rings are allowed in drywall applications. Angle cut plaster rings are not permitted. Coordinate masonry cutting to achieve neat openings for boxes. A single gang box can be used in drywall and masonry, for a single device location, when a single conduit enters box.

Shallow 4 inch square by 1 1/2 inch deep boxes can be used as device boxes for power provided the box and plaster ring is sized for installed device and conductors.

Low Voltage:

Recessed (1/4 inch maximum) outlet boxes in masonry, concrete, tile construction or drywall shall be minimum 4 11/16 inch square by 2 1/8 inch deep with single gang device ring (unless noted otherwise on drawings). Device covers shall be square-cut except rounded corner plaster rings are allowed in drywall applications. Angle cut plaster rings are not permitted. Coordinate masonry cutting to achieve neat openings for boxes.

Provide one conduit from each communications outlet box. Conduit runs between outlet boxes for communications are not allowed. Terminate conduit [above accessible ceiling] [above accessible ceiling in corridor] [on cable tray] [as detailed on drawings].

Provide knockout closures for unused openings.

Support boxes independently of conduit except for cast boxes that are connected to two rigid metal conduits, both supported within 12 inches (300 mm) of box.

Use multiple-gang boxes where more than one device are mounted together; do not use sectional boxes. Provide non-metallic barriers to separate wiring of different voltage systems.

Install boxes in walls without damaging wall insulation.

Coordinate mounting heights and locations of outlets mounted above counters, benches, and backsplashes.

Ceiling outlets shall be 4 inch square, minimum 2 1/8 inch (54 mm) deep except that concrete boxes and plates will be approved where applicable. Position outlets to locate luminaires as shown on reflected ceiling plans.

In inaccessible ceiling areas, position outlets and junction boxes within 6 inches (150 mm) of recessed luminaire, to be accessible through luminaire ceiling opening.

Provide recessed outlet boxes in finished areas; secure boxes to interior wall and partition studs, accurately positioning to allow for surface finish thickness. Use stamped steel stud bridges for flush outlets in hollow stud wall, and adjustable steel channel fasteners for flush ceiling outlet boxes.

Align wall-mounted outlet boxes for switches, thermostats, and similar devices.

Provide cast ferrous alloy or aluminum outlet boxes in exterior and wet locations.

Surface wall outlets shall be 4 inch (100 mm) square with raised covers for one and two gang requirements. For three gang or larger requirements, use gang boxes with non-overlapping covers.

Outlet Box Extender applications:

Provide box extenders for boxes that are set too far back in the wall due to un-anticipated wall finishes. Outlet Box Extenders will NOT be allow for installations where the EC has not accommodated for wall finishes that were expected prior to installation. Place the box extender over the existing box face to make the box face flush with the wall finish.

CONSTRUCTION VERIFICATION

Contractor is responsible for utilizing the construction verification checklists supplied under specification Section 26 08 00 in accordance with the procedures defined for construction verification in Section 01 91 00.

END OF SECTION

SECTION 26 05 53

IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

SCOPE

The work under this section includes the products and execution requirements relating to labeling of power, control, and signal wiring. Further, this section includes the installation of labels, nameplates, and directories for electrical junction boxes, wiring devices, and electrical equipment. Included are the following topics:

PART 1 - GENERAL

- Scope
- Related Work
- Submittals

PART 2 - PRODUCTS

- Materials

PART 3 - EXECUTION

- General
- Junction and Pullbox Identification
- Communication Conduit Labeling
- Power, Control and Signal Wire Identification
- Wiring Device Identification
- Support Wire Identification
- Nameplate Engraving For Electrical Equipment
- Panelboard Directories

RELATED WORK

Applicable provisions of Division 1 shall govern work under this section.

Section 26 05 19 – Low-Voltage Electrical Power Conductors and Cables

Section 01 91 00 – Commissioning Process

SUBMITTALS

Include schedule for nameplates.

Prior to installation, the Contractor shall provide samples of all label types planned for the project. These samples shall include examples of the lettering to be used. Samples shall be mounted on 8 1/2" x 11" sheets annotated, explaining their purposed use.

PART 2 - PRODUCTS

MATERIALS

Labels: All labels shall be permanent, and machine generated. NO HANDWRITTEN OR NON-PERMANENT LABELS ARE ALLOWED.

All wiring labels shall be white/transparent vinyl or vinyl-cloth, self-laminating, wraparound type. Flag type labels are not allowed. The labels shall be of adequate size to accommodate the circumference of the cable being labeled and properly self-laminate over the full extent of the printed area of the label.

Tape (wiring phase identification only): Scotch #35 tape in appropriate colors for system voltage and phase.

Nameplates: Engraved three-layer laminated plastic. Normal system shall use nameplates with black letters on white background, emergency system (NEC 700) shall use white letters on red background, legally required standby system (NEC 701) shall use white letters on blue background, and optional standby system (NEC 702) shall use white letters on yellow background.

Adhesive type labels not permitted except for identification of wires, wiring devices (device plates), 8" square and smaller junction boxes, and control devices.

See Junction and Pullbox Identification and Wiring Device Identification sections for allowed usage of permanent marker.

PART 3 - EXECUTION

GENERAL

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 shall be labeled for voltage in addition to other requirements listed herein.

All branch circuit and power panels shall be identified with the same symbol used in circuit directory in main distribution center.

Clean all surfaces before attaching labels with the label manufacturer's recommended cleaning agent. Install all labels firmly as recommended by the label manufacturer. Labels shall be installed plumb and neatly on all equipment.

Install nameplates parallel to equipment lines. Secure nameplates to equipment fronts using screws, rivets or manufacturer approved adhesive or cement.

Embossed tape will not be permitted for any application.

Provide a sign at each service disconnect indicating "Service Disconnect", and locate at the switch or circuit breaker, per NEC 230.70(B).

JUNCTION AND PULLBOX IDENTIFICATION

Junction and pullbox identification shall include:

Provide circuit numbers and source panel designations for power wiring junction boxes. Other system junction boxes shall be identified as shown on details or approved shop drawings.

Where exposed, junction boxes larger than 8" square shall utilize engraved nameplates with 1/2" minimum letter height. Identify system source(s) and load(s) served.

Where exposed, 8" square and smaller junction boxes shall utilize machine generated, adhesive labels.

Where located above an accessible ceiling, junction boxes may be neatly identified using a permanent marker.

COMMUNICATION CONDUIT LABELING

All conduits installed between Telecommunication Equipment Rooms shall be clearly labeled in accordance with ANSI/TIA/EIA-606. Both ends of the conduits shall be labeled.

All labels shall be mechanical, no hand written labels.

The label shall indicate the location of the far end of the conduit run and a unique conduit number. (i.e. TR-1A-01 or Room #216 – 01).

POWER, CONTROL AND SIGNAL WIRE IDENTIFICATION

Provide wire labels on each conductor in panelboard gutters, pull boxes, outlet and junction boxes, and at load connection. Identify with branch circuit or feeder number for power and lighting circuits, and with wire number as indicated on schematic and interconnection diagrams or equipment manufacturer's shop drawings for control and signal wiring.

All wiring shall be labeled within 2 to 4 inches of terminations. Each end of a wire or cable shall be labeled as soon as it is terminated including wiring used for temporary purposes.

WIRING DEVICE IDENTIFICATION

Wall switches, receptacles, occupancy sensors, wall dimmers, device plates and box covers, poke-through fittings, access floor boxes, photocells, and time clocks shall be identified with circuit numbers and source (ex. Panel ABC-3). In exposed areas, identifications should be made inside of device covers, unless directed otherwise. Use machine-generated adhesive labels, or neatly hand-written permanent marker.

SUPPORT WIRE IDENTIFICATION

Support wires that are installed in addition to the ceiling grid support wires to provide secure support for raceways, cables assemblies, boxes, cabinets, and fittings shall be distinguishable from the ceiling grid support wires per NEC 300.11(A). This identification shall be either approximately 6 inches of fluorescent orange paint, or orange tape flags 3/4 inches high-by-2 inches wide (minimum) within 12 inches of the bottom of the support wires.

NAMEPLATE ENGRAVING FOR ELECTRICAL EQUIPMENT

Provide nameplates of minimum letter height as scheduled below.

Distribution Panelboards, Branch Panelboards, Switchboards and Motor Control Centers: 1 inch (25 mm); identify equipment designation. 1/2 inch (13 mm); identify voltage rating, source and room location of the source. Panelboards serving NEC 700, 701 or 702 loads shall identify which branch they serve.

Circuit Breakers, Switches, and Motor Starters in Distribution Panelboards, Switchboards and Motor Control Centers: 1/2 inch (13 mm); identify circuit and load served, including location.

Individual Circuit Breakers, Disconnect Switches, Enclosed Switches, and Motor Starters: 1/2 inch (13 mm); identify source and load served.

Transformers: 1 inch (25 mm); identify equipment designation. 1/2 inch (13 mm); identify primary and secondary voltages, primary source and location, and secondary load and location.

PANELBOARD DIRECTORIES

Typed directories for panels must be covered with clear plastic, and have a metal frame. Room number on directories shall be Owner's numbers, not Plan numbers unless Owner so specifies.

END OF SECTION

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SECTION 26 05 73

SHORT CIRCUIT/COORDINATION STUDY
AND
ARC FLASH HAZARD STUDY

PART 1 - GENERAL

SCOPE

The electrical contractor shall retain the services of an independent third party firm to perform a short circuit/coordination study and arc flash hazard study as described herein.

Preliminary studies shall be submitted to the Design Engineer prior to receiving final approval of the distribution equipment shop drawings and/or prior to release of equipment for manufacture. The preliminary submittal shall contain sufficient study data to ensure that the selection of device ratings and characteristics will be satisfactory.

Upon completion of electrical distribution system installation, a complete study of the electrical system, including new and existing components, shall be conducted based on actual installed components. The Owner will provide a copy of a previous study to the party performing the study to assist in providing data related to the existing feeders and equipment.

The studies shall include all portions of the electrical distribution system from the normal power source or sources, and emergency / standby sources, down to and including the smallest circuit breaker in the distribution system (for short circuit calculations). Normal system connections and those which result in maximum fault conditions shall be adequately covered in the study.

The firm should be currently involved in high- and low-voltage power system evaluation. The study shall be performed, stamped and signed by a registered professional engineer in the State of Wisconsin. Credentials of the individual(s) performing the study and background of the firm shall be submitted to the Design Engineer for approval prior to start of the work. A minimum of five (5) years experience in power system analysis is required for the individual in charge of the project.

The firm performing the study should demonstrate capability and experience to provide assistance during start up as required.

The study and assessment shall be performed based on SKM's Dapper, Captor and PowerTool software.

Included are the following topics:

PART 1 - GENERAL

- Scope
- Related Work
- Quality Assurance
- Data Collection for the Study
- Submittals

PART 2 - PRODUCTS

Not Used

PART 3 – EXECUTION

- Short Circuit and Coordination Study
- Field Settings
- Arc Flash Hazard Study

RELATED WORK

Applicable provisions of Division 1 govern work under this section.

#

#Bid No. 315011

Short Circuit Coordination and Arc Flash Hazard Study

26 05 73 - 1

Section 26 14 13 - Switchboards
Section 26 24 16 – Panelboards
Section 01 91 00 – Commissioning Process

QUALITY ASSURANCE

Reference standards listed in the IEEE “Buff Book”, latest edition.

DATA COLLECTION FOR THE STUDY

The contractor shall provide the required data for preparation of the studies. The engineer performing the system studies shall furnish the contractor with a listing of the required data immediately after award of the contract.

The contractor shall expedite collection of the data to assure completion of the studies as required for final approval of the distribution equipment shop drawings and/or prior to release of the equipment for manufacture.

SUBMITTALS

THIRD PARTY QUALIFICATIONS

Submit qualifications of individual(s) who will perform the work to Design Engineer for approval prior to commencement of the studies.

DRAFT REPORT

Submit a draft of the study to Design Engineer for review prior to delivery of the study to the Owner. Make all additions or changes as required by the reviewer.

FINAL STUDY REPORT

Provide studies in conjunction with equipment submittals to verify equipment ratings required.

The results of the power system study shall be summarized in a final report. Six (6) bound copies of the final report shall be submitted. Provide two (2) copies in PDF format of the study, so that it can be more easily stored and shared. Provide 2 copies on CD of the report in MS word, and 2 copies (on CD) of the one-line diagram in CAD format. Also provide 2 copies on CD of the final SKM file in a format that can be utilized with the current version of SKM.PowerTool software.

The report shall include the following sections:

- I. Overview
- II. Short Circuit Study
 - SC-1 Purpose
 - SC-2 Explanation of Data
 - SC-3 Assumptions
 - SC-4 Analysis of Results
 - SC-5 Recommendations
 - SC-6 DAPPER Fault Analysis Input Report
- III. Protective Device Coordination Study
 - PDC-1 Purpose
 - PDC-2 Explanation of Data
 - PDC-3 Assumptions
 - PDC-4 Analysis of Results
 - PDC-5 Recommendations (Including NEC 700-27 Requirement)
 - PDC-6 CAPTOR Results
 - PDC-7 Example Drawings
- IV. Arc Flash Study
 - ARC-1 Purpose
 - ARC-2 Explanation of Data

- ARC-3 Assumptions
- ARC-4 Analysis of Results
- ARC-5 Recommendations
- ARC-6 SKM Arc Flash Evaluation Report
- V. Prioritized Recommendations and Conclusions
- VI. Appendices
 - APP-1 DAPPER One-line Diagrams
 - APP-2 AutoCAD One-line Diagrams
 - APP-3 SKM Protective Device Summaries
 - APP-4 Reference Data
 - APP-5 Sample Work Permit Form
 - APP-6 Copy of Warning Labels, including study date

The above sections shall include the following items in detail:

- Obtain available fault current from the local utility company.
- Short circuit studies shall evaluate the available fault current at each bus (each change of impedance), including all three-phase motors.
- Coordination study recommendations for relay settings, breaker settings, and motor protection settings.
- Recommendations for improving the coordination and/or load distribution, as well as ground fault requirements.
- Arc flash values for two normal cases to define the highest values (low short circuit and high short circuit).
- Arc flash values for two maintenance cases, which define the arc flash values available at the equipment that would be available if the instantaneous trip of the upstream circuit breaker is set at a minimum value. This is recommended if someone has to work on live equipment.
- IEEE standard one-line diagram with equipment evaluation and circuit breaker setting forms that clearly define the system data and are easy to interpret.
- Recommendations to reduce the arc flash incident energy in all areas that require class2 and higher PPE.
- Prioritized report summarizing all recommendations from this study. This shall include observed NEC code violations and their corrective action.
- The contractor shall provide a one-line diagram that meets IEEE/ANSI standard 141, mounted on 24" x 36" (minimum) Styrofoam backboard. This one-line diagram shall be mounted in each electrical room.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

SHORT CIRCUIT AND COORDINATION STUDY

The short circuit, coordination, and arc flash hazard studies shall be performed using SKM Dapper, Captor and PowerTool for Windows software packages. In the short circuit study, provide calculation methods and assumptions, the base per unit quantities selected, one-line diagrams, source impedance data including

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Short Circuit Coordination and Arc Flash Hazard Study

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power company system characteristics, typical calculations, and recommendations. Calculate short circuit interrupting and momentary (when applicable) duties for an assumed 3-phase bolted fault at each supply switchgear lineup, unit substation primary and secondary terminals, low voltage switchgear lineup, switchboard, motor control center, distribution panelboard, pertinent branch circuit panelboard, and other significant locations throughout the system. Provide a ground fault current study for the same system areas, including the associated zero sequence impedance data. Include in tabulations fault impedance, X to R ratios, asymmetry factors, motor contribution, short circuit KVA, and symmetrical and asymmetrical fault currents.

In the protective device coordination study, provide time-current curves graphically indicating the coordination proposed for the system, centered on conventional, full-size, log-log forms. Include with each curve sheet a complete title and one-line diagram with legend identifying the specific portion of the system covered by that particular curve sheet. Include a detailed description of each protective device identifying its type, function, manufacturer, and time-current characteristics. Tabulate recommended device tap, time dial, pickup, instantaneous, and time delay settings.

Include on the curve sheets power company relay and fuse characteristics, system medium-voltage equipment relay and fuse characteristics, low-voltage equipment circuit breaker trip device characteristics, pertinent transformer characteristics, pertinent transformer characteristics, pertinent motor and generator characteristics, and characteristics of other system load protective devices. Include at least all devices down to largest branch circuit and largest feeder circuit breaker in each motor control center, and main breaker in branch panelboards.

Include all adjustable settings for ground fault protective devices. Include manufacturing tolerance and damage bands in plotted fuse characteristics. Show transformer full load and 150, 400, or 600 percent currents, transformer magnetizing inrush, ANSI transformer withstand parameters, and significant symmetrical and asymmetrical fault currents. Terminate device characteristic curves at a point reflecting the maximum symmetrical or asymmetrical fault current to which the device is exposed.

Select each primary protective device required for a delta-wye connected transformer so that its characteristic or operating band is within the transformer characteristics, including a point equal to 58 percent of the ANSI withstand point to provide secondary line-to-ground fault protection. Where the primary device characteristic is not within the transformer characteristics, show a transformer damage curve. Separate transformer primary protective device characteristic curves from associated secondary device characteristics by a 16 percent current margin to provide proper coordination and protection in the event of secondary line-to-line faults. Separate medium-voltage relay characteristic curves from curves for other devices by at least a 0.4-second time margin.

Include complete fault calculations as specified herein for each proposed and ultimate source combination. Note that source combinations may include present and future supply circuits, large motors, or generators as noted on drawing one-lines.

Utilize equipment load data for the study obtained by the Contractor from contract documents, including contract addendums issued prior to bid openings.

Include fault contribution of all motors in the study. Notify the Engineer in writing of circuit protective devices not property rated for fault conditions.

Provide settings for the chiller motor starters or obtain from the mechanical contractor, include in the study package, and comment.

When an emergency generator is provided, include phase and ground coordination of the generator protective devices, to meet NEC 700.27 requirements. Show the generator decrement curve and damage curve along with the operating characteristic of the protective devices. Obtain the information from the generator manufacturer and include the generator actual impedance value, time constants and current boost data in the study. Do not use typical values for the generator.

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Short Circuit Coordination and Arc Flash Hazard Study

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Evaluate proper operation of the ground relays in 4-wire distributions with more than one main service circuit breaker, or when generators are provided, and discuss the neutral grounds and ground fault current flows during a neutral to ground fault.

For motor control circuits, show the MCC full-load current plus symmetrical and asymmetrical of the largest motor starting current to ensure protective devices will not trip major or group operation.

FIELD SETTINGS

The Contractor shall perform field adjustments of the protective devices as required to place the equipment in final operating condition. The settings shall be in accordance with the approved short circuit study, protective device coordination study and arc flash hazard study.

Necessary field settings of devices and adjustments and minor modifications to equipment to accomplish conformance with the approved short circuit and protective device coordination study shall be carried out by the Contractor at no additional cost to the owner.

ARC FLASH HAZARD STUDY

As part of the short circuit and coordination study, arc flash hazard study shall be included. The study shall include the following:

1. Determine and document all possible utility and generator/emergency sources that are capable of being connected to each piece of electrical gear. Calculations shall be based on highest possible source connection.
2. Calculations to conform to National Fire Protection Association (NFPA) 70E – 2003 calculation standards. All incident energy units shall be calculated in calories per square centimeter.
3. Provide recommended boundary zones and personal protective equipment (PPE) based on the calculated incident energy and requirements of NFPA 70E-2003 for each piece of electrical gear.

Electrical Contractor shall provide labeling as required by OSHA based upon the results of the arc flash hazard study. At a minimum, the labeling shall contain the following information: PPE level, Flash Hazard Boundaries, Flash Protection Boundary, and Shock Hazard Boundaries such as Limited Approach Boundary, Restricted Approach Boundary, Prohibited Approach Boundary, and study date."

END OF SECTION

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SECTION 26 24 13

SWITCHBOARDS

PART 1 - GENERAL

SCOPE

The work under this section includes main and/or distribution switchboard(s) specified herein and shown on the Drawings. Included are the following topics:

PART 1 - GENERAL

- Scope
- Related Work
- References
- Submittals
- Operation and Maintenance Data
- Delivery, Storage, and Handling

PART 2 - PRODUCTS

- Switchboard Construction and Ratings
- Pull Box
- Pull Section
- Main Circuit Breaker
- Circuit Breaker Distribution Sections
- Coordination of Overcurrent Protective Devices
- Instruments and Sensors
- Surge Protective Devices

PART 3 - EXECUTION

- Installation
- Field Quality Control
- Adjusting
- Construction Verification Items

RELATED WORK

Applicable provisions of Division 1 govern work under this section.

Section 26 05 73- Short Circuit/Coordination and Arc Flash Hazard Study
Section 26 43 13- Surge Protective Devices for Low Voltage Electrical Power Circuits
Section 01 91 00 – Commissioning Process

REFERENCES

- ANSI C57.13 – Instrument Transformers
- NEMA AB 1 - Molded Case Circuit Breakers
- NEMA KS 1 - Enclosed Switches
- NEMA PB 2 - Dead Front Distribution Switchboards
- NEMA PB 2.1 - Proper Handling, Installation, Operation and Maintenance of Deadfront Switchboards Rated 600 Volts or Less.
- UL-891 - Dead Front Switchboards
- Wisconsin Administrative Code SPS 316 - Electrical

SUBMITTALS

Include plan and elevation layouts showing overall dimensions and compartment layout with available spaces; conduit entrance locations and requirements; nameplate legends; one-line diagrams; size and number of bus bars per phase, neutral, and ground; switchboard instrument details; instructions for handling and installation of switchboard; and electrical characteristics including voltage, frame size and trip

ratings, withstand ratings, time-current curves, and interrupting ratings confirming a fully-rated system for all equipment and components.

Submit the required coordination study and the overcurrent device set point recommendations to the consulting engineer for review and approval. Submittal shall be on or before date of switchboard and panelboard equipment submittal.

OPERATION AND MAINTENANCE DATA

All operations and maintenance data shall comply with the submission and content requirements specified under section GENERAL REQUIREMENTS.

In addition to the general content specified under GENERAL REQUIREMENTS supply the following additional documentation:

1. Bus tightening intervals and procedures
2. Overcurrent protective device testing and maintenance procedures
3. Coordination study and the overcurrent device set point recommendations
4. Field report noting final adjustments to overcurrent protective device settings

DELIVERY, STORAGE, AND HANDLING

Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

Handle in accordance with NEMA PB2.1 and manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to switchboard internal components, enclosure, and finish.

PART 2 - PRODUCTS

SWITCHBOARD CONSTRUCTION AND RATINGS

Switchboard electrical rating and short circuit current rating shall be as shown on the Drawings and as required by short circuit/coordination study.

The switchboard and overcurrent devices contained within shall be fully-rated.

Main Section Devices: Individually mounted.

Distribution Section Devices: Group-mounted and/or individually mounted, complete with bus in an integrated assembly. All breakers shall be bolted, quick-make, quick-break, trip indicating and common trip on all multi-pole breakers. No handle ties will be permitted.

Buses:

The switchboard bussing (and all other current carrying parts such as fingers, neutral and ground buses) shall be plated copper. The bussing shall be of sufficient cross-sectional area to meet UL 891 temperature rise requirements.

For 4-wire systems, the neutral bus shall be the equivalent ampacity as the phase bus bars.

Provide a copper ground bus through the length of the switchboard sized per UL 891 and NFPA requirements.

Ground bus shall be continuous throughout the length of the switchboard. Factory supplied bus jumpers shall be utilized for field connection of ground bus between shipping splits. Field fabricated jumpers are not permitted.

Distribution sections shall be fully bussed and fully equipped for the future breakers, including all connectors and mounting hardware.

Line and load terminations shall be rated for the size, number of conductors and conductor material.

Line and Load Terminations: Accessible from the front only of the switchboard, suitable for the conductor materials used.

Enclosure:

Factory assembled, dead front, metal-enclosed, and self-supporting switchboard assembly conforming to NEMA PB2, and complete from incoming line terminals to load side terminations.

All closure plates shall be screw removable and small enough for easy handling by one person.

Finish: Manufacturer's standard medium gray enamel over external surfaces. Coat internal surfaces with minimum one coat corrosion resistant paint, or plate with cadmium or zinc.

Enclosure shall be NEMA PB 2 Type 4

Front accessible only.

The center grip of the operating handle of all switches or circuit breakers, when at the highest position, shall not be more than 6 feet – 3.5 inches high in the switchboard enclosure. Note: When the switchboard is mounted on 3.5 inch housekeeping pad the height of the operating handle shall not exceed 6 feet -7 inch above the floor.

Provide metering transformer compartment for Utility Company's use. Compartment size, location, bus spacing and drilling, door, and locking and sealing requirements shall meet the requirements of the local utility company. Compartment shall be in compliance with local utility service requirements.

PULL BOX (TOP HAT)

Same construction as switchboard, width and depth to match switchboard. The top and sides shall be removable.

PULL SECTION

Same construction as switchboard, width, depth and height to match switchboard. The top and sides shall be removable.

Provide a pull section on all switchboards fed with incoming cables.

Compartment shall include switchboard bus extension drilled and tapped for the incoming cable terminations.

MAIN CIRCUIT BREAKER

The main circuit breaker in 480V switchboards shall be an individually mounted and bussed molded case circuit breaker, 100% rated, with a full function electronic trip unit.

Individually mounted mains shall be located (top, middle or bottom) per manufacturers requirements based on location of cabling entrance into section. Provide minimum distance between cable entry opening and termination lugs of main OCPD per manufacturer [and local utility].

Provide Infrared inspection window to inspect line and load side termination lugs of individually mounted main OCPD.

Ground fault protection shall be included at the main disconnect for 480/277 volt switchboards 1000 amperes and larger. Ground fault trip shall be of the residual type and an integral part of the breaker. The

ground fault system shall include a memory circuit for positive tripping action despite intermittent arcing ground faults. Provide an integral means of testing the ground fault system to meet the on-site testing requirements of NEC Article 230-95(c).

CIRCUIT BREAKER DISTRIBUTION SECTIONS

Distribution circuit breakers shall be group mounted in frame sizes 100 amp through 1200 amp. Frame sizes larger than 1200 amp shall be individually mounted.

The circuit breakers are to be totally front accessible and mounted in the switchboard to permit installation, maintenance and testing without reaching over line side bussing. The circuit breakers are to be removable by the disconnection of only the load side terminations and line and load side connections are to be individual to each circuit breaker. Common mounting brackets or electrical bus connectors are not acceptable.

Circuit breakers shall be provided with provisions for mounting handle padlock attachments.

Breaker feeder lugs shall be dual rated for use with either aluminum or copper conductors.

Each circuit breaker is to be furnished with an externally operable mechanical means to trip the circuit breaker, enabling maintenance personnel to verify the ability of the circuit breaker trip mechanism to operate, as well as exercise the circuit breaker operating mechanisms.

A minimum of 20% future circuit breaker spaces shall be included. Spaces for future circuit breakers shall be "prepared" spaces. These spaces shall be provided with the necessary mounting hardware and bus extensions so that when future breakers are added, only the breaker itself needs to be purchased by the installer.

Circuit breakers in 480V switchboards shall be fully adjustable LSI circuit breakers with electronic trip for frame sizes 400A and greater.

Circuit Breakers:

Electronic Trip Circuit Breakers: As scheduled on the drawings, electronic circuit breakers shall have, at a minimum, adjustments for long time, short time and instantaneous trip. Provide integral ground fault sensing with adjustable ground fault trip where indicated on the drawings.

Molded Case Circuit Breakers: As scheduled on the drawings, integral thermal and instantaneous magnetic trip elements in each pole.

COORDINATION OF OVERCURRENT PROTECTIVE DEVICES

Provide a coordination study of the electrical system and recommend set points for all of the overcurrent and ground fault trip adjustments on the equipment provided. The coordination study and set point recommendations shall be submitted to the consulting engineer for approval. Submittal shall be on or before date of switchboard and panelboard equipment submittal. The study shall meet the requirements of specification section 26 05 73.

SURGE PROTECTIVE DEVICE

Provide a surge protective device meeting the requirements of specification section 26 43 13. Surge protective devices shall be served from an overcurrent protective device within the switchboard.

Surge protective device shall be installed external to the switchboard.

PART 3 - EXECUTION

INSTALLATION

Install switchboard in locations shown on Drawings, in accordance with manufacturer's written instructions and NEMA PB 2.1.

Install switchboard on a 3.5 inch high concrete equipment pad.

Install 90 degree C insulated conductors based on ampacity of 75 degree C conductors when utilizing 100% rated OCPD's. Consult manufacturer's requirements for specific devices.

Tighten accessible bus connections and mechanical fasteners after placing switchboard per manufacturer's requirements.

FIELD QUALITY CONTROL

Inspect completed installation for physical damage, proper alignment, anchorage, and grounding.

Check tightness of accessible bolted bus joints using a calibrated torque wrench. Tightness shall be in accordance with manufacturer's recommended values.

Measure insulation resistance of each bus section phase to phase and phase to ground for one minute each. Test voltage shall be 1000 volts, and minimum acceptable value for insulation resistance is 2 megohms.

Touch up scratched or marred surfaces to match original finish.

ADJUSTING

Adjust all operating mechanisms for free mechanical movement.

Adjust trip and time delay settings to values as recommended in coordination study or as instructed by the A/E. Include a copy of the coordination study and recommended circuit breaker set points in the O&M manual.

CONSTRUCTION VERIFICATION

Contractor is responsible for utilizing the construction verification checklists supplied in accordance with the procedures defined for construction verification in Section 01 91 00.

END OF SECTION

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SECTION 26 27 02

EQUIPMENT WIRING SYSTEMS

PART 1 - GENERAL

SCOPE

The work under this section includes electrical connections to equipment specified under other Divisions and/or Sections, or furnished by Owner, including, but not limited to:

- HVAC and Plumbing motors, VFDs, and panels
- Misc. Equipment

Included are the following topics:

PART 1 - GENERAL

- Scope
- Related Work
- References
- Submittals
- Coordination

PART 2 - PRODUCTS

- Cords and Caps
- Other Products

PART 3 - EXECUTION

- Inspection
- Preparation
- Installation
- HVAC and Plumbing Connections
- Equipment Connection Schedule

RELATED WORK

Applicable provisions of Division 1 govern work under this Section.

Section 26 05 19 – Low-Voltage Electrical Power Conductors and Cables.

Section 26 05 33 – Raceway and Boxes for Electrical Systems.

Section 01 91 00 – Commissioning Process

REFERENCES

Wisconsin Administrative Code SPS 316 - Electrical

SUBMITTALS

Product Data: Provide data for cord and wiring devices.

COORDINATION

Coordinate all equipment requirements with the various contractors and the Owner. Review the complete set of drawings and specifications to determine the extent of wiring, starters, devices, etc., required.

PART 2 - PRODUCTS

CORDS AND CAPS

Straight-blade Attachment Plug: NEMA WD 1.

Locking-blade Attachment Plug: NEMA WD 5.

Attachment Plug Configuration: Match receptacle configuration at outlet provided for equipment.

Cord Construction: Oil-resistant thermoset insulated multi-conductor flexible cord with identified equipment grounding conductor, suitable for hard usage in damp locations.

Cord Size: Suitable for connected load of equipment and rating of branch circuit overcurrent protection.

OTHER PRODUCTS

Refer to related sections for other product requirements.

PART 3 - EXECUTION

INSPECTION

Verify that equipment is ready for electrical connection, wiring, and energizing.

PREPARATION

Review equipment submittals prior to installation and electrical rough-in. Verify location, size, and type of connections. Coordinate details of equipment connections with supplier and installer.

INSTALLATION

Use wire and cable with insulation suitable for temperatures encountered in heat-producing equipment.

Provide a green equipment ground conductor for all installed equipment wiring.

Make conduit connections to equipment using flexible PVC-coated metal conduit.

Install pre-finished cord set where connection with attachment plug is indicated or specified, or use attachment plug with suitable strain-relief clamps.

Provide suitable strain-relief clamps for cord connections to outlet boxes and equipment connection boxes.

Make wiring connections in control panel or in wiring compartment of pre-wired equipment in accordance with manufacturer's instructions. Provide interconnecting wiring where indicated.

Install disconnect switches, controllers, control stations, and control devices such as limit switches and temperature switches as indicated. Connect with conduit and wiring as indicated.

HVAC AND PLUMBING CONNECTIONS

Provide all power wiring including all circuitry carrying electrical energy from panelboard or other source through starters, variable frequency drives (VFDs), and disconnects to motors or to packaged control panels. Packaged control panels may include disconnects and starters and overcurrent protection. Provide all wiring between packaged control panels and motors.

Contractor shall verify with mechanical contractor the electrical requirements including voltages, horsepower, disconnecting means, starters and variable frequency drives for motors and equipment prior to ordering circuit breakers, disconnects and starters.

VFD Installations: Install VFD input wiring and output wiring in separate conduit systems. Do not mix VFD input power and output power, or control wiring in a common raceway.

Provide 120 volts to each temperature control panel. Coordinate quantity and exact locations with HVAC/DDC contractors.

Unless otherwise specified, all electrical motors and control devices such as aqua-stats, float and pressure switches, fan powered VAV boxes, switches, electro-pneumatic switches, solenoid valves and damper

motors requiring mechanical connections shall be furnished and installed and wired by the Contractor supplying the devices.

Each motor terminal box shall be connected with a minimum 12", maximum 36" piece of flexible PVC-coated metal conduit to a fixed junction box. Conduit must be installed perpendicular to direction of equipment vibration to allow conduit to freely flex.

Check for proper rotation of each motor.

EQUIPMENT CONNECTION SCHEDULE

As indicated on the drawings.

END OF SECTION

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SECTION 26 27 26

WIRING DEVICES

PART 1 - GENERAL

SCOPE

This section describes the products and execution requirements relating to furnishing and installing wiring devices and related systems for the project. Included are the following topics:

PART 1 - GENERAL

- Scope
- Related Work
- Submittals
- Operation and Maintenance Data

PART 2 - PRODUCTS

- Wall Switches
- Receptacles
- Occupancy Sensors
- Device Plates and Box Covers

PART 3 - EXECUTION

- Installation
- Field Quality Control
- Occupancy Sensors
- Adjusting

RELATED WORK

Applicable provisions of Division 1 govern work under this Section.

Section 01 91 00 – Commissioning Process

SUBMITTALS

Provide product data showing model numbers, configurations, finishes, dimensions, and manufacturer's instructions.

For occupancy sensor shop drawings, the manufacturer's actual layout of occupancy sensors and the wiring diagrams shall be provided.

OPERATION AND MAINTENANCE DATA

All operations and maintenance data shall comply with the submission and content requirements specified under section GENERAL REQUIREMENTS.

PART 2 - PRODUCTS

WALL SWITCHES

General: Heavy duty use toggle switch, rated 20 amperes and 120/277 volts AC. Switches shall be UL20 Listed and meet Federal Specification WS-896. All switches shall be heavy duty Specification Grade.

Handle: Ivory made of nylon or high impact resistant material.

Wall Switches for Lighting Circuits and Motor Loads Under 1/2 HP: All switches shall be back and side wired, screw clamp type, suitable for solid or stranded wire up to #10 AWG, with separate green ground screw. Switches shall be as follows:

Hubbell 1221*,
Leviton 1221-S*,
Pass & Seymour CSB20AC1-*,
or approved equal. (* indicates color selection).

RECEPTACLES

General Requirements: NEMA Type 5-20R, ivory nylon or high impact resistant face. Receptacles shall be UL498 Listed and meet Federal Specification WC-596. All duplex receptacles shall be heavy duty Specification Grade, 20 amp rated.

Generally, all receptacles shall be duplex convenience type unless otherwise noted.

All receptacles installed in bathrooms, kitchens, and within 6 feet of the outside edge of sinks shall be GFCI type.

All receptacles installed in outdoor locations, garages, rooftops, and in other damp or wet locations shall be GFCI type with a weather-resistant (WR) rating.

Convenience and Straight-blade Receptacles: All receptacles shall be back and side wired, screw clamp type, suitable for solid or stranded wire up to #10 AWG, with a separate green ground screw. Receptacles shall be as follows:

Hubbell 5362*,
Leviton 5362-S*,
Pass & Seymour PS5362*,
or approved equal. (* indicates color selection).

GFCI Receptacles: Duplex convenience receptacle with integral ground fault current interrupter meeting the requirements of UL standard 943 Class A. GFCI receptacles shall be as follows:

Hubbell GFR5362*TR,
Leviton N7899-*,
Pass & Seymour 2095*,
or approved equal. (* indicates color selection).

GFCI Receptacles with a weather-resistant (WR) rating: Weather-Resistant duplex convenience receptacle with integral ground fault current interrupter meeting the requirements of UL standard 943 Class-A. WR GFCI receptacles shall be as follows:

Hubbell GFR5362*TR,
Leviton WR899-*,
Pass & Seymour 2095TRWR*,
or approved equal. (* indicates color selection).

Specific-use Receptacle Configuration: As indicated on drawings.

OCCUPANCY SENSORS

General Requirements: All occupancy sensors shall be hardwired type; battery type shall not be permitted.

Sensors shall use either passive infrared, or if dual technology, passive infrared and passive acoustic sensing or passive infrared and ultrasonic sensing for detecting room occupancy.

Sensitivity shall be user adjustable or self-adjusting type.

The delay timer shall be adjusted within a range of 6 to 30 minutes by the contractor in the field. The sensor shall have a test mode for performance testing.

The test LED shall indicate motion.

Line voltage sensors are acceptable, especially in exposed ceiling areas where all wiring shall be installed in conduit, including low voltage cabling if power packs are used. Provide power pack as required for low voltage sensors.

Occupancy sensors and power packs shall have five year warranties.

Wall Mounted (Wall Switch Type): The unit shall fit in/on a standard single gang switch box.

Rated capacity: 600 watts minimum at 120 volts, 60 Hz; 1000 watts minimum at 277 volts, 60 Hz.
The sensor shall have two switches where dual-level lighting is required. The switch shall have manual override for positive OFF and automatic ON.

The area of coverage shall be approximately 180 degrees by 35-40 feet.

Ceiling Mounted: The unit shall fit in/on a standard octagon box. All ceiling mounted sensors shall be installed to a box with ring and box support.

The coverage area shall be 360 degrees by approximately 15 feet radius when mounted at 9 foot height. The sensor shall have provisions, such as masking, to block out problem areas.

Ceiling/Corner Mounted: The unit shall fit in/on a standard octagon box. All ceiling mounted sensors shall be installed to a box with ring and box support.

The coverage area shall be 90 degrees or greater by approximately 40 feet radius when mounted at 9 foot height. The sensor shall have provisions, such as masking, to block out problem areas.

Power Packs: Provide power packs as required for low voltage sensors. Rated capacity shall be 20 amps at 120 or 277 volts for fluorescent lamps.

The unit shall fit on a standard octagon box. All power packs shall be installed onto a supported box.

Low voltage cabling shall be plenum rated or installed in conduit in plenum-rated areas.

DEVICE PLATES AND BOX COVERS

Decorative Cover Plate: 302/304 lined stainless steel.

Weatherproof Cover: All receptacles installed in wet locations shall have an enclosure that is weatherproof whether or not the attachment plug is inserted. Covers shall be gasketed metal with hinged "in-use" device covers, powder coat painted. Non-metallic covers are not allowed. Covers shall be latching type and shall be lockable. Covers shall be identified as "extra-duty" type per NEC 406.9(B)(1).

Damp Location Cover: All receptacles installed outdoors in a location protected from the weather or in other damp locations shall have an enclosure that is weatherproof when the receptacle is covered (attachment plug not inserted and receptacle covers closed). Covers shall be gasketed metal with hinged device covers, powder coat painted. Non-metallic covers are not allowed.

Surface Cover Plate: Raised galvanized steel.

PART 3 - EXECUTION

INSTALLATION

See plans for device mounting heights.

Install wall switches with OFF position down.

Install convenience receptacles with grounding pole on bottom.

Install box for information outlet at the same height as adjacent convenience receptacles. Locate boxes for information outlet as close as practical to duplex power outlet, approximately 2-inches apart.

Install specific-use receptacles at heights shown on Contract Drawings.

Install decorative plates on switch, receptacle, and blank outlets in finished areas.

Install galvanized steel plates on outlet boxes and junction boxes in unfinished areas, above accessible ceilings, and on surface-mounted outlets.

Install devices and wall plates flush and level.

Receptacles shall have a bonding conductor from grounding terminal to the metal conduit system. Self-grounding receptacles using mounting screws as bonding means are not approved.

FIELD QUALITY CONTROL

Inspect each wiring device for defects.

Operate each wall switch and sensor with circuit energized, and verify proper operation.

Verify that each receptacle device is energized.

Test each receptacle device for proper polarity.

Test each GFCI receptacle device for proper operation.

OCCUPANCY SENSORS

Power packs used in return air plenum ceiling areas shall be installed in an approved enclosure or UL listed for return air plenum.

Provide a minimum of 4' of coiled cable for ceiling-mounted sensors.

Occupancy sensors shall be installed at locations indicated on the manufacturer's submittal layout drawings. Sensors shall be located to prevent false "ON" tripping of the lights.

Sensitivity Test: After the sensor has been energized for at least 15 minutes, walk to the middle of the room (if conference room) or sit at the normal desk position (if an office). Make no motion for 20 seconds. Move one arm up and down slowly. The test LED should blink.

Time Delay Test: Set the time delay for 10 minutes. Walk into the room to activate the sensor then leave room. Sensor must turn lights off at approximately 10 minutes. Walk into the room again to reactivate the lights. Lights should activate within 1 second.

ADJUSTING

Adjust devices and wall plates to be flush and level.

Mark all conductors with the panel and circuit number serving the device with a machine generated label, at the device, and on the back of the device cover.

END OF SECTION

SECTION 26 27 28

DISCONNECT SWITCHES

PART 1 - GENERAL

SCOPE

The work under this section includes disconnect switches, fuses and enclosures. Included are the following topics:

PART 1 - GENERAL

- Scope
- Related Work
- References
- Submittals
- Operation and Maintenance Data
- General

PART 2 - PRODUCTS

- Disconnect Switches
- Fuses

PART 3 - EXECUTION

- Installation
- Construction Verification Items

RELATED WORK

Applicable provisions of Division 1 govern work under this Section.

Section 26 27 02- Equipment Wiring Systems

Section 26 29 00- Low voltage Controllers

Section 01 91 00 – Commissioning Process

REFERENCES

NECA (National Electrical Contractors Association) "Standard of Installation."

NEMA ICS 2 – Industrial Control Devices, Controllers, and Assemblies.

NEMA KS 1 – Enclosed Switches.

UL 50 – Enclosures for Electrical Equipment.

UL 98 – Enclosed and Dead-front Switches.

NFPA 70 – National Electrical Code

Wisconsin Administrative Code SPS 316 - Electrical

SUBMITTALS

Include outline drawings with dimensions, and equipment ratings for voltage, ampacity, horsepower, and short circuit.

OPERATION AND MAINTENANCE DATA

All operations and maintenance data shall comply with the submission and content requirements specified under section GENERAL REQUIREMENTS.

GENERAL

Provide disconnect switches for loads required by code. Review HVAC and Plumbing specifications to determine what equipment is furnished with disconnect switches. Install disconnect switches whether furnished under this contract or not. It is the Electrical Contractors responsibility to determine the need for

a disconnect switch for each load. The contractors shall include in their bid the code required disconnect switches whether indicated on the drawings or not.

PART 2 - PRODUCTS

DISCONNECT SWITCHES

Fusible Switch Assemblies (use only when overcurrent protection is required): NEMA Type Heavy Duty; quick-make, quick-break, load interrupter, enclosed knife switch with externally operable handle interlocked to prevent opening front cover with switch in ON position. Handle lockable in OFF position. Fuse Clips: designed to accommodate Class R, Class J or Class CC (motors) cartridge type fuses.

Nonfusible Switch Assemblies: NEMA Type Heavy Duty; quick-make, quick-break, load interrupter, enclosed knife switch with externally operable handle interlocked to prevent opening front cover with switch in ON position. Handle lockable in OFF position.

Enclosure:

Indoor: NEMA 1 code gauge steel with rust inhibiting primer and baked enamel finish

Outdoors: NEMA 3R code gauge zinc coated steel with baked enamel finish or NEMA 4 when indicated on drawings.

Provide manufacturer's equipment ground kit in all disconnect switches.

In applications where the switch serves as the service entrance disconnect, provide service ground kit, label as service disconnect and provide UL listing for service disconnect.

FUSES

Fuses 600 Amperes and Less: Dual element, time delay, 600 volt, UL Class J Interrupting Rating: 200,000 rms amperes.

Fuses 601 Amperes and Larger: Low Peak, time delay, 600 volt, UL Class L. Interrupting Rating: 200,000 rms amperes.

Fuses 30 Amperes and less: Time-Delay, 600 volt, UL Class CC. Interrupting rating: 200,000 rms amperes.

Provide three (3) spares of each size and type fuse.

Provide cabinet/enclosure for spare fuses sized to accommodate all required spare fuses for entire facility. Cabinet shall have hinged and latched cover. Label cabinet "Spare Fuses". Locate cabinet in main electrical room.

PART 3 - EXECUTION

INSTALLATION

Install disconnect switches where indicated on Drawings or required by NEC.

Provide identification as specified in Section 26 05 53.

Provide label on inside of disconnect cover identifying the type and size of fuse to be utilized.

CONSTRUCTION VERIFICATION

Contractor is responsible for utilizing the construction verification checklists supplied in accordance with the procedures defined for construction verification in Section 01 91 00.

END OF SECTION

SECTION 26 29 00

LOW-VOLTAGE CONTROLLERS

PART 1 - GENERAL

SCOPE

The work under this section includes manual motor starters, magnetic motor starters, combination magnetic motor starters and motor control centers. Included are the following topics:

PART 1 - GENERAL

- Scope
- Related Work
- Coordination with Other Trades
- References
- Submittals
- Operation and Maintenance Data
- Delivery, Storage, and Handling
- Spare Parts

PART 2 - PRODUCTS

- Manual Motor Starters
- Magnetic Motor Starters
- Controller Overcurrent Protection and Disconnecting Means

PART 3 - EXECUTION

- Installation
- Construction Verification Items

RELATED WORK

Applicable provisions of Division 1 shall govern work under this Section.

Section 26 05 29 - Hangers and Supports for Electrical Systems
Section 01 91 00 - Commissioning Process

COORDINATION WITH OTHER TRADES

Motors: In general, all electric motors required for this installation will be supplied with equipment, apparatus and/or appliances covered under other sections of the specifications.

Equipment:

All building utility motors such as fans, pumps, overhead doors, etc., together with certain "controlling equipment" for same, except motor starters and related apparatus, will be furnished under other sections of the specifications and delivered to the building site unless specifically noted otherwise. The above mentioned "controlling equipment" pertains to electrical thermostats, electro-pneumatic and pneumatic-electric and detection devices, or any other device not purely electrically operating in nature.

The starters for these motors shall be furnished and installed by the Electrical Trade unless noted otherwise (See Motor Schedule on Drawings).

The Electrical Trade shall set and connect all specified starting equipment, install all power conduits and wiring and shall furnish and make all connections from starting equipment to motors as required to leave the apparatus in running condition.

Wiring Connections:

Furnish branch circuits for all motors to the starting equipment and then to the motors, complete with all control wiring for automatic and remote control where required or noted. Conduits to motors shall

terminate in the conduit fittings on the motors, the final connection being made with flexible, PVC-coated metal conduit.

Provide all necessary labor and material to completely connect all electrical motors and controls (where required) in connection with the building utility equipment, including fans, pumps, overhead door operators, etc.

All conduits and wiring required for control work from the holding coil circuit of the starter, including the furnishing and installation of control devices such as auxiliary contacts, control relays, time delay relays, pilot lights, selector switches, alternators, etc., shall be provided and installed by other trades unless otherwise indicated.

Power Branch Circuits:

Wire sizes for branch circuits not specifically called for on drawings or in specifications shall be based on 125 percent of the full load current of the motor unless the voltage drop of motor branch circuits exceeds 1-1/2 percent from the distribution panel to the motor; in which case, voltage drop shall govern wire sizes. A power factor of 80 percent shall be used for motors in such calculations.

REFERENCES

ANSI/NEMA ICS 6 - Industrial Control and Systems: Enclosures.

ANSI/UL 248-8 - Low-Voltage Fuses - Part 8: Class J Fuses.

NEMA AB 1 - Molded-case Circuit Breakers, Molded Case Switches, and Circuit-breaker Enclosures.

NEMA ICS 2 - Industrial Control and Systems Controllers, Contactors, and Overload Relays Rated 600 Volts.

NEMA ICS 18 - Motor Control Centers.

NEMA KS 1 - Enclosed and Miscellaneous Distribution Equipment Switches.

NEMA PB 1 - Panelboards.

NEMA PB 1.1 - General Instructions for Proper Installation, Operation, and Maintenance of Panelboards Rated 600 Volts or Less.

SUBMITTALS

Indicate on shop drawings, front and side views of motor control center enclosures with overall dimensions. Include conduit entrance locations and requirements; nameplate legends; size and number of bus bars per phase, neutral and ground; electrical characteristics including voltage, frame size and trip ratings, withstand ratings, and time-current curves of all equipment and components.

Provide product data on motor starters and combination motor starters, relays, pilot devices, and switching and overcurrent protective devices.

OPERATION AND MAINTENANCE DATA

All operations and maintenance data shall comply with the submission and content requirements specified under section GENERAL REQUIREMENTS.

DELIVERY, STORAGE, AND HANDLING

Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

Handle in accordance with manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to components, enclosure, and finish.

SPARE PARTS

Keys: Furnish two (2) each to Owner.

Provide three (3) spares of each size and type fuse used. Provide enclosure for spare fuses.

Fuse Pullers: Furnish one fuse puller to Owner.

PART 2 - PRODUCTS

MANUAL MOTOR STARTERS

Single-phase Manual Motor Starter: Provide a motor-rated wall switch for lighting circuits and motor loads under 1/2 HP. Provide switch with a toggle handle operator and with an optional handle guard in a NEMA Type 1 enclosure to prevent accidental operation of the toggle operator, and to allow the toggle operator to be padlocked in either the On or Off position.

Three-phase Manual Motor Starter: NEMA ICS 2; size as shown on Drawings. AC general-purpose Class A manually operated full-voltage controller for induction motors rated in horsepower, with overload protection, red pilot light and toggle operator.

Enclosure: NEMA Type 1, or as indicated on the drawings.

Provide manufacturer's equipment grounding kit in all starter enclosures.

MAGNETIC MOTOR STARTERS

Magnetic Motor Starters: NEMA ICS 2; AC general-purpose Class A magnetic controller for induction motors rated in horsepower; size 0 minimum.

Full Voltage Starting: Non-reversing type.

Size: NEMA ICS 2; size as shown on Drawings, size 0 minimum.

Coil Operating Voltage: 120 volts, 60 Hz.

Overload Protection: The overload shall be solid-state, self-powered, provide phase loss and phase unbalance protection, have a permanent tamper guard, and be ambient insensitive. The overload shall have a mechanical test function.

Enclosure: NEMA Type 1, or as indicated on the drawings.

Provide manufacturer's equipment ground kit in all starter enclosures.

Auxiliary Contacts: NEMA ICS 2, two (2) field convertible contacts in addition to seal-in contact.

Selector Switches: NEMA ICS 2, HAND-OFF-AUTO in front cover.

Indicating Lights: NEMA ICS 2; red "RUN" LED Push-to-test type in front cover.

Control Power Transformers: Each magnetic starter shall have a fused primary and a fused 120V secondary control transformer, sized for the load, 50 VA minimum. Additionally, the X2 terminal of the control transformer shall be grounded.

Combination Motor Starters: Combine motor starters with motor circuit protector disconnect in common enclosure.

CONTROLLER OVERCURRENT PROTECTION AND DISCONNECTING MEANS

Motor Circuit Protector: NEMA AB 1; circuit breakers with integral instantaneous magnetic trip in each pole.

FUSES

Fuses 600 Amperes and Less: Dual element, time delay, 600 volt, UL Class J. Interrupting Rating: 200,000 rms amperes.

PART 3 - EXECUTION

INSTALLATION

Install motor control equipment in accordance with manufacturer's instructions.

Set overload protection in motor starters to match installed motor characteristics.

Motor Data: Provide neatly typed label inside each motor starter enclosure door identifying motor served, nameplate horsepower, full load amperes, code letter, service factor, and voltage/phase rating.

CONSTRUCTION VERIFICATION

Contractor is responsible for utilizing the construction verification checklists supplied under specification Section 26 08 00 in accordance with the procedures defined for construction verification in Section 01 91 00.

END OF SECTION

SECTION 26 43 13

SURGE PROTECTIVE DEVICES FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS

PART 1 - GENERAL

SCOPE

The work under this section includes Surge Protective Devices (SPD) as indicated on the project drawings and electrical diagrams. Included are the following topics:

PART 1 - GENERAL

- Scope
- Related Work
- Reference Standards
- Quality Assurance
- Warranty
- Submittals
- Operation and Maintenance Data

PART 2 - PRODUCTS

- Surge Protective Devices

PART 3 - EXECUTION

- Installation
- Construction Verification Items

RELATED WORK

Applicable provisions of Division 1 govern work under this Section.

Section 01 91 00 – Commissioning Process

REFERENCE STANDARDS

- UL 1449, Third Edition – Standard For Safety For Surge Protective Devices.
- ANSI/IEEE C62.41.1 Guide on the Surge Environment in Low-Voltage AC Power Circuits.
- ANSI/IEEE C62.41.2 Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits.
- ANSI/IEEE C62.45 Recommended Practice on Surge Testing for Equipment Connected to Low Voltage AC Power Circuits.
- IEEE C62.62 Standard Test Specification for Surge Protective Devices For Low-Voltage AC Power Circuits.
- NFPA 70, NEC Article 285

QUALITY ASSURANCE

The manufacturer shall have been in the Surge Protective Device industry for a minimum of 5 years.

WARRANTY

The manufacturer shall provide a minimum 5 year warranty from the date of shipment of the SPD.

SUBMITTALS

Include all SPD data necessary to show device is in compliance with all product specifications. Include product data sheets showing the device performance, dimensions, weight, connections, and mounting requirements, along with installation instructions.

OPERATION AND MAINTENANCE DATA

All operations and maintenance data shall comply with the submission and content requirements specified under section GENERAL REQUIREMENTS.

PART 2 - PRODUCTS

SURGE PROTECTIVE DEVICES

The SPD shall be Listed in accordance with UL 1449, Third Edition. The product and ratings shall be included in the database of the UL.com web site.

The surge protective device (SPD) shall be designated a location Type 1 or Type 2 device intended for installation on the load side of the service equipment overcurrent device, including SPDs located at the branch panel.

The SPD shall be connected in parallel with the facility's electrical system.

The SPD shall be made up of metal oxide varistors (MOV's), or a combination of MOV's with selenium cells or silicon avalanche diodes, ensuring that all of the performance requirements are met. Gas tubes shall not be used.

The entire SPD shall be enclosed in a metal or ABS enclosure, NEMA rated for the location. SPDs at main service equipment shall be mounted outside the switchboard or panelboard (not integral to, or installed within the switchboard or panelboard). SPDs for branch panelboard (2nd tier) locations may be mounted outside of, or integral to, the branch panelboard.

The SPD shall have a maximum continuous operating voltage (MCOV) rating not less than 115% of nominal voltage of the system it is protecting.

Protection Modes:

The SPD shall have line to neutral (L-N), line to ground (L-G), line to line (L-L) and neutral to ground (N-G) protection modes for three-phase grounded wye configured systems. For a three-phase delta configured system, the device shall have line to line (L-L) and line to ground (L-G) protection modes.

Voltage Protection Rating (VPR):

The UL 1449 Voltage Protection Rating (VPR) for the device shall not exceed the following:

208Y/120 volt applications:	900V L-N, L-G, N-G; 1200V L-L
480Y/277 volt applications:	1200V L-N, L-G, N-G; 2000V L-L
480 volt delta applications:	1800V L-G, 2000V L-L

Nominal Discharge Current (In):

The UL 1449 Nominal Discharge Current Rating (In) shall not be less than the following:

20kA for service entrance, switchboard, and main distribution panel locations
10kA for branch panelboard (2 nd tier) locations

Short Circuit Current Rating (SCCR):

The SPD shall have a UL 1449 Short Circuit Current Rating (SCCR) of not less than 200kA.

Surge Current Rating:

The single-pulse (8 X 20 microsecond waveform as specified in ANSI/IEEE Standard C62.41) surge current capacity shall not be less than the following:

100kA per mode (200kA per phase) for service entrance, switchboard, and main distribution panel locations

Each SPD shall include externally-mounted LED visual status indicators that indicate the on-line status of the unit, for each phase.

At service entrance, switchboard, and main distribution panel locations each SPD shall include the following features:

- audible diagnostic monitoring by way of an audible alarm function
- one set of NO/NC dry contacts for alarm conditions

PART 3 - EXECUTION

INSTALLATION

Install SPD units in accordance with manufacturer's written instructions, applicable requirements of NEC and NEMA standards, and recognized industry practices.

The SPD units shall be installed at the locations shown on the drawings, or as indicated in the one-line diagram. They shall be parallel-connected to, and located adjacent to the switchboard or panelboard being protected. Locate as close as practical to the bus, keeping lead length as short as possible (less than 3 feet preferred to ensure optimum performance).

SPDs shall be connected through a multi-pole circuit breaker or fused disconnect switch, not into main lugs. Circuit breaker or fused disconnect switch shall be 60A for main service device, 30A for branch panelboard device or as recommended by the manufacturer.

Use schedule 40 PVC conduit or metallic conduit between the SPD and the switchboard or panelboard as recommended by the manufacturer. Avoid sharp bends, excess length, and splices in the wires. Where possible, use a close-nippled connection with wires going directly to a circuit breaker within the switchboard or panelboard.

Setup and test per the manufacturer's recommendations.

CONSTRUCTION VERIFICATION

Contractor is responsible for utilizing the construction verification checklists supplied in accordance with the procedures defined for construction verification in Section 01 91 00.

END OF SECTION

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SECTION 26 51 13

INTERIOR LIGHTING FIXTURES, LAMPS, AND BALLASTS

PART 1 - GENERAL

SCOPE

The work under this section includes interior luminaires and accessories, exit signs, lamps, and ballasts. Included are the following topics:

PART 1 - GENERAL

- Scope
- Related Work
- Reference Standards
- Definitions
- Submittals
- Operation and Maintenance Data
- Extra Material

PART 2 - PRODUCTS

- Interior Luminaires and Accessories
- Lamps
- LED Luminaires
- Fluorescent Ballasts
- HID Ballasts
- Metal Halide High Frequency Electronic Ballasts

PART 3 - EXECUTION

- Installation
- Adjusting and Cleaning
- Interface with Other Products
- Field Quality Control
- All Fixture Connections Including Master-Slave

RELATED WORK

Applicable provisions of Division 1 govern work under this Section.

Section 26 27 26 - Wiring Devices

REFERENCE STANDARDS

RoHS - Restriction of Hazardous Substances. Council of the European Union (EC) Directive 2002/95/EC on the restriction of the use of certain hazardous substances in electrical and electronic equipment.

LM-79-08 (or latest) - IES Approved Method for the Electrical and Photometric Measurements of Solid-State Lighting Products.

LM-80-08 (or latest) - IES Approved Method for Measuring Lumen Maintenance of LED Light Sources.

TM-21-11 (or latest) - IES Technical Memorandum on Projecting Long Term Lumen Maintenance of LED Light Sources.

NEMA SSL 1-2010 (or latest) - Electronic Drivers for LED Devices, Arrays, or Systems.

DEFINITIONS

Driver - the power supply used to power LED fixtures, modules, or arrays.

L70, L₇₀, or L_{70%} - The reported life of an LED component or system to reach 70% lumen maintenance, or 70% of the LED's original light output. This test is being developed by the IES and is currently described by TM-21-11.

LED's - Broadly defined as complete light fixture with light emitting diode (LED) packages, modules, light bars or arrays, complete with driver.

LED luminaire failure - Negligible light output from more than 10 percent of the LED's constitutes luminaire failure.

SUBMITTALS

Include outline drawings, lamp and ballast data, support points, weights, accessory information and performance data for each luminaire type.

For each luminaire type, submit luminaire information including catalog cuts with highlighted catalog numbers and required accessories:

- Luminaire:
 - Manufacturer and catalog number.
 - Type (identification) as indicated on the plans and schedule.
- Ballast:
 - Manufacturer and catalog number.
 - Type (Programmed Start, etc.), Ballast Factor, THD, etc.
 - Quantity per fixture.
- Lamps:
 - Manufacturer, catalog number, and wattage
 - Quantity per fixture

OPERATION AND MAINTENANCE DATA

All operations and maintenance data shall comply with the submission and content requirements specified under section GENERAL REQUIREMENTS.

EXTRA MATERIAL

Provide three (3) percent of each lamp type, but not less than one (1) of each type.

Provide one (1) of each type of LED module, light bar, or array (if applicable). If the LED's are integrated into the fixture and are not separate components, then extra LED's are not required.

Provide one (1) ballast of each type. This includes LED drivers.

PART 2 - PRODUCTS

INTERIOR LUMINAIRES AND ACCESSORIES

See the Lighting Fixture Schedule on the drawings for type of fixtures and catalog numbers. Catalog numbers are shown on the drawings for quality and performance requirements only. Fixtures manufactured by others are equally acceptable provided they meet or exceed the performance of the indicated fixtures, and meet the intent of the design.

Luminaire shall be certified by a Nationally Recognized Testing Laboratory (UL, ETL, or IEC).

Provide lighting fixtures with quick-connect disconnecting means, similar to Thomas & Betts Sta-Kon.

Fluorescent T8 lamps and ballasts shall be listed on CEE high-performance qualifying product list and approved by Focus-On-Energy.

LAMPS

General Use Incandescent Lamps and Incandescent Reflector Lamps are prohibited. Use LED or compact fluorescent retrofit lamps in lieu of incandescent or halogen for specialty fixtures. LED retrofit lamps shall be:

- Rated for the voltage of the incandescent lamp they are replacing.
- Dimmable where required as indicated on the plans.

- Rated for the fixture in which they are being installed. Verify whether the fixture is enclosed and whether the retrofit lamp is rated for enclosed fixtures and the temperatures that will be encountered.
- Lamps shall provide delivered footcandles equal to or greater than the footcandles provided by an equivalent incandescent lamp.
- Lamps shall have an average rated life of 25,000 hours, minimum.
- Lamp color temperature shall be nearly equal to the incandescent lamp it is replacing.

Four Foot Fluorescent Lamps: High Performance T8 Lamps:

- Minimum 3000 initial lumens and minimum of 2820 mean lumens.
- Minimum 30,000 hour rated life at three-hour starts using programmed-start ballasts.
- Color Rendering Index (CRI) of 80 or higher.
- 4100°K color temperature.
- Lamps shall be suitable for use with instant start ballasts and occupancy sensors.
- Lamps shall meet Toxicity Characteristic Leaching Procedure (TCLP) requirements for low mercury as defined by the EPA.
- Mean system efficacy equal to 88 MLPW minimum using programmed-start ballasts.

Acceptable lamp manufacturers and catalog numbers are (or equal):

GE - F32T8/XL/SPX41/HL/ECO
 OSRAM/SYLVANIA - F032/841/XPS/ECO3
 PHILIPS - F32T8/ADV85/ALTO
 STANDARD PRODUCTS - F32T8/841/XL31

Manufacturer names and catalog numbers are used to develop quality and performance requirements only. Lamps manufactured by others will be accepted provided they meet or exceed the specifications.

HID Lamps:

Metal halide HID lamps shall be pulse-start, clear coated, suitable for all burning positions, and shall have a maintenance factor of 0.75 or greater and CRI of 65 or higher. High pressure sodium lamps shall be clear coated and suitable for all burning positions. See lighting fixture schedule on drawings.

All lamps shall be new.

LED LUMINAIRES

- LED Luminaires shall meet all DesignLights Consortium® (DesignLights.org) Product Qualification Criteria. This does not require that the luminaire be listed on the DesignLights Consortium's® Qualified Products List, but they must meet the Product Qualification Criteria. The technical requirements that the luminaire shall meet for each Application Category are:
 - Minimum Light Output.
 - Zonal Lumen Requirements.
 - Minimum Luminaire Efficacy.
 - Minimum CRI.
 - L70 Lumen Maintenance.
 - Minimum Luminaire Warranty of 5 years (not pro-rated) to include LED driver and all LED components.

Additional requirements:

- Color Temperature of 3000K-5000K for interior fixtures as listed in the Light Fixture Schedule on the plans. The color temperature of exterior LED fixtures should not exceed 4100K (nominal).
- Color Consistency: LED manufacturer shall use a maximum 3-step MacAdam Ellipse binning process to achieve consistent fixture-to-fixture color for interior fixtures. Exterior fixtures shall use a maximum 5-step MacAdam Ellipse binning process.
- Luminaire shall be mercury-free, lead-free, and RoHS compliant.
- Luminaire shall comply with FCC 47 CFR part 15 non-consumer RFI/EMI standards.

- Light output of the LED system shall be measured using the absolute photometry method following IES LM-79 and IES LM-80 requirements and guidelines.
- Luminaire shall maintain 70% lumen output (L70) for a minimum of 50,000 hours.
- Driver shall have a rated life of 50,000 hours, minimum.
- Lumen output shall not depreciate more than 20% after 10,000 hours of use.
- Driver and LEDs shall be furnished from a single manufacturer to ensure compatibility.
- Luminaire Color Rendering Index (CRI) shall be a minimum of 80 for interior fixtures, and a minimum of 70 for exterior fixtures.
- LED fixture shall be thermally designed as to not exceed the maximum junction temperature of the LED for the ambient temperature of the location the fixture is to be installed. Rated case temperature shall be suitable for operation in the ambient temperatures typically found for the intended installation. Exterior luminaires to operate in ambient temperatures of -20°F to 122°F (-29°C to 50°C).
- LED driver shall have a minimum power factor (pf) of 0.9 and a maximum crest factor (cf) of 1.5 at full input power and across specified voltage range.
- Luminaire shall operate normally for input voltage fluctuations of plus or minus 10 percent.
- Luminaire shall have a maximum Total Harmonic Distortion (THD) of 20% at full input power and across specified voltage range.
- Wiring connections to LED drivers shall utilize polarized quick-disconnects for field maintenance.
- All connections to luminaires shall be reverse polarity protected and provide high voltage protection in the event connections are reversed or shorted during the installation process.
- Fuse Protections: All luminaires shall have built-in fuse protection. All power supply outputs shall be either fuse protected or be Polymeric Positive Temperature Coefficient (PTC)-protected as per Class 2 UL listing.
- All luminaires shall be provided with knockouts for conduit connections.
- The LED lighting fixture shall carry a limited 5-year warranty minimum for LED light engine(s)/board array, and driver(s).
- Provide all of the following data on submittals:
 - Delivered lumens
 - Input watts
 - Efficacy
 - Color rendering index.

Dimming:

- LED driver shall be compatible with dimming controls where dimming is indicated on the plans. Dimmable drivers shall use Dimming Constant Current (DCC) or Pulse Width Modulation (PWM) operation.
- LED fixtures shall dim to (20%, 15%, 10%, 5%, or 0.1%) as specified in the Light Fixture Schedule on the plans without visible flicker or “popcorn effect”. “Popcorn effect” is defined as the fixture being on a pre-set dimmed level (less than 100%), and going to 100% prior to returning to the pre-set level when power is returned to the fixture.

FLUORESCENT BALLASTS

All fluorescent ballasts shall be electronic type and shall meet the following specs:

- UL Listed (Class P) sound rating A and CSA certified.
- Comply with EMI and RFI limits set by the FCC (CFR 47 part 18) or NEMA and not interfere with normal electrical equipment.
- Meet any applicable standards set forth by ANSI.
- Be potted or conformal coated in a metallic case and not contain PCBs.
- Provide normal rated lamp life as stated by lamp manufacturers (i.e. rated life at 3 hour burn time per start).
- Provide independent test results from an approved testing laboratory for all of the specifications below. This is required for all submitted ballasts.

- Nominal power factor of .90 or higher.
- Total harmonic distortion of less than 10% at 120 or 277 volts (universal voltage).
- Ballast factor 0.70 through 1.2, as shown on the lighting fixture schedule.
- Frequency of operation shall be 40 kHz - 50 kHz and units shall operate without visible flicker.
- Ballast efficiency factor shall meet Consortium of Energy Efficiency (www.cee1.org) specifications (adopted by Focus on Energy program).
- Multi-lamp ballasts shall operate in parallel so that when one lamp burns out, the other lamps will continue to operate at full light output.
- Ballast Efficiency Factor (BEF) shall be as shown in the table below:

Number of Lamps	Low (BF ≤ 0.85)	Normal (0.85 < BF ≤ 1)	High (BF > 1.0)
PROGRAMMED-START BALLASTS (T8 lamps)			
1	≥ 2.84	≥ 2.84	≥ 2.95
2	≥ 1.48	≥ 1.47	≥ 1.51
3	≥ 0.97	≥ 1.00	≥ 1.00
4	≥ 0.76	≥ 0.75	≥ 0.75

- Ballasts shall carry a minimum 5 year warranty with a \$10 replacement labor allowance.
- Ballasts shall not be affected by lamp failure.
- Ballasts shall be a standard production item.
- 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.
- Ballasts shall withstand line transients as defined in IEEE 587, Category A.
- SYSTEM PERFORMANCE: System performance for programmed-start ballasts shall be as follows:

1. Programmed-Start, Low Ballast Factor (BF = 0.71)

Lamps	Nominal Lamp Watts	System Input (Watts @ Univ Volt)
1 – F32T8	32	25
2 – F32T8	32	47
3 – F32T8	32	73
4 – F32T8	32	93

2. Programmed-Start, Normal Ballast Factor (BF = 0.88)

Lamps	Nominal Lamp Watts	System Input (Watts @ Univ Volt)
1 – F32T8	32	31
2 – F32T8	32	60
3 – F32T8	32	88
4 – F32T8	32	118

Acceptable ballast manufacturer's names and product lines are as follows:

Osram Sylvania – Quicktronic High Efficiency and Quicktronic PROstart.

GE Lighting – Ultramax and UltraStart.

Maxlite – High Efficiency Ballast.

Advance – Optanium.

Universal Lighting Technologies – F32T8.

Manufacturer names are used to develop quality and performance requirements only. All manufacturers and their products shall meet the system performance requirements and this entire specification.

HID BALLASTS

Physical Requirements:

- Core and coil shall be vacuum impregnated with silica-filled polyester resin.
- Core and coil shall use pre-insulated individual input voltage leads; floating lead and tab terminals are not acceptable.
- Oil-filled capacitors shall be housed in corrosion-resistant steel or aluminum cans and contain ¼” quick disconnect terminals.
- Dry capacitors shall be housed in a flame-retardant thermoplastic case with lead wire terminations and have no exposed live parts.
- Igniters shall be polyester filled with either a plastic or aluminum external housing.
- HID ballast kits with igniters shall have the igniters pre-wired to the core and coil, and have push-in connectors installed on the core and coil “cap” leads.

Lighting Performance Requirements:

- Ballasts shall be designed to provide reliable lamp starting down to –40°C for High Pressure Sodium, –30°C for probe-start Metal Halide, and –30°C / –40°C for pulse-start Metal Halide lamps (depending on lamp specifications).

Electrical Performance Requirements:

- Capacitors shall be 100°C dry type where rated voltage is ≤ 400 , and contain bleeder resistors where required by UL. All oil-filled capacitors shall contain an internal protective device.
- Igniter shall be designed to operate an average of 10,000 hours at a case temperature of 75°C.
- Igniter shall be 105°C rated.

Regulatory Requirements:

- Ballast shall be designed and manufactured in accordance with the ANSI Standard for HID Ballasts, ANSI C82.4.
- Ballast shall be UL recognized in accordance with UL 1029 Standard for HID Ballasts or CSA certified in accordance with CAN/CSA-22.2 No. 74-92.
- Manufacturer shall provide written warranty against defects in workmanship for two years.

METAL HALIDE HIGH FREQUENCY ELECTRONIC BALLASTS

- Ballast variation in output power shall be +/- 0.5%.
- Ballast variation in input voltage shall be +/- 10%.
- Ballast shall be equipped with safety shutdown feature to prevent excessive pulsing of failed lamps.
- Ballast shall have Total Harmonic Distortion of less than 10%.
- Ballast power factor shall be greater than 0.95.
- Ballast shall be thermally protected to shut off when temperatures reach unacceptable levels.
- Ballast shall have an acceptable remote mounting distance of not less than 15 feet.

PART 3 - EXECUTION

INSTALLATION

Verify ceiling types with Architectural plans or with existing ceilings. Verify specified fixtures are compatible with specified ceiling type(s) prior to ordering fixtures.

Install in accordance with manufacturer’s instructions.

Install suspended luminaires using aircraft cable, or pendants supported from swivel hangers. Heavy duty chain supports may be used where indicated on the fixture schedule. Provide aircraft cable, pendants, or chain lengths required to suspend luminaire at indicated height. All aircraft cables or pendant supported luminaires

shall have an independent support to structure at all cable or pendant support locations. When chain is used, tie-wrap the fixture whip to the chain.

Support luminaires larger than 2 x 4 foot (600 x 1 200 mm) size independent of ceiling framing.

Provide independent support for all fixtures over 50 lbs.

Locate ceiling luminaires as indicated on reflected ceiling plan.

Install surface mounted luminaires and exit signs plumb and adjust to align with building lines and with each other. Secure to prohibit movement.

The Contractor shall install fixture supports as required. Fixture installations with fixtures supported only by insecure boxes will be rejected. It shall be the Contractor's responsibility to support all lighting fixtures adequately, providing extra steel work for the support of fixtures if required. Any components necessary for mounting fixtures shall be provided by the Contractor. No plastic, composition or wood type anchors shall be used.

Install recessed luminaires to permit removal from below.

Install recessed luminaires using accessories and firestopping materials to meet regulatory requirements for fire rating.

Install code required hardware to secure recessed grid-supported luminaires in place.

Install wall mounted luminaires and exit signs at height as scheduled. Use pendants supported from swivel hangers in exposed ceiling/structure locations where necessary to mount exit signs at the specified height.

Install accessories furnished with each luminaire.

Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within luminaire.

Bond fixtures and metal accessories to branch circuit equipment grounding conductor.

Install specified lamps in each luminaire and exit sign.

HID High-Bay or Low-Bay Luminaires: Use power hook hangers rated 500 pounds (225 kg) minimum and provide safety chain between ballast and structure. Also provide safety chain between reflector and ballast.

All lamps shall be delivered to the job in sealed cartons and protected from dirt and dust during storage on the project. Lamps shall be taken directly from the cartons and installed in the fixture with special care so that they do not become dusty and are not soiled in the operation.

Lamps installed in fixtures using dimming ballasts shall be burned in at 100% rated output by the contractor for a minimum of 100 hours as recommended by the ballast manufacturer.

All new lamps shall be operational at the Substantial Completion of the project.

ADJUSTING AND CLEANING

Align luminaires and clean lenses and diffusers at completion of Work. Clean paint splatters, dirt, and debris from installed luminaires.

Aim and adjust luminaires as indicated on Drawings or as directed by the A/E.

Touch up luminaire finish at completion of work.

INTERFACE WITH OTHER PRODUCTS

Interface with air handling accessories furnished and installed under Division 23.

Provide controls as indicated on the plans. Refer to section 26 27 26 - Wiring Devices. Controls shall be compatible with the fixtures/ballasts/drivers being installed.

FIELD QUALITY CONTROL

Operate each luminaire after installation and connection. Inspect for proper connection and operation.

ALL FIXTURE CONNECTIONS INCLUDING MASTER-SLAVE

Direct box or conduit connections for surface and recessed fixtures: Use flexible metal conduit from a J-box for recessed lay-in light fixtures. Flexible metal conduit shall be 3/8" (10 mm) minimum diameter and six foot (1.8 m) maximum length. Flexible whip between master and slave fixtures may be supported off of the ceiling grid wires. Conduit length shall allow movement of the fixture for maintenance purposes. Minimum wire size shall be #18 AWG for single fixture or master-slave fixture.

The flexible connectors shall be steel or die-cast, galvanized, snap-in type with locknut, clamp type with locknut, or snap-in connector including those used on the master-slave unit.

END OF SECTION

SECTION 28 23 00

VIDEO MONITORING SYSTEM

PART 1 - GENERAL

Applicable provisions of Division 0 and 1 shall govern work of this Section.

PART 1 – GENERAL

- Scope
- Related Work
- Regulatory Requirements
- Submittals

PART 2 – PRODUCTS

- Cabling
- Miscellaneous Items

PART 3 – EXECUTION

- General
- Continuity of Existing Services and Systems
- Cable Installation
- System Power
- Testing and Acceptance
- Operations and Maintenance Manuals
- Warranty and Support

SCOPE

This section covers the cabling requirements of a Video Monitoring System (VMS) for the project.

Detailed requirements of the system and responsibilities to provide, furnish and/or install are as follows:

Contractor-furnished, Contractor installed

- Cabling
- Cable Pathways
- Camera Rough-in

Owner-furnished, Owner-installed

- Cameras
- Monitors
- Software

All equipment, cables and related termination, support and grounding hardware, bonding as required for a full and functioning system, shall be installed, wired, tested, labeled, and documented by the Contractor, as detailed in this and related section(s).

RELATED WORK

Section 01 91 00 – Commissioning Process

Division 26 Sections:

- Section 26 05 26 – Grounding and Bonding for Electrical Systems
- Section 26 05 29 – Hangers and Supports for Electrical Systems
- Section 26 05 33 – Raceway and Boxes for Electrical Systems
- Section 26 05 53 – Identification for Electrical Systems

REGULATORY REQUIREMENTS

UL Listed

FCC Part 15 as applicable to the equipment type(s) included

SUBMITTALS

Submit the following for approval prior to ordering any equipment in accordance with requirements of Division 1, General Conditions:

- Product data for all equipment, hardware cabling and miscellaneous components proposed,
- Floor plan drawings showing equipment and device locations with proposed conduit wiring, pull box and junction box locations,
- Schematic drawings - specific to project - of all circuits from the field devices to the required connection points. The diagrams shall show schematic wiring of equipment and all connections to be made to devices. Terminal connections in the equipment shall be numbered to correspond to the diagrams for use in making connections. Wiring diagrams shall be coordinated so that terminal numbering, circuit designation and equipment or device designations are the same on all drawings. All drawings must be submitted and approved by the Engineer before installation starts, but such approval will not waive any specification requirements unless specifically stated.

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 the contract documents.

- Markings shall be reproducible (arrow, underlines, circled, checkmark, etc.).
- Where sheet or drawing includes options, mark proposed option(s).
- When manufacturer's reference numbers are different from those specified, provide explanation and cross-reference number for each item.

Work shall not proceed without Engineer approval of the submitted items.

No substituted materials shall be installed except by written approval from the Engineer.

The Owner reserves the right to make changes to descriptive information, component selection and nomenclature during shop drawing review without incurring any additional cost.

PART 2 - PRODUCTS

CABLING

Horizontal Cabling

4-pair UTP; Category 6.

MISCELLANEOUS ITEMS

Surge Protection

Outdoor cameras served by copper cabling shall incorporate Surge Protection in the path from camera to network electronics.

Surge Protection features:

- Supports Category 6 transmission.
- Protects 10/100/1000 Base-T Ethernet networks.
- Provides protection for both common- and differential-mode surges.
- Supports Modes A and B of 802.11af-2003 (PoE) and 802.11at-2009 (PoE+) standards.
- Complies with Telcordia GR-1089-CORE (Intra-Building).
- Network Interface: 8P8C Modular Jacks (e.g. RJ45).
- External Ground Lug

PART 3 - EXECUTION

GENERAL

The complete installation shall be done in a neat, workmanlike manner in accordance with Division 26 of these documents and manufacturer's recommendations.

The installation shall conform to site requirements for security and inmate care. Temporary or permanent installations, which conflict with site operations, security or inmate care, shall be immediately corrected by the contractor with no additional compensation.

CONTINUITY OF EXISTING SERVICES AND SYSTEMS

No outages shall be permitted on existing systems except at the time and during the interval specified by Agency and site representatives. Obtain written approval for any outages.

Any outage must be scheduled when the interruption causes the least interference with normal site schedules and business routines. No extra costs will be paid to the Contractor for such outages which must occur outside of regular weekly working hours.

This Contractor shall restore any circuit interrupted as a result of this work to proper operation as soon as possible.

CABLE INSTALLATION

General

All wiring shall be run in conduit or as designated on the plan drawings. All cable shall be free of tension at both ends.

Size conduit per manufacturers recommendations or per project plans, whichever is larger.

All video, network, power and control wire and cable (as applicable) shall be secured with multi-use cable straps. Cable straps shall be Hook-and-Loop type to provide easy access for servicing of cable.

Horizontal Cabling

Provide 4-pair cable to each camera location for video signal (and PoE if applicable).

Terminate horizontal cabling at Telecommunications Room (Equipment Room, Telecom Enclosure, etc.) in a Modular Patch Panel.

- Cables designated for cameras shall be terminated on patch panel shared with other 4-pair horizontal cabling.

Terminate cabling at camera location in an 8P8C Modular Plug.

Provide Power Supply (non-PoE) cabling as applicable per manufacturer's recommendations.

Provide documentation horizontal cabling identifying on which Patch Panel port each camera cable is terminated (e.g. Camera X = port Y).

SYSTEM POWER

Surge Suppression

Install per manufacturer's recommendations.

Position Surge Suppression as close to building entrance as practicable or as noted on drawings. Document location on record documents.

Bond to communications ground. Size grounding conductor per manufacturer's recommendations.

TESTING AND ACCEPTANCE

General

Conduct tests upon completion of all work or during course of construction when identifiable portion(s) of overall work are complete.

OPERATIONS AND MAINTENANCE MANUALS

General

Submit quantities required by Division 1 and Section 26 05 00.

Provide documents in hard copy and in electronic form.

Submit product and test data as Adobe Acrobat (.pdf) files.

Submit drawings and schematics as Adobe Acrobat (.pdf) files and AutoCAD (.dwg) files.

Submit images of individual camera views as JPEG (.jpg; preferred) or Adobe Acrobat (.pdf) files.

As a minimum, O&M Manuals shall include:

- Drawings annotated to show as-installed camera locations, cable routes and major equipment locations
- Cabling Schematics
- Approved Submittals
- Test plan and test report sheets

WARRANTY AND SUPPORT

Warranty

This Contractor shall guarantee the following for a period of two (2) years from date of substantial completion of this work:

- All provided materials and equipment
- Installation of all equipment, hardware, cabling and related components.

Warranties shall include labor, materials and travel time.

See Division 1, GENERAL CONDITIONS, and GENERAL REQUIREMENTS - Guarantee Documents and the individual technical sections for further requirements.

Contractor shall repair, replace or alter systems or parts of systems having failed, or found defective or not meeting specified performance requirements. This shall be at no cost to the State.

If while fulfilling requirements of this warranty, the Contractor disturbs other work, the Contractor shall arrange for such disturbed work to be restored to its original condition by the responsible Contractor. This shall be at no cost to the State.

END OF SECTION

SECTION 31 10 00

SITE CLEARING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Conditions of the Contract and portions of Division One of this Project Manual apply to this Section as though repeated herein.
- B. Section 31 20 00, Erosion Control and Section 01 74 19 Recycling.

1.02 SUMMARY

- A. Section Includes:
 - 1. Preparation
 - 2. Existing Utilities
 - 3. Clearing and Grubbing
 - 4. Stripping and Stockpiling Topsoil
 - 5. Site Improvements
 - 6. Disposal of Surplus and Waste Materials

1.03 MATERIAL OWNERSHIP

- A. Except for stripped topsoil and other materials indicated to be stockpiled or otherwise remain on Owner's property, cleared materials shall become Contractor's property and shall be removed from Project site.

1.04 PROJECT CONDITIONS

- A. Traffic: Minimize interference with site traffic, adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.
 - 1. Do not close or obstruct street or traffic patterns of other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
 - 2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.
- B. Utility Locator Service: Notify utility locator service for area where Project is located before site clearing.
- C. Do not commence site clearing operations until temporary erosion- and sedimentation-control measures are in place. See Section 31 25 00.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Satisfactory Soil Material: Requirements for satisfactory soil material are specified in Section 31 20 00"

PART 3 - EXECUTION

3.01 PREPARATION

- A. Protect and maintain benchmarks and survey control points from disturbance during construction. Identify existing benchmarks that will interfere with construction to Owner. Owner will relocate existing benchmarks outside of the Work limits.
- B. Locate and clearly identify trees, shrubs, and other vegetation to remain or to be relocated.
- C. Protect existing site improvements to remain from damage during construction.
 - 1. Restore damaged improvements to their original condition, as acceptable to Owner.

3.02 EXISTING UTILITIES

- A. Locate existing underground utilities in areas of work. If utilities are to remain in place, provide adequate means of protection during earthwork operations.
- B. Should uncharted or incorrectly charted piping or other utilities be encountered during excavation, consult utility owner immediately for directions. Cooperate with Owner and utility companies in keeping respective services and facilities in operation. Repair damaged utilities to satisfaction of utility owner.
- C. Interrupting Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
 - 1. Notify Owner not less than two days in advance of proposed utility interruptions.
 - 2. Do not proceed with utility interruptions without Owner's written permission.

3.03 CLEARING AND GRUBBING

- A. Remove obstructions, trees, shrubs, and other vegetation to permit installation of new construction.
 - 1. Remove stumps and roots, obstructions, and debris to a depth of 18 inches below exposed subgrade.

3.04 TOPSOIL STRIPPING AND STOCKPILING

- A. Strip topsoil in a manner to prevent intermingling with underlying subsoil or other waste materials.
- B. Stockpile topsoil away from edge of excavations without intermixing with subsoil. Grade and shape stockpiles to drain surface water. Maintain to prevent windblown dust and erosion by water.
- C. Place stockpiles in Owner-approved location.

3.05 SITE IMPROVEMENTS

- A. Remove existing above- and below-grade improvements as indicated and necessary to facilitate new construction.

3.06 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off Owner's property or as allowed by Owner in adjacent sanitary landfill.
- B. Separate recyclable materials produced during site clearing from other nonrecyclable materials. Store or stockpile without intermixing with other materials and transport them to recycling facilities. Do not interfere with other Project work.
- C. Refer to specification Section 01 74 19.

END OF SECTION

SECTION 31 20 00

EXCAVATING, BACKFILLING AND COMPACTION

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Conditions of the Contract and portions of Division One of this Project Manual apply to this Section as though repeated herein.

1.02 DESCRIPTION

- A. Section includes excavating, backfilling, compacting, grading, and restoration to the lines and grades shown on the Drawings.
- B. Trenching, backfilling, compaction and grading for utility installation.

1.03 REFERENCES

- A. American Society for Testing and Materials (ASTM):
 - 1. ASTM D 1557 - Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m³)).
 - 2. ASTM D 6938 - Standard Test Method for In-place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depths).
 - 3. ASTM D 4253 - Standard Test Method for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table.
 - 4. ASTM D 4254 - Standard Test Method for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density.
 - 5. ASTM C 136 - Method for Sieve Analysis of Fine and Coarse Aggregates.
 - 6. ASTM D 422 - Method for Particle-Size Analysis of Soils.
 - 7. ASTM D 2487 – Standard Practice for Classification of Soils for Engineering Purposes.
- B. State of Wisconsin Department of Transportation (WisDOT):
 - 1. Standard Specifications for Highway and Structure Construction, latest edition.
- C. State of Wisconsin Department of Natural Resources (WDNR):
 - 1. WDNR Conservation Practice Standards, latest edition.

1.04 QUALITY ASSURANCE

- A. Perform Work in accordance with Wisconsin Department of Transportation Standards and as specified in the project specifications.

1.05 SUBMITTALS

- A. Submit in accord with the General Conditions of the Contract.
- B. Submit in airtight container a sample of each type of fill to testing laboratory. Sample size to be in accordance with laboratory requirements.

PART 2 PRODUCTS

2.01 FILL MATERIAL

A. Granular Fill:

1. On-site or imported sand or sand and gravel fill with no stones larger than 3 inches.
2. Crushed concrete meeting Granular Fill requirements if approved by Engineer.
3. On-site existing asphalt pavement that has been crushed with no particles larger than 1 1/2 inches may be used as Granular Fill below new asphalt pavement areas if approved by Engineer.

B. Well-graded Sand or Gravel:

1. Imported well-graded sand or gravel fill with no more than 12 percent by weight passing the No. 200 US sieve and no stones larger than 3 inches.

C. Crushed Aggregate Base Course (Dense Graded Base):

1. Imported fill or crushed concrete conforming to WisDOT crushed aggregate base course requirements for 1-1/4 inch dense graded base aggregate as specified in Section 305.2, WisDOT Standard Specifications.

D. Open Graded Base Course:

1. Imported fill or crushed concrete conforming to open graded base course material as specified in Section 310.2, WisDOT Standard Specifications.

E. 3" Dense Graded Base:

1. Imported fill or crushed concrete conforming to WisDOT crushed aggregate base course requirements for 3-inch dense graded base aggregate as specified in Section 305.2, WisDOT Standard Specifications.

F. Sand Bedding Material

1. In accordance with pipe manufacturer's recommendations.

G. General Fill:

1. On site or imported soil that is free of vegetation, ash, wood, organics, debris, refuse, frozen material, and rock or stone greater than 6 inches in largest dimension.
2. Crushed concrete meeting General Fill requirements if approved by Engineer.

H. Clay Fill:

1. On site or imported clay to be placed as compacted clay capping layer over retaining wall backfill not overlain by pavement, as directed by Engineer.

2.02 GEOTEXTILES

A. Non-woven Geotextile:

1. Mirafi 160N or approved equal.

B. Woven Geotextile:

1. Mirafi 600X or approved equal.

2.03 TOPSOIL, SEED, FERTILIZER AND MULCH

A. Topsoil:

1. Natural silty clay loam soils available from the overlying portions of the excavation area.

B. Seed Mixture

1. Native Seed Mix: Place along grassed areas on either side of building addition and ramp. 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 Forbs), as distributed by Cardno Native Plant Nursery or approved equal.
2. WisDOT Seed Mix No. 20: Place along other disturbed areas to be vegetated.

C. Fertilizer: Type B as specified in Section 629, WisDOT Standard Specifications.

2.04 ASPHALT PAVING

- A. Binder and surface courses as shown on Drawings, conforming to WisDOT Standard Specifications.

PART 3 EXECUTION

3.01 INSPECTION

- A. Examine the areas and conditions where Work will be performed and notify the Engineer in writing of conditions detrimental to the proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected.

3.02 EXCAVATING

A. General:

1. Excavate to the limits and depths shown on the Drawings.
2. Segregate and stockpile excavated materials.
3. Stockpile clean soil on site as directed by the Owner or Engineer.
4. Removal of materials beyond the limits and depths shown on the Drawings without authorization of Engineer shall be at the Contractor's expense, including backfill and compaction.
5. For foundation excavations, use a smooth-edge backhoe bucket for excavation and hand trim clay/silt foundation soils to minimize foundation subgrade disturbance.

B. Undercutting for Removal of Unsuitable Soils

1. Excavate exploratory test pits as directed by Engineer to delineate extent of excavation to remove unsuitable soils in building and ramp areas.
2. Excavate unsuitable soils such as non-engineered fill, buried topsoil, and moderately compressible clayey sand/sandy clay soils, if any, as directed by Engineer. Replace unsuitable soils with compacted compacted backfill as directed by Engineer.
3. Where directed by Engineer, excavate below foundation subgrades to remove unsuitable soils. Excavate laterally beyond outside foundation edge for a minimum of 0.5 foot for each foot of excavation depth below foundation grade as directed by Engineer.
4. Once unsuitable soils are removed, compact subgrade. Statically recompact native clays with smooth drum roller (without vibration). Recompact granular soils with vibration.
5. After compaction, follow Proofrolling Subgrade Stabilization measures in 3.02D.

C. Undercutting Below Footings

1. Pocket penetrometer readings less than 1.5 tons per square foot, as performed by soil testing agency, will require undercutting as directed by soil testing agency.

2. Where undercutting is required, widen the base of the undercut excavation beyond the footing edges at least 0.5 foot in each direction for each foot of undercut depth for stress distribution.
3. Where undercut will be above water table, backfill with Granular Fill to at least 95 percent of modified Proctor maximum dry density when directed by soil testing agency or Engineer. Alternatively, use 3" Dense Graded Base to stabilize softer clays by working thin lifts of stone in the subgrade with heavy construction equipment until deflection ceases when directed by soil testing agency or Engineer.
4. Where undercut excavation will extend at or slightly below the water table, place a 6 inch to 12 inch layer of Open Graded Base to stabilize wet soils prior to subsequent fill placement as directed by soil testing agency or Engineer. If Open Graded Base layer exceeds 12 inches, wrap Open Graded Base in non-woven geotextile fabric.
5. Recompact granular soils exposed at footing grade with a vibratory plate compactor prior to formwork/concrete placement.

D. Proofrolling and Subgrade Stabilization:

1. Proofroll subgrade with a loaded triaxle dump truck or loaded scraper as directed by Engineer.
2. Stabilize a soft or loose subgrade by excavating soft or loose soil and placing Granular Fill compacted to at least 95 percent of modified Proctor maximum dry density when directed by Engineer. Alternatively, use 3" Dense Graded Base to stabilize softer clays by working thin lifts of stone in the subgrade with heavy construction equipment until deflection ceases when directed by Engineer.
3. Re-establish subgrade elevation with compacted backfill as specified in Part 3.04 when directed by Engineer or soil testing agency.
4. Where new fill will tie into existing fill in ramp area, cut 2-foot wide by 1-foot high benches into existing soils for each vertical foot of new fill to be placed.
5. Compact building and pavement subgrades prior to filling or placing concrete as directed by Engineer. For sand or gravel subgrades, compact with a vibratory compactor. For silt or clay subgrades, compact with a smooth drum roller without vibration.

E. Contaminated Soil Hauling and Disposal

1. Haul excavated contaminated soil to the on-site disposal facility.
2. Owner will arrange for disposal facility approval.
3. Owner will pay for disposal fees.
4. Measurement of soil hauled will be based on disposal facility scale readings.
5. Use only trucks with Solid Waste Transporters Licenses.

F. Trenching:

1. Unauthorized trenching: Removal of materials beyond the elevations or dimensions indicated on the Drawings without authorization of Engineer shall be at the Contractor's expense, including backfill and compaction.
2. Excavate to the dimensions and elevations shown on the Drawings to permit proper installation of utility piping.
3. Grade bottom of trench so that pipes can be laid without sags or humps.
4. Unsuitable soil: Remove unsuitable soils as required by pipe manufacturer's specifications. Replace the excavated material in accordance with pipe manufacturer's recommendations.

G. Saw Cutting:

1. Saw cut and strip away concrete and asphalt surfaces prior to excavating.
2. Re-saw cut damaged asphalt and concrete prior to placing base course as directed by the Engineer.

3. Reuse in accordance with backfill material as described in this specification, or recycle in accordance with specification Section 31 50 11.

H. Dewatering:

1. Dewater excavation with pumps and shallow sump pits to facilitate soil excavation below water table.
2. Construct berms or flumes to direct water away from open excavation.
3. Maintain excavations and trenches free of water.
4. Dewatering shall be done in accordance with WDNR Conservation Practice Standard 1061.

I. Do not backfill excavation or trenches until an inspection has been made and backfilling authorized by the Engineer.

J. Perform all Work in accordance with OSHA requirements.

3.03 PREPARATION AND RESTORATION

- A. Remove ice and snow before placing fill. Do not place fill on frozen subgrade.
- B. Cut out soft areas of unsuitable subgrade.
- C. Prepare, maintain, and document proper subbase.
- D. Engineer will observe surface conditions of subgrade prior to placement of fill or concrete.

3.04 BACKFILLING

A. General:

1. Clear excavation of trash and debris before backfilling.
2. Reconsolidate and compact stockpiled, clean soil into excavation prior to backfilling with off-site fill materials as directed by soil testing agency or Engineer.
3. Place and compact building floor slab fill to floor slab subgrade elevation prior to excavation to establish foundation subgrades. Place floor slab fill laterally 5 feet beyond the building footprint prior to excavating for foundations.
4. Carefully place backfill material to protect underground structures and utilities.
5. Do not backfill with frozen material.
6. Remove ice and snow before placing fill. Do not place fill on frozen subgrade.
7. During cold weather, protect exposed subgrades from freezing before and after footing construction.
8. Do not backfill excavation until an inspection has been made and backfilling authorized by the soil testing agency or Engineer.
9. Place non-woven geotextile above open graded fill such as open graded base if open graded fill thickness will exceed 12 inches, as directed by soil testing agency or Engineer. Install geotextile in accordance with manufacturer's recommendations.
10. If backfill settles below the adjacent ground surface, prior to one year following completion of Work, Contractor shall refill settled area and mechanically compact the surface. If backfill settlement damages structures, pavement, landscaping, or buried utilities, Contractor shall repair damaged facilities to the satisfaction of the Owner.

B. Backfill Below Foundations and Floor Slabs, Around Foundations and Buildings, and below Ramp Area:

1. Includes fill materials to be placed within the one horizontal to one vertical zone of influence under footings and foundations and within 10 feet of building lines.
2. Backfill excavation with Granular Fill in lifts not exceeding 10-inches before compaction. Do not use crushed asphalt pavement as Granular Fill below foundations, floor slabs, or

the ramp area. Mechanically compact to at least 95 percent of modified Proctor maximum dry density.

C. Backfill behind Retaining Wall:

1. Backfill behind retaining wall with Well-Graded Sand or Gravel compacted to a minimum of 95 percent of modified Proctor maximum dry density.
2. Where pavement will not extend to the back of the retaining wall, place 2-foot thick clay cap over retaining wall backfill and compact to a minimum of 90 percent of modified Proctor maximum dry density.

D. Backfill in Paved Areas:

1. Backfill excavation in paved areas with Granular Fill in lifts not exceeding 10-inches before compaction. Crushed asphalt pavement meeting the requirements of Part 2.01 A may be used as Granular Fill below asphalt pavement areas if approved by Engineer. Mechanically compact to at least 90 percent of modified Proctor maximum dry density at depths more than 3 feet below pavement subgrade and to at least 95 percent of modified Proctor maximum dry density at depths less than 3 feet below pavement subgrade.
2. On site General Fill consisting of clay/silt soils may be used as fill more than 3 feet below pavement subgrade if dried back to facilitate compaction. Compact to at least 90 percent of modified Proctor maximum dry density at depths more than 3 feet below pavement.
3. In ramp slab area, place woven geotextile between dense graded base and open graded base layers. Install geotextile in accordance with manufacturer's recommendations.

E. Backfill in Non-Paved Areas:

1. Backfill excavation in non-paved areas with Granular Fill or General Fill backfill in 10-inch lifts, mechanically compact to at least 90 percent of modified Proctor maximum dry density for sand/gravel materials, and to at least 85 percent for clay/silt materials.

F. Dense Graded Base (Crushed Aggregate Base Course) below Pavement:

1. Mechanically compact in accordance with WisDOT Section 301.3.4.2, Standard Compaction.

G. Testing:

1. Owner shall provide and pay for an independent soil testing agency and laboratory to perform compaction and gradation testing. Contractor to coordinate work performed by soil testing agency and independent testing laboratory.

3.05 GRADING

- A. Grade and finish to within 0.10 foot of grades provided.
- B. Uniformly grade areas within limits of backfilled trenches, including adjacent transition areas.

3.06 EXCESS SOIL

- A. Load and haul any excess fill material not usable or used during construction to on-site area as directed by Owner.

3.07 ASPHALT PAVING

- A. Place and compact asphalt in accordance with the WisDOT Standard Specifications.
- B. Provide flow lines and transitions that will be smooth, uniform and cause minimum resistance to flow.

3.08 GRASSED AREA RESTORATION

- A. Place topsoil, seed, fertilizer, and mulch to maximize the germination and viability of the grass seed, and minimize the soil and seed loss due to erosion. Place erosion mat at locations shown on Drawings. Refer to Section 31 25 00 for erosion mat specifications.
- B. Topsoil:
 - 1. Place and spread to a uniform depth of 4 inches or such greater depth as designated by the Engineer. Limit preparation to areas that will be planted immediately.
 - 2. Remove rocks, twigs, and other foreign material. Dress the entire surface to present a uniform appearance. Appropriate pitch shall be maintained.
- C. Seed:
 - 1. Native Seed Mix:
 - Application rate shall be 38.25 PLS per acre.
 - Apply by light discing or harrowing just prior to the final raking and leveling of the topsoil.
 - 2. WisDOT Seed Mix: Place in accordance with Section 630 WisDOT Standard Specifications.
- D. Mulch:
 - 1. Place on seeded area within two days of seed application.
 - 2. Spread uniformly over the designated areas to a loose depth of 0.5 to 1.5 inches.
 - 3. Secure netting in place over mulch.
 - 4. Maintain the mulched areas and repair any areas damaged by wind, erosion, traffic, fire, or other causes prior to final acceptance of Work under the contract.

END OF SECTION

SECTION 31 25 00

EROSION CONTROL

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Conditions of the Contract and portions of Division One of this Project Manual apply to this Section as though repeated herein.

1.02 DESCRIPTION

- 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.

1.03 REFERENCES

- A. State of Wisconsin Department of Transportation (WisDOT):
 - 1. Standard Specifications for Road and Bridge Construction, latest edition.
 - 2. Erosion Control Product Acceptability List (PAL), latest edition.
- B. State of Wisconsin Department of Natural Resources (WDNR)
 - 1. WDNR Technical Standards, latest edition.
- C. Project Erosion Control Plan prepared by Dane County.

1.04 QUALITY ASSURANCE

- A. Contractor shall repair any areas damaged by erosion for a period of 1 year following completion of construction.

1.05 SUBMITTALS

- A. Submit in accord with the General Conditions of the Contract.
- B. Submit silt fence product identification and material specifications 2 weeks prior to installation.
- C. Submit erosion mat product identification, material specifications and manufacturer's installation recommendations 2 weeks prior to installation.
- D. Submit temporary seeding product identification specifications 2 weeks before installation.

PART 2 PRODUCTS

2.01 SILT FENCE

- A. Comply with the requirements of WDNR Technical Standard 1056 (Silt Fence).

- 2.02 TRACKING PAD
 - A. Aggregate base course exposed with asphalt and concrete removal to serve as stone tracking pad for project.
- 2.03 EROSION MAT
 - A. Class I, Type A erosion mat included on WisDOT PAL.
- 2.04 INLET PROTECTION
 - A. Type D-M, complying with City of Madison standards and WDNR Technical Standard 1060 (Storm Drain Inlet Protection for Construction Sites).
- 2.05 TEMPORARY SEED
 - A. Consist of winter wheat or annual ryegrass, in accordance with WDNR Technical Standard 1059 (Seeding for Construction Site Erosion Control).
- 2.06 MULCH
 - A. Comply with WDNR Technical Standard 1058 (Mulching for Construction Sites).

PART 3 EXECUTION

- 3.01 GENERAL
 - A. Examine the areas and conditions where Work will be performed and notify Engineer in writing of conditions detrimental to proper and timely completion of Work. Do not proceed with Work until unsatisfactory conditions have been corrected.
 - B. Minimize the amount of disturbed area open at a given time.
 - C. Execute construction to minimize surface water runoff from or to disturbed areas.
 - D. Avoid runoff or deposition of site materials into drainage features or off the property.
 - E. Do no track or spill site materials off the property. Off-property tracking or spills must be cleaned up immediately. Washing is
 - F. Periodically inspect site work and erosion controls for erosion, sedimentation, or defects. Correct deficiencies identified in a timely manner.
 - G. Replace or repair erosion controls affected by the construction. Erosion controls are to be returned to installed conditions or reinstalled to accommodate construction.
 - H. Install erosion controls for soil stockpiled for seven or more days during the Work and/or when rain is expected.
 - I. Alterations or additions to the existing erosion controls shall not affect the performance of the erosion control plan and must conform to WDNR best management practices.
- 3.02 SILT FENCE INSTALLATION AND MAINTENANCE
 - A. Place in accordance with WDNR Technical Standard 1056 (Silt Fence).
 - B. Inspect weekly and within 24 hours after each rainfall.

- C. Repair or replace if silt fence is torn, sagging, overtopped, blown over (laying down), or in any way is not functioning for sediment containment.
- D. Remove sediment when sediment deposits reach no more than one half of silt fence height.
- E. Remove silt fence once contributing drainage area is stabilized with vegetation or impervious surface.

3.03 TRACKING PAD MAINTENANCE

- A. Inspect weekly and within 24 hours after each rainfall.

3.04 INLET PROTECTION INSTALLATION AND MAINTENANCE

- A. Place in accordance with WDNR Technical Standard 1060 (Storm Drain Inlet Protection for Construction Sites) and manufacturer's recommendations.
- B. Repair or replace if fabric is torn, overtopped or in any way not functioning for sediment removal/containment.
- C. Inspect weekly and within 24 hours after each rainfall.
- D. Remove inlet protection once contributing drainage area is stabilized with vegetation or impervious surface.

3.05 TEMPORARY SEEDING APPLICATION

- A. Apply temporary seeding in accordance with Temporary Seeding rates specified in WDNR Technical Standard 1059 (Seeding for Construction Site Erosion Control).
- B. Repair and reseed areas that have erosion damage as directed by Engineer.
- C. Inspect weekly and within 24 hours after each rainfall.

3.06 MULCH PLACEMENT AND MAINTENANCE

- A. Place mulch on seeded areas within 24 hours after seeding has been completed.
- B. Begin mulching at top of slope and proceed downward.
- C. Maintain mulched areas and repair any areas damaged by wind, erosion, traffic, or other causes prior to final acceptance of work under contract.
- D. Place mulch in accordance with WDNR Technical Standard No. 1058 (Mulching for Construction Sites).
- E. Inspect weekly and within 24 hours after each rainfall.

END OF SECTION

SECTION 32 13 13

EXTERIOR CONCRETE PAVING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Conditions of the Contract and portions of Division One of this Project Manual apply to this Section as though repeated herein
- B. Wisconsin Department of Transportation (WisDOT) Standard Specifications for Highway and Structure Construction.

1.02 DESCRIPTION

- A. Section includes all labor, materials, equipment, and related services necessary to furnish and install all concrete pavement and as indicated on drawings or specified herein.
- B. Section Includes:
 - 1. Exterior Concrete Paving, with the exception of concrete stoop at existing personnel door along east side of building.
- C. Refer to Section 03 30 00 for interior cast-in-place concrete specification.

1.03 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Design Mixtures: For each concrete paving mixture. Include alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
- C. Provide reinforcement plan, control joint plan, and pouring plan. Include bar sizes, lengths, material, grade, bar schedules, bar arrangement, mechanical connections and supports for concrete reinforcement.

1.04 QUALITY ASSURANCE

- A. Ready-Mix-Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
- B. ACI Publications: Comply with ACI 301 (ACI 301M) unless otherwise indicated.

PART 2 PRODUCTS

2.01 STEEL REINFORCEMENT

- A. Recycled Content: Provide steel reinforcement with an average recycled content of steel so postconsumer recycled content plus one-half of preconsumer recycled content is not less than 25 percent.

- B. Plain-Steel Welded Wire Reinforcement: ASTM A 185/A 185M, fabricated from as-drawn steel wire into flat sheets.

2.02 CONCRETE MATERIALS

- A. Cementitious Material: Use cementitious materials, of same type, brand, and source throughout Project, meeting WisDOT Section 501:
 - 1. Portland Cement: ASTM C 150, white portland cement Type I:
 - a. Fly Ash: ASTM C 618, Class C.
 - b. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.
- B. Normal-Weight Aggregates: ASTM C 33, Class 4S, uniformly graded. Provide aggregates from a single source.
- C. Water: Potable and complying with ASTM C 94/C 94M.
- D. Air-Entraining Admixture: ASTM C 260.
- E. Chemical Admixtures: Admixtures certified by manufacturer to be compatible with other admixtures and to contain not more than 0.1 percent water-soluble chloride ions by mass of cementitious material.

2.03 CURING MATERIALS

- A. Absorptive Cover: AASHTO M 182, Class 3, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. (305 g/sq. m) dry or cotton mats.
- B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- C. Water: Potable.
- D. Evaporation Retarder: Waterborne, monomolecular, film forming, manufactured for application to fresh concrete.
- E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.
- F. White, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 2, Class B, dissipating.

2.04 RELATED MATERIALS

- A. Joint Fillers: ASTM D 1751, asphalt-saturated cellulosic fiber or ASTM D 1752, cork or self-expanding cork in preformed strips.

2.05 CONCRETE MIXTURES

- A. Prepare design mixtures, proportioned according to ACI 301 (ACI 301M), with the following properties:

1. Compressive Strength (28 Days): 4,500 psi
2. Slump Limit: 3 inches (100 mm), plus or minus 1 inch (25 mm).
3. Air Content: 6 percent plus or minus 1.5 percent.

B. Chemical Admixtures: Use admixtures according to manufacturer's written instructions.

2.06 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M and ASTM C 1116/C 1116M. Furnish batch certificates for each batch discharged and used in the Work.

1. When air temperature is between 85 and 90 degrees F, reduce mixing and delivery time from 1.5 hours to 75 minutes; when air temperature exceeds 90 degrees F, reduce mixing and delivery time to 60 minutes.

PART 3 EXECUTION

3.01 EXAMINATION AND PREPARATION

A. Proof-roll prepared subbase surface below concrete paving to identify soft pockets and areas of excess yielding.

B. Remove loose material from compacted subbase surface immediately before placing concrete.

3.02 EDGE FORMS AND SCREED CONSTRUCTION

A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.

B. Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage.

3.03 STEEL REINFORCEMENT

A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.

3.04 JOINTS

A. General: Form construction, isolation, and contraction joints and tool edges true to line, with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline unless otherwise indicated.

B. Construction Joints: Set construction joints at side and end terminations of paving and at locations where paving operations are stopped for more than one-half hour unless paving terminates at isolation joints.

C. Isolation Joints: Form isolation joints of preformed joint-filler strips abutting foundation walls, manholes, inlets, structures, other fixed objects, and where indicated.

- D. Contraction Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of the concrete thickness.
- E. Edging: After initial floating, tool edges of paving, gutters, curbs, and joints in concrete with an edging tool. Repeat tooling of edges after applying surface finishes. Eliminate edging-tool marks on concrete surfaces.

3.05 CONCRETE PLACEMENT.

- A. Moisten subbase to provide a uniform dampened condition at time concrete is placed.
- B. Comply with ACI 301 (ACI 301M) requirements for measuring, mixing, transporting, placing, and consolidating concrete.
- C. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.
- D. Screed paving surface with a straightedge and strike off.
- E. Commence initial floating using bull floats or darbies to impart an open-textured and uniform surface plane before excess moisture or bleed water appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading surface treatments.
- F. Cold-weather Placement: Comply with ACI 306.1.
- G. Hot-weather Placement: Comply with ACI 301.

3.06 FLOAT FINISHING

- A. General: Do not add water to concrete surfaces during finishing operations.
- B. Float Finish: Begin the second floating operation when bleed-water sheen has disappeared and concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats or by hand floating if area is small or inaccessible to power units. Finish surfaces to true planes. Cut down high spots and fill low spots. Refloat surface immediately to uniform granular texture.
 - 1. Medium-to-Fine-Textured Broom Finish: Draw a soft-bristle broom across float-finished concrete surface perpendicular to line of traffic to provide a uniform, fine-line texture.

3.07 CONCRETE PROTECTION AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.
- B. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.
- C. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h (1 kg/sq. m x h) before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete but before float finishing.

- D. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.
- E. Curing Methods: Cure concrete by moisture curing, moisture-retaining-cover curing, curing compound, or a combination of these.

3.08 PAVING TOLERANCES

- A. Comply with tolerances in ACI 117 and as follows:
 - 1. Elevation: 3/4 inch (19 mm).
 - 2. Thickness: Plus 3/8 inch (10 mm), minus 1/4 inch (6 mm).
 - 3. Surface: Gap below 10-foot- (3-m-) long, unlevelled straightedge not to exceed 1/2 inch (13 mm).
 - 4. Joint Spacing: 3 inches (75 mm).
 - 5. Contraction Joint Depth: Plus 1/4 inch (6 mm), no minus.
 - 6. Joint Width: Plus 1/8 inch (3 mm), no minus.
- B. Material will be tested by independent testing agency paid for by Owner.

3.09 REPAIRS AND PROTECTION

- A. Remove and replace concrete paving that is broken, damaged, or defective or that does not comply with requirements in this Section. Remove work in complete sections from joint to joint unless otherwise approved by Engineer.
- B. Protect concrete paving from damage. Exclude traffic from paving for at least 14 days after placement. When construction traffic is permitted, maintain paving as clean as possible by removing surface stains and spillage of materials as they occur.
- C. Maintain concrete paving free of stains, discoloration, dirt, and other foreign material. Sweep paving not more than two days before date scheduled for Substantial Completion inspections.

END OF SECTION

SECTION 33 48 00

PIPING AND MANHOLES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Conditions of the Contract and portions of Division One of this Project Manual apply to this Section as though repeated herein.

1.02 DESCRIPTION

- A. Section includes requirements for subsurface drainage and storm water piping and manholes.

1.03 REFERENCES

- A. American Society of Testing Materials (ASTM)
 - 1. ASTM F405-13 - Standard Specification for Corrugated Polyethylene (PE) Pipe, and Fittings.
- B. State of Wisconsin Department of Transportation (WisDOT):
 - 1. Standard Specifications for Highway and Structure Construction, latest edition.

1.04 SUBMITTALS

- A. Submit in accord with the General Conditions of the Contract.
- B. Submit shop drawings for all piping systems and manholes and appurtenances.

PART 2 PRODUCTS

2.01 TOE DRAIN PIPE AND FITTINGS

- A. Manufacturers
 - 1. Advanced Drainage Systems, Inc.
 - 2. Approved equal.
- B. High Density Polyethylene (HDPE) corrugated perforated pipe with smooth interior pipe wall.
- C. Pipe to be wrapped with geotextile by pipe manufacturer.
- D. Suitable for H20 wheel loadings.
- E. Slot perforation of 0.875 inch by 0.120 inch.
- F. Fittings to conform to Advanced Drainage Systems N-12 fittings.

2.02 STORM SEWER PIPE

- A. SDR 35 PVC or equivalent.

2.03 MANHOLE

- A. Description: Standard precast concrete manhole.
- B. Joint Sealant: ATSM C 990, bitumen or butyl rubber.
- C. Casting: WisDOT Type L

PART 3 EXECUTION

3.01 INSTALLATION

A. Piping

1. Set to elevations indicated on Drawings.
2. Install pipe in accordance with manufacturer's instructions and Section 31 20 00.

B. Manholes

1. Set to elevations indicated on Drawings.
2. Install in accordance with manufacturer's instructions and Section 31 20 00.
3. All jointings and connections must be watertight.
4. Seal joints between concrete sections with preformed flexible joint sealant installed in accordance with applicable requirements of ASTM C 990 and manufacturer's instructions. Connections should be made with mortar joints.
5. Clean out all soil, debris, or other accumulated matter from all manholes before the Engineer will accept the work. Remove all materials in all of these structures deposited or lodged due to the Contractor's operations.

END OF SECTION