



CONSTRUCTION DOCUMENTS PROJECT MANUAL

DANE COUNTY DEPARTMENT OF PUBLIC WORKS,
HIGHWAY AND TRANSPORTATION

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

REQUEST FOR BIDS NO. 309030 PUBLIC SAFETY COMMUNICATION CENTER INFRASTRUCTURE UPGRADES CITY-COUNTY BUILDING 210 MARTIN LUTHER KING JR. BLVD. MADISON, WISCONSIN

*** Pre-bid meeting is scheduled on Wednesday December 16, 2009 at 9:00 AM***
City-County Building, 210 Martin Luther King Jr. Blvd, in Room 310

Opening Date / Time: **TUESDAY, DECEMBER 29, 2009 / 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:

ROB NEBEL, PROJECT MANAGER
TELEPHONE NO.: 608/267-0119
FAX NO.: 608/267-1533
E-MAIL: NEBEL@CO.DANE.WI.US

DOCUMENT INDEX FOR RFB NO. 309030

NOTE:

This project was previously listed as RFB No. 109055. Please disregard any reference to this bid number. All documents within these Specifications and Drawings containing references to this number are current and accurate for this project.

PROCUREMENT AND CONTRACTING REQUIREMENTS

- Project Manual Cover Page
- Documents Index and Dane County Vendor Registration Program
- Invitation to Bid (Legal Notice)
- Instructions to Bidders
- Bid Form
- Fair Labor Practices Certification
- Best Value Contracting Application
- Sample Public Works Contract
- Sample Bid Bond
- Sample Performance Bond
- Sample Payment Bond
- General Conditions of Contract
- Supplementary Conditions

DIVISION 01 - GENERAL REQUIREMENTS

- 01 00 00 – Basic Requirements
- 01 74 19 – Recycling
- 01 53 29 – Interim Life Safety Program
- 01 56 39 – Protection of Existing Trees
- 01 81 19 – Indoor Air Quality Control

Machine-Readable Project Information Transfer

DIVISION 02 - EXISTING CONDITIONS

- 02 41 19 – Selective Demolition

DIVISION 03 - CONCRETE

- 03 30 00 – Cast-In-Place Concrete
- 03 54 13 – Gypsum Cement Underlayment

DIVISION 04 - MASONRY

- 04 20 00 Unit Masonry

DIVISION 05 - METALS

- 05 50 00 – Miscellaneous Metals

DIVISION 06 - WOOD, PLASTICS, AND COMPOSITES

- 06 09 00 – Rough and Finish Carpentry
- 06 40 00 – Millwork

DIVISION 07 - THERMAL AND MOISTURE PROTECTION

- 07 21 00 – Building Insulation
- 07 53 00 – EPDM Roof Patching
- 07 60 00 – Architectural Sheet Metal Work
- 07 84 00 – Firestopping
- 07 90 00 – Caulking and Sealants

DIVISION 08 - OPENINGS

- 08 11 00 – Hollow Metal Doors
- 08 14 00 – Wood Doors
- 08 56 53 – Bullet Resistant Aluminum Windows
- 08 70 00 – Finish Hardware
- 08 80 00 – Glass and Glazing

DIVISION 09 - FINISHES

- 09 21 16 – Gypsum Board Assemblies
- 09 24 00 – Portland Cement Plaster
- 09 30 00 – Tiling
- 09 51 00 – Acoustical Ceilings
- 09 65 00 – Resilient Base
- 09 68 13 – Carpet Tile
- 09 69 00 – Access Floor System
- 09 84 00 – Acoustical Wall Panels
- 09 90 00 – Painting

DIVISION 10 - SPECIALTIES

- 10 44 00 – Fire Extinguishers and Cabinets
- 10 51 13 – Metal Lockers

DIVISION 12 - FURNISHINGS

- 12 21 00 – Horizontal Blinds

DIVISION 13 -SPECIAL CONSTRUCTION

- 13 40 00 – Bullet Resistant Transaction Window

DIVISION 21 - FIRE SUPPRESSION

- 21 05 00 – Common Work Results for Fire Protection
- 21 05 29 – Hanger and Supports for Fire Suppression Piping and Equipment
- 21 10 00 – Water-Based Fire Suppression Systems

DIVISION 22 - PLUMBING

- 22 05 00 – Common Work Results for Plumbing
- 22 05 14 – Plumbing Specialties
- 22 05 29 – Hangers and Supports for Plumbing Piping and Equipment
- 22 07 00 – Plumbing Insulation
- 22 11 00 – Facility Water Distribution
- 22 13 00 – Facility Sanitary Sewerage
- 22 14 00 – Facility Storm Drainage

DIVISION 23 - HEATING, VENTILATING, AND AIR CONDITIONING

- 23 01 30.51 – HVAC Air Duct Cleaning
- 23 05 00 – Common Work Results for HVAC
- 23 05 13 – Common Motor Requirements for HVAc Equipment
- 23 05 14 – Variable Frequency Drives
- 23 05 15 – Piping Specialties
- 23 05 23 – General Duty Valves for HVAC
- 23 05 29 – Hangers and Supports for HVAC Piping and Equipment
- 23 05 48 – Vibration and Seismic Controls for HVAC Piping and Equipment
- 23 05 93 – Testing, Adjusting and Balancing for HVAC
- 23 07 00 – HVAC Insulation
- 23 09 23 – HVAC Controls and Instruments
- 23 09 24 – Direct Digital Control System for HVAC (DDCS)

- 23 09 25 – Integrated Automation System (IAS)
- 23 21 13 – Hydronic Piping
- 23 21 23 – Hydronic Pumps
- 23 25 00 – HVAC Water Treatment
- 23 31 00 – HVAC Ducts and Casings
- 23 33 00 – Air Duct Accessories
- 23 36 00 – Air Terminal Units
- 23 37 13 – Diffusers, Registers, and Grilles
- 23 41 00 – Particulate Air Filtration
- 23 57 00 – Heat Exchangers for HVAC
- 23 64 15 – Dedicated Heat Recovery Chiller
- 23 65 33 – Drycooler Units
- 23 82 00 – Heating Terminal Units

DIVISION 26 - ELECTRICAL

- 26 05 00 – Common Work Results for Electrical
- 26 05 02 – Electrical Demolition for Remodeling
- 26 05 04 – Cleaning, Inspection and Testing Electrical Equipment
- 26 05 19 – Low-Voltage electrical Power Conductors and Cables
- 26 05 26 – Grounding and Bonding for Electrical Systems
- 26 05 29 – Hangers and Supports for Electrical Systems
- 26 05 33 – Raceway and Boxes for Electrical Systems
- 26 05 53 – Identification for Electrical Systems
- 26 24 16 – Panelboards
- 26 27 02 – Equipment Wiring Systems
- 26 27 26 – Wiring Devices
- 26 27 28 – Disconnect Switches
- 26 28 13 – Fuses
- 26 29 00 – Low-Voltage Controllers
- 26 33 53 – Uninterruptible Power Supply System
- 26 51 13 – Interior Lighting Fixtures, Lamps, and Ballasts

DIVISION 27 - COMMUNICATIONS

- 27 00 00 – Communication Cable and Equipment

DIVISION 28 - ELECTRONIC SAFETY AND SECURITY

- 28 20 00 – Closed Circuit Television System
- 28 31 00 – Fire Detection and Alarm

DRAWINGS

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

- T1.0 Title Sheet
- A1.1 Code Review Sheet
- A1.2 Phasing Diagram
- AD2.1 Demolition Plan
- A2.1 Floor Plan
- A2.2 Reflected Ceiling Plan
- A3.1 Roof Plan, Elevation, & Section
- A4.1 Doors, Frames, Windows, & Details
- A5.1 Schedules & Interior Elevations
- HT1.1 HVAC Temporary Plan
- HD2.1 HVAC Demolition Plan

H2.1	HVAC New Work Plan
H2.2	HVAC New Work Plan
H2.3	HVAC New Work Plan
H3.1	HVAC Demolition & New Work Plan
H4.1	HVAC Details
H4.2	HVAC Details
H5.1	HVAC Schedules
H5.2	HVAC Schedules
H6.1	HVAC Controls Sequences
H6.2	HVAC Controls Sequences
H6.3	HVAC Controls Sequences
E0.1	Electrical Symbols & Abbreviations
ET1.1	Electrical Temporary Plans
ED1.1	Electrical Demolition Plans
E2.1	Electrical New Work Plan
E2.1	Electrical Demolition and New Work Plan
E4.1	Electrical Schedules
E5.1	Electrical On Line Diagrams
TT1.1	Telecom Temporary Plan
TD2.1	Telecom Demolition Plan
T2.1	Telecom New Work Plan
P0.1	Plumbing Symbols, Notes, & Abbreviations
PD2.1	Plumbing & Fire Protection Demolition Plan
P2.1	Plumbing & Fire Protection

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., TUESDAY, DECEMBER 29, 2009

REQUEST FOR BIDS NO. 309030

PUBLIC SAFETY COMMUNICATIONS CENTER INFRASTRUCTURE UPGRADES

**CITY-COUNTY BUILDING
210 MARTIN LUTHER KING, JR. BLVD.
MADISON, WISCONSIN**

Dane County is inviting Bids for the remodel of approximately 10,000 square feet to the 911 Center. Construction consists of electrical, heating and ventilating, telephone / data and architectural.

Request for Bids package may be obtained at Dane County Public Works, Highway & Transportation Dept., 1919 Alliant Energy Center Way, Madison, WI 53713, by calling 608-266-4018, or downloading it from www.countyofdane.com/pwht/bid/logon.aspx. Please call Rob Nebel, Assistant Public Works Director, at 608-267-0119 for any questions or additional information.

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

Pre-bid tour will be held on Wednesday, December 16, 2009 at 9:00 a.m. Meet in Room 310 of the City-County Building, 210 Martin Luther King, Jr. Blvd., Madison, WI. Bidders are strongly encouraged to attend.

PUBLISH: DECEMBER 3 & 10, 2009 - WISCONSIN STATE JOURNAL

DECEMBER 2 & 9, 2009 - DAILY REPORTER

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 Wednesday December 16, 2009 at 9:00 AM at City-County Building, 210 Martin Luther King Jr. Blvd, in Room 310. Attendance by all bidders is optional, however bidders and subcontractors are strongly encouraged to attend.
- D. Visits at other times can also be arranged. Coordinate site access activities with Project Engineer, Steve Richards, 608/219-6339. Notification of site visits must be received 24 hours prior to visit.
- E. Failure to visit site or failure to examine any and all Construction Documents will in no way relieve successful Bidder from necessity of furnishing any necessary materials or equipment, or performing any work, that may be required to complete the Work in accordance with Drawings and Specifications. Neglect of above requirements will not be accepted as reason for delay in the Work or additional compensation.

2. DRAWINGS AND SPECIFICATIONS

- A. Drawings and Specifications that form part of this Contract, as stated in Article 1 of General Conditions of Contract are enumerated in Document Index of these Construction Documents.
- B. Complete sets of Drawings and Specifications for all trades will be issued to all Bidders, irrespective of category of work to be bid on, in order that all Bidders may be familiar with work of other trades as they affect their bid.
- C. Hard copies are available for pick up at the Dane County Public Works office located at 1919 Alliant Energy Center Way, Madison WI. A fully refundable deposit in the amount of \$35.00 is required for hard copies of plans and specifications. For deposit refund, return complete sets of Drawings and Specifications to same location they were picked up within 90 days after Bid Opening date. After that time, deposit will be forfeited.

3. INTERPRETATION

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

4. QUALIFICATIONS OF BIDDER (CONTRACTOR AND SUBCONTRACTOR)

- A. Before award of Contract can be approved, Owner shall be satisfied that Bidder involved meets following requirements:
 - 1. Has completed at least one (1) project of at least fifty percent (50%) of size or value of Division of work being bid and type of work completed is similar to that being bid. If greater magnitude of experience is deemed necessary, other than size or value of work, such requirements will be described in appropriate section of Specifications.
 - 2. Maintains permanent place of business.
 - 3. Can be bonded for terms of proposed Contract.
 - 4. Has record of satisfactorily completing past projects. Successful Bidder may be required to provide list of maximum five (5) most recent, similar projects, with architect or engineer's and owner's names, addresses and telephone numbers for each project. Submit to Public Works Project Engineer within three (3) days after request of such information. 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 Opening.
- C. If successful Bidder so delivers Contract, Certificate of Insurance, and Performance and Payment Bonds, check will be returned to Bidder. In case Bidder fails to deliver such Contract, insurance, and bond, amount of bid guarantee will be forfeited to County as liquidated damages.
- D. All checks tendered as bid guarantee, except those of three lowest qualified, responsible bidders, will be returned to their makers within three (3) days after Bid Opening. All such retained checks will be returned immediately upon signing of Contract and Performance and Payment Bonds by successful Bidder.

6. WITHDRAWAL OF BIDS

- A. Bids may be withdrawn by written request received from bidder or authorized representative thereof prior to time fixed for Bid Opening, without prejudice to right of bidder to file new Bid. Withdrawn Bids will be returned unopened. Negligence on part of bidder in preparing their Bid confers no right for withdrawal of Bid after it has been opened.
- B. No Bid may be withdrawn for period of sixty (60) days after Bid Opening date.

- C. If Bid contains error, omission or mistake, bidder may limit liability to amount of bidder's guarantee by giving written Notice of Intent not to execute Contract to Owner within seventy-two (72) hours of Bid Opening.

7. CONTRACT FORM

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

8. CONTRACT INTERESTS BY COUNTY PUBLIC OFFICIALS

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

9. EMERGING SMALL BUSINESS PROVISIONS

- A. **Emerging Small Business Definition.** For purposes of this provision, ESB is defined as:
 - 1. Independent business concern that has been in business minimum of one year;
 - 2. Business located in State of Wisconsin;
 - 3. Business comprised of less than 25 employees;
 - 4. Business must not have gross sales in excess of three million dollars (\$3,000,000.00) over past three years; and
 - 5. Business does not have history of failing to complete projects.
- B. **Emerging Small Business (ESB) Involvement.** Bidder shall make good faith effort to award minimum of ten percent (10%) of the Work to ESBs. Bidder shall submit report to Dane County Contract Compliance Officer within twenty-four (24) hours after Bid Opening demonstrating such efforts. Good faith efforts means significant contact with ESBs for purposes of soliciting bids from them. Failure to make or demonstrate good faith efforts will be grounds for disqualification.
- C. **Emerging Small Business Report.** Emerging Small Business Enterprise Report is to be submitted by Bidder in separate envelope marked "Emerging Small Business Report". This report is due by 2:00 p.m. following specified twenty-four (24) hours after Bid Opening. Bidder who fails to submit Emerging Small Business Report shall be deemed not responsive.
- D. **ESB Goal.** Ten percent (10%) ESB participation is goal of this project. ESB utilizations are shown as percentage of total Bid. If Bidder meets or exceeds specified goal, Bidder is only required to submit Form A - Certification, and Form B - Involvement. Goal shall be met if Bidder qualifies as ESB.

- E. **Report Contents.** Following award of Contract, Bidder shall submit copies of executed contracts for all Emerging Small Businesses. Emerging Small Business Report shall consist of these:
1. Form A - Certification;
 2. Form B - Involvement;
 3. Form C - Contacts;
 4. Form D - Certification Statement (if appropriate); and
 5. Supportive documentation (i.e., copies of correspondence, telephone logs, copies of advertisements).
- F. **ESB Listing.** Bidders will solicit bids from ESB listing provided by Dane County.
- G. **ESB Certification.** All contractors, subcontractors and suppliers seeking ESB certification must complete and submit Emerging Small Business Certification Application to Dane County Contract Compliance Program.
- H. **Certification Statement.** If ESB firm has not been certified by County as ESB prior to submittal of this Bid, ESB Report cannot be used to fulfill ESB goal for this project unless firm provides "Form D - Certification Statement". Certification statement must be completed and signed by ESB firm.
- I. **Questions.** Questions concerning Emerging Small Business provisions shall be directed to:
Dane County Contract Compliance Officer
City-County Building, Room 421
210 Martin Luther King, Jr. Blvd.
Madison, WI 53703
608/266-5623
- J. **Substituting ESBs.** In event of any significant changes in subcontract arrangements or if need arises to substitute ESBs, Bidder shall report such proposed changes to Contract Compliance Officer to making any official changes and request authorization to substitute ESB firm. Bidder further agrees to make every possible effort to replace ESB firm with another qualified ESB firm.
- K. **Good Faith Efforts.** Good faith efforts can be demonstrated by meeting all of these obligations:
1. Selecting portions of the Work to be performed by ESBs in order to increase likelihood of meeting ESB goal including, where appropriate, breaking down Contract into smaller units to facilitate ESB participation.
 2. Advertising in general circulation, trade associations, and women / minority focus media concerning subcontracting opportunities.
 3. Providing written notices to reasonable number of specific ESBs that their interest in Contract was being solicited in sufficient time to allow ESBs to participate effectively.
 4. Following up on initial solicitations of interest by contacting ESBs within five (5) working days prior to Bid Opening date to determine with certainty whether ESB were interested, to allow ESBs to prepare bids.

5. Providing interested ESB with adequate information about Drawings, Specifications and requirements of Contract.
6. Using services of available minority, women and small business organizations and other organizations that provide assistance in recruitment of MBEs / WBEs / ESBs.
7. Negotiating in good faith with interested ESBs, not rejecting ESBs as unqualified without sound reason based on thorough investigation of their capabilities.
8. Submitting required project reports and accompanying documents to County's Contract Compliance Officer within twenty-four (24) hours after Bid Opening.

L. **Appeals Disqualification of Bid.** Bidder who is disqualified may appeal to Public Works & Transportation Committee and Equal Opportunity Commission.

10. METHOD OF AWARD - RESERVATIONS

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

11. SECURITY FOR PERFORMANCE AND PAYMENTS

- A. Simultaneous with delivery of signed Contract, Bidder shall be required to furnish Performance and Payment Bonds as specified in Article 29 of General Conditions of Contract, "Contract Security". Surety Company shall be licensed to do business in Wisconsin. Performance and Payment Bonds must be dated same date or subsequent to date of Contract. Performance and Payment Bonds must emulate information in Sample Performance and Payment Bonds in Construction Documents.
- B. Provide certified copy of power of attorney from Surety Company showing that agent who signs Bond has power of attorney to sign for Surety Company. Secretary or Assistant Secretary of company must sign this certification, not attorney-in-fact. Certification must bear same or later date as Bond. Power of Attorney must emulate model power of attorney information detailed in Sample Performance and Payment Bonds.
- C. If Bidder is partnership or joint venture, State certified list, providing names of individuals constituting partnership or joint venture must be furnished. Contract itself may be signed by one partner of partnership, or one partner of each firm comprising joint venture, but Performance and Payment Bonds must be signed by all partners.
- D. If Bidder is a corporation, it is necessary that current certified copy of resolution or other official act of directors of corporation be submitted showing that person who signs Contract is authorized to sign contracts for corporation. It is also necessary that corporate seal be affixed to resolution, contract, and performance and payment bonds. If your corporation has

no seal, it is required that above documents include statement or notation to effect that corporation has no seal.

12. TAXES

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

13. SUBMISSION OF BIDS

- A. All Bids shall be submitted on standard Bid Form bound herein and only Bids that are made on this Bid Form will be considered. Entire Bid Form and other supporting documents, if any, shall be removed or copied from Construction Documents, filled out, and submitted in manner specified hereinafter. Submit completed Bid Bond with Bid as well.
- B. No bids for any subdivision or any sub-classification of this Work, except as indicated, will be accepted. Any conditional Bid, amendment to Bid Form or appended item thereto, or inclusion of any correspondence, written or printed matter, or details of any nature other than that specifically called for, which would alter any essential provision of Construction Documents, or require consideration of unsolicited material or data in determining award of Contract, will disqualify Bid. Telecommunication alterations to Bid will not be accepted.
- C. Bidders must submit single Bid for all the Work.
- D. Bid amounts shall be inserted in words and in figures in spaces provided on Bid Form; in case of conflict, written word amounts will govern.
- E. Addenda issued after Bid Letting shall become part of Construction Documents. Bidders shall acknowledge receipt of such addenda in appropriate space provided on Bid Form. Bid will be rejected if receipt of any particular addendum applicable to award of Contract has not been acknowledged on Bid Form.
- F. Bids shall be signed, placed in envelope, sealed and delivered before time of closing to place designated in Invitation to Bid, and identified with project name, bid number, location, category of work being bid upon, Bid Opening date, name and address of bidder.
- G. Bidder shall be responsible for sealed Bid being delivered to place designated for Bid Opening on or before date and time specified. Bids received after time of closing will be rejected and returned to bidder unopened.
- H. Bid will be considered invalid and will be rejected if bidder has not signed it.
- I. Faxed Bids will not be accepted.

- J. Bidder's organization shall submit completed with Bid, Fair Labor Practices Certification form, included in these Construction Documents.

14. SUBCONTRACTOR LISTING

- A. Bidders shall be required to submit list of major subcontractors for General Construction, Plumbing, HVAC, 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. Bidder shall state amount that is included in Base Bid for all equipment, materials and labor required to complete the Work described. Informational bids are amounts requested for accounting purposes and for allocation of funds only. It is not intended to omit any of the Work described or related items from this project.
- B. Description of requested Informational Bids, if any, is as set forth in Construction Documents.

17. UNIT PRICES

- A. Provide unit prices where 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. SPECIAL HAZARDS COVERAGE

- A. Not Applicable.

FORM A

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

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

PROJECT NAME: _____

BID NO.: _____ BID OPENING DATE: _____

BIDDER INFORMATION

COMPANY NAME: _____

ADDRESS: _____

TELEPHONE NO.: _____

CONTACT PERSON: _____

FORM B

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

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

COMPANY NAME: _____

PROJECT NAME: _____ BID NO.: _____

ESB NAME: _____ CONTACT PERSON: _____

ADDRESS: _____ PHONE NO.: _____

CITY: _____ STATE: _____ ZIP: _____

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

ESB NAME: _____ CONTACT PERSON: _____

ADDRESS: _____ PHONE NO.: _____

CITY: _____ STATE: _____ ZIP: _____

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

ESB NAME: _____ CONTACT PERSON: _____

ADDRESS: _____ PHONE NO.: _____

CITY: _____ STATE: _____ ZIP: _____

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

FORM C

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

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

COMPANY NAME: _____

PROJECT NAME: _____ BID NO.: _____

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

FORM D

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

I, _____, _____ of
Name Title

_____ certify to best of my knowledge and
Company

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

Bidder's Signature

Date

BID FORM

BID NO. 309030

**PROJECT: DANE COUNTY PUBLIC SAFETY COMMUNICATION CENTER
INFRASTRUCTURE UPGRADES
CITY-COUNTY BUILDING**

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

BASE BID - LUMP SUM:

Work includes construction services for office space remodel of approximately 10,000 sq. ft. including drywall partitions, flooring, ceiling, HVAC, electrical and fire protection. The undersigned, having examined the site where the Work is to be executed and having become familiar with local conditions affecting the cost of the Work and having carefully examined the Drawings and Specifications, all other Construction Documents and Addenda thereto prepared by Dane County Department of Public Works, Highway & Transportation hereby agrees to provide all labor, materials, equipment and services necessary for the complete and satisfactory execution of the entire Work, as specified in the Construction Documents, for the Base Bid stipulated sum of:

_____ and _____ /100 Dollars
Written Price

\$ _____
Numeric Price

The undersigned further agrees to add the alternate(s) portion of the Work as described, for the following addition(s) to or subtraction(s) from the Base Bid stipulated below. They further agree to honor the alternate(s) bid for 60 days from date of Award of Contract.

ALTERNATE BID 1 - LUMP SUM:

Provide credit for deleting plate to plate heat exchanger HX-1 and all associated piping and controls to that unit. Replace heat recovery chillers CH-1 and CH-2 with normal chillers at the same conditions as scheduled for the heat recovery chillers.

_____ and _____ /100 Dollars
Written Price

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

ALTERNATE BID 2 – LUMP SUM:

Provide a price addition for providing variable frequency drives (VFD) on each existing heating pumps (P-1 and P-2) located on the second floor which serve the first floor heating water system. Provide piping and controls to operate the pumps using the VFDs. The two pumps are 7.5 horse power each, 460 volt 3 phase. Do not provide a bypass for the VFDs.

_____ and _____ /100 Dollars
Written Price

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

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

Addendum No(s). _____ through _____

Dated _____

Dane County Department of Public Works must have this project completed by May 18, 2010. Assuming this Work can be started by January 18, 2010, what dates can you commence and complete this job?

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

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

(Name of Corporation, Partnership or Person submitting Bid)

Select one of the following:

1. A corporation organized and existing under the laws of the State of _____, or
2. A partnership consisting of _____, or
3. A person conducting business as _____;

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

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

SIGNATURE: _____
(Bid is invalid without signature)

Print Name: _____ Date: _____

Title: _____

Address: _____

Telephone No.: _____ Fax No.: _____

Email Address: _____

Contact Person: _____

THIS PAGE IS FOR BIDDERS' REFERENCE AND NEED NOT BE SUBMITTED WITH BID FORM.

BID CHECK LIST:

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

Bid Form (pg. 1-3)

Bid Bond

Fair Labor Practices Certification

BIDDERS SHOULD BE AWARE OF THE FOLLOWING:

DANE COUNTY VENDOR REGISTRATION PROGRAM

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

www.danepurchasing.com/registration

DANE COUNTY BEST VALUE CONTRACTING PRE-QUALIFICATION

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

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

EQUAL BENEFITS REQUIREMENT

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

www.danepurchasing.com/partner_benefit.aspx

FAIR LABOR PRACTICES CERTIFICATION

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

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

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

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

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

Officer or Authorized Agent Signature

Date

Printed or Typed Name and Title

Printed or Typed Business Name

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

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

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

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



DANE COUNTY DEPARTMENT of PUBLIC WORKS, HIGHWAY and TRANSPORTATION

County Executive
Kathleen M. Falk

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

Commissioner / Director
Gerald J. Mandli

BEST VALUE CONTRACTING APPLICATION

CONTRACTORS / LICENSURE APPLICANTS

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

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

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

EXEMPTIONS

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

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

SIGNATURE SECTION

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

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

Signature

Date

Printed or Typed Name and Title

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

REMEMBER!

Return all to forms and attachments, or questions to:

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

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

APPENDIX A

APPRENTICEABLE TRADES

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

COUNTY OF DANE

PUBLIC WORKS CONTRACT

Contract No. _____ Bid No. 309030

Authority: Res. _____, [2009-10]

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

WITNESSETH:

WHEREAS, COUNTY, whose address is c/o Associate Public Works Director, 1919 Alliant Energy Center Way, Madison, WI 53713, desires to have CONTRACTOR provide Infrastructure Upgrades for the Public Safety Communications Center including Alternate Bid(s) (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 Venture Architects (hereinafter referred to as "the Architect / Engineer"), and as enumerated in the Project Manual Document Index, all of which are made a part hereof and collectively evidence and constitute the Contract.

2. COUNTY agrees to pay the CONTRACTOR in current funds for the performance of the Contract subject to additions and deductions, as provided in the General Conditions of Contract, and to make payments on account thereof as provided in Article entitled, "Payments to Contractor" of the General Conditions of Contract.

3. During the term of this Contract, CONTRACTOR agrees to take affirmative action to ensure equal employment opportunities. The CONTRACTOR agrees in accordance with Wisconsin Statute 111.321 and Chapter 19 of the Dane County Code of Ordinances not to discriminate on the basis of age, race, ethnicity, religion, color, gender, disability, marital status, sexual orientation, national origin, cultural differences, ancestry, physical appearance, arrest record or conviction record, military participation or membership in the national guard, state defense force or any other reserve component of the military forces of the United States, or political beliefs.

Such equal opportunity shall include, but not be limited to, the following: employment, upgrading, demotion, transfer, recruitment, advertising, layoff, termination, training, rates of pay, and any other form of compensation. CONTRACTOR agrees to post in conspicuous places, available to all employees and applicants for employment, notices setting forth the provisions of this paragraph.

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

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

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

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

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

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

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

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

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

* * * * *

FOR CONTRACTOR:

Signature Date

Printed or Typed Name and Title

Signature Date

Printed or Typed Name and Title

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

* * * * *

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

FOR COUNTY:

Kathleen M. Falk, County Executive Date

Robert Ohlsen, County Clerk Date

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:

GENERAL CONDITIONS OF CONTRACT

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1. CONSTRUCTION DOCUMENTS

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

2. DEFINITIONS

- A. These terms as used in this Contract are respectively defined as follows:
 - 1. All uses of term "County" in Construction Documents shall mean Dane County.
 - 2. All uses of term "Department" in Construction Documents shall mean Department of Public Works, Highway & Transportation, which is a unit of Dane County government. Department is County agency overseeing Contract with Contractor.
 - 3. Public Works Project Engineer is appointed by and responsible to Department. Public Works Project Engineer has authority to act on behalf of Department and will sign change orders, payment requests and other administrative matters related to projects.
 - 4. Public Works Project Engineer is responsible for supervision, administration and management of field operations involved in construction phase of this Work.
 - 5. 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 omission 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 time 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 Engineer.
- C. Contractor shall furnish, erect, maintain and remove such temporary works as may be required.
- D. Contractor shall observe, comply with, and be subject to all terms, conditions, requirements and limitations of Construction Documents.
- E. At the Work site, Contractor shall give personal superintendence to the Work or shall employ construction superintendent or foreman, experienced in character of work covered by Contract, who shall have full authority to act for Contractor. Understand that such superintendent or foreman shall be acceptable to Architect / Engineer and Department.
- F. Remove from project or take other corrective action upon notice from Architect / Engineer or Department for Contractor's employees whose work is considered by Architect / Engineer or Department to be unsatisfactory, careless, incompetent, unskilled or otherwise objectionable.
- G. Contractor and subcontractors shall be required to conform to Labor Laws of State of Wisconsin and various acts amendatory and supplementary thereto and to other laws, ordinances and legal requirements applicable to the Work.
- H. Presence and observation of the Work by Architect / Engineer or Public Works Project Engineer shall not relieve Contractor of any obligations.

14. WEATHER CONDITIONS

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

15. PROTECTION OF WORK AND PROPERTY

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

16. INSPECTION AND TESTING OF MATERIALS

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

18. CHANGES IN THE WORK

- A. Make no changes, except in cases of emergency, in the Work covered by approved Construction Documents without having prior written approval of Department. Charges or credits for the Work covered by approved change shall be determined 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 Engineer to proceed.

19. EXTRAS

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

20. TIME FOR COMPLETION

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

21. CORRECTION OF WORK

- A. All work, all materials whether incorporated in the Work or not, and all processes of manufacture shall at all times and places be subject to inspection of Architect / Engineer and Public Works Project Engineer who shall be judge of quality and suitability of the Work, materials, and processes of manufacture for purposes for which they are used. Should they fail to meet Architect / Engineer's and Public Works Project Engineer's approval they shall be reconstructed, made good, replaced or corrected, by Contractor at Contractor's expense. 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 Engineer of such conditions before they are disturbed. Architect / Engineer will thereupon promptly investigate conditions, and if Architect / Engineer finds that they materially differ from those shown on Drawings or

indicated in Specifications, Architect / Engineer will at once make such changes as necessary, any increase or decrease of cost resulting from such changes to be adjusted in manner provided in above Article 18 entitled "Changes in the Work".

23. RIGHT OF DEPARTMENT TO TERMINATE CONTRACT

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

24. CONSTRUCTION SCHEDULE AND PERIODIC ESTIMATES

- A. Contractor shall be responsible for Construction Schedule and coordination. 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 Engineer.
- 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 manpower in such quantities and crafts as will eliminate backlog of work.
 - b) Increase number of working hours per shift, shifts per working day, working days per week, amount of construction equipment, or any combination of foregoing to eliminate backlog of work.
 - c) Reschedule work (yet remain in conformance with Drawings and Specifications).
 3. Prior to proceeding with any of above actions, Contractor shall notify Public Works Project Engineer.
- E. Maintain current Construction Schedule at all times. Revise Construction Schedule in same detail as original and accompany with explanation of reasons for revision. Schedule shall be subject to approval by Architect / Engineer and Public Works Project Engineer.

25. PAYMENTS TO CONTRACTOR

- A. Contractor shall provide:
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 Engineer. 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 Engineer 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, anytime after fifty percent (50%) of the Work has been furnished and installed at site, County will make remaining payments in full if Architect / Engineer and Public Works Project Engineer find that progress of the Work corresponds with Construction Schedule. If Architect / Engineer and Public Works Project Engineer find that progress of the Work does not correspond with Construction Schedule, County may retain up to ten percent (10%) of each Application and Certificate for Payment for the Work completed.
- 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.
- 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, workmen, mechanics, material men, and furnishers of machinery and parts thereof, equipment, power tools, and all supplies, including commissary, incurred in performance of this Contract.
- D. At Department's request, Contractor shall furnish satisfactory evidence that all obligations of nature designated above have been paid, discharged or waived.

27. ACCEPTANCE OF FINAL PAYMENT AS RELEASE

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

28. PAYMENTS BY CONTRACTOR

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

29. CONTRACT SECURITY

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

30. ASSIGNMENTS

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

31. MUTUAL RESPONSIBILITY OF CONTRACTORS

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

32. SEPARATE CONTRACTS

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

33. SUBCONTRACTS

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

- F. Contractor shall insert in all subcontracts, Articles 26, 33, 43 and 45, respectively entitled: “Withholding of Payments”, “Subcontracts”, “Affirmative Action Provision and Minority / Women / Disadvantaged Business Enterprises”, and “Minimum Wages”, and shall further require all subcontractors to incorporate physically these same Articles in all subcontracts.

34. PUBLIC WORKS PROJECT ENGINEER’S AUTHORITY

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

35. ARCHITECT / ENGINEER’S AUTHORITY

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

36. STATED ALLOWANCES

- A. Stated allowances enumerated in Instructions to Bidders shall cover net cost of materials or equipment, and all applicable taxes. Contractor’s cost of delivery and unloading at site, handling costs on site, labor, installation costs, overhead, profit and any other incidental costs shall be included in Contractor’s bid, but not as part of cash allowance.
- B. Department will solicit at least two (2) bids on materials or equipment for which allowance is stated and select on basis of lowest qualified responsible bid. Contractor will then be

instructed to purchase "Allowed Materials". If actual price for purchasing "Allowed Materials", including taxes, is more or less than "Cash Allowance", Contract price shall be adjusted accordingly. Adjustment in Contract price shall not contain any cost items excluded from cash allowance.

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 Engineer.
- D. Where guarantees or warranties are required in sections of Specifications for periods in excess of one (1) year, such longer terms shall apply; however, Contractor's Performance and Payment Bonds shall not apply to any guarantee or warranty period in excess of one (1) year.

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 effect Contractor is "Equal Opportunity Employer". Contractor agrees to furnish all information and reports required by County's Contract Compliance Officer as same relate to affirmative action and nondiscrimination, which may include any books, records, or accounts deemed appropriate to determine compliance with Chapter 19, Dane County Code of Ordinances, and provision of this Contract.

B. Minority / Women / Disadvantaged / Emerging Small Business Enterprises.

1. Chapter 19.508 of Dane County Code of Ordinances is official policy of Dane County regarding utilization of, to fullest extent of, Minority Business Enterprises (MBEs), Women Business Enterprises (WBEs) Disadvantage Business Enterprises (DBEs) and Emerging Small Business Enterprises (ESBEs).
2. Contractor may utilize MBEs / WBEs / DBEs / ESBEs as subcontractors or suppliers. List of subcontractors will be required of low bidder as stated in this Contract. List shall indicate which are MBEs / WBEs / DBEs / ESBEs and percentage of subcontract awarded, shown as percentage of total dollar amount of bid.

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 Engineer, Contractor is chargeable with unwarranted delay in final cleanup of punch list items or other Contract requirements.
 - 2. Secures endorsement from insurance carrier and consent of Surety permitting occupancy of building or use of the Work during remaining period of construction, or, secures consent of Surety.
 - 3. Assumes all costs and maintenance of heat, electricity and water.
 - 4. Accepts all work completed within that portion or unit of the Work to be occupied, at time of occupancy.

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, workman or mechanic employed by Contractor and all subcontractors during billing period including accurate record of number of hours worked by each employee and actual wages paid as stipulated in Wisconsin Statute 66.0903. If Wisconsin Prevailing Wage Rate Determination is required for this Work, use "Prime Contractor Affidavit of Compliance With Prevailing Wage Rate Determination" and "Agent or Subcontractor Affidavit of Compliance With Prevailing Wage Rate Determination" (if applicable). If Wisconsin Prevailing Wage Rate Determination is not required for this Work, use "Dane County, Wisconsin Contractor Wage Affidavit". Forms of such affidavits are included in Supplementary Conditions.

48. CLAIMS

- A. No claim may be made until Department's Associate Public Works Director has reviewed Architect / Engineer's decision as provided for in Article 35 of General Conditions of Contract. If any claim remains unresolved after such review by Department's Associate

Public Works Director, claim may be filed under Wisconsin Statute 893.80. Work shall progress during period of any dispute or claim. Unless specifically agreed between parties, venue will be in Dane County, Wisconsin.

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.

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 45, "Minimum Wages", paragraph B. Following Prevailing Wage Rate Determination No. 200901609 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. Prime Contractor Affidavit of Compliance With Prevailing Wage Rate Determination (ERD-5724)
 2. Agent or Subcontractor Affidavit of Compliance With Prevailing Wage Rate Determination (ERD-10584)
 3. Disclosure of Ownership (ERD-7777)
 4. Request To Employ Subjourneyperson (ERD-10880)

Prime Contractor Affidavit of Compliance With Prevailing Wage Rate Determination

NOTICE REQUIRED UNDER Section 15.04(1)(m), Wisconsin Statutes. Authorization for this form is provided under Sections, 66.0903(9)(b) and 103.49(4r)(9b) Wisconsin Statutes. The use of this form is mandatory. The penalty for failing to complete this form is prescribed in Section 103.005(12), Wisconsin Statutes. Personally identifiable information may be used for secondary purposes.

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

State Of)	Project Name		
	Project Number	Determination Number	
)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) 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 of 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 or Business				
Street Address or P O Box	City	State	Zip Code	Telephone Number () -
Print Name of Authorized Officer			Date Signed	
Signature of Authorized Officer				

List of Agents and Subcontractors

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

If you have any questions call (608) 266-0028

Agent or Subcontractor Affidavit of Compliance With Prevailing Wage Rate Determination

NOTICE REQUIRED UNDER Section 15.04(1)(m), Wisconsin Statutes. Authorization for this form is provided under Sections, 66.0903(9)(b) and 103.49(4r)(9b) Wisconsin Statutes. The use of this form is mandatory. The penalty for failing to complete this form is prescribed in Section 103.005(12), Wisconsin Statutes. Personally identifiable information may be used for secondary purposes.

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

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

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

- **I am** the duly authorized officer of the corporation, partnership, sole proprietorship or business indicated below. We have recently completed all of the work required under the terms and conditions of a subcontract with the above-named awarding contractor. We make this affidavit in accordance with the requirements set forth in Section 66.0903(9)(b) or 103.49(4r)(b), Wisconsin Statutes and Chapter DWD 290 of the Wisconsin Administrative Code in order to obtain FINAL PAYMENT from such awarding contractor.
- **I have** fully complied with all of 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 contractor.

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

List of Agents and Subcontractors

Name			Name		
Street Address			Street Address		
City	State	Zip Code	City	State	Zip Code
Telephone Number () -			Telephone Number () -		
Name			Name		
Street Address			Street Address		
City	State	Zip Code	City	State	Zip Code
Telephone Number () -			Telephone Number () -		
Name			Name		
Street Address			Street Address		
City	State	Zip Code	City	State	Zip Code
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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) 266-0028

Disclosure of Ownership

Notice required under Section 15.04(1)(m), Wisconsin Statutes. The statutory authority for the use of this form is prescribed in Sections 66.0903(12)(d) and 103.49(7)(d), Wisconsin Statutes. The use of this form is mandatory. The penalty for failing to complete this form is prescribed in Section 103.005(12), Wisconsin Statutes. Personal information you provide may be used for secondary purposes.

- (1) On the date a contractor submits a bid to or completes negotiations with a state agency or local governmental unit, on a project subject to Section 66.0903 or 103.49, Wisconsin Statutes, the contractor shall disclose to such state agency or local governmental unit the name of any "other construction business", which the contractor, or a shareholder, officer or partner of the contractor, owns or has owned within the preceding three (3) years.
- (2) The term "other construction business" means any business engaged in the erection, construction, remodeling, repairing, demolition, altering or painting and decorating of buildings, structures or facilities. It also means any business engaged in supplying mineral aggregate, or hauling excavated material or spoil as provided by Sections 66.0903(3), 103.49(2) and 103.50(2), Wisconsin Statutes.
- (3) This form must **ONLY** be filed, with the state agency or local governmental unit that will be awarding the contract, if **both (A) and (B) are met.**
 - (A) The contractor, or a shareholder, officer or partner of the contractor:
 - (1) Owns at least a 25% interest in the "other construction business", indicated below, on the date the contractor submits a bid or completes negotiations.
 - (2) Or has owned at least a 25% interest in the "other construction business" at any time within the preceding three (3) years.
 - (B) The Wisconsin Department of Workforce Development (DWD) has determined that the "other construction business" has failed to pay the prevailing wage rate or time and one-half the required hourly basic rate of pay, for hours worked in excess of the prevailing hours of labor, to any employee at any time within the preceding three (3) years.

Other Construction Business

Name of Business

Street Address or P O Box

City

State

Zip Code

Name of Business

Street Address or P O Box

City

State

Zip Code

Name of Business

Street Address or P O Box

City

State

Zip Code

Name of Business

Street Address or P O Box

City

State

Zip Code

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

Print the Name of Authorized Officer

Signature of Authorized Officer

Date Signed

Name of Corporation, Partnership or Sole Proprietorship

Street Address or P O Box

City

State

Zip Code

If you have any questions call (608) 266-0028

Request To Employ Subjourneyperson

Personal information you provide may be used for secondary purposes. [See Section 15.04(1)(m), Wisconsin Statutes for details.] The use of this form is mandatory. The authority for the use of this form is prescribed in Section DWD 290.025, Wisconsin Administrative Code. The penalty for failing to complete this form is prescribed in Section 103.005(12), Wisconsin Statutes.

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

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

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

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

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

Signature of Requestor _____ Date Signed _____

MAIL COMPLETED REQUEST TO Equal Rights Division, Labor Standards Bureau, P. O. Box 8928 Madison WI 53708.
 You may call (608) 266-6860 if you need assistance in completing your request

Jim Doyle
Governor
Roberta Gassman
Secretary
Jennifer A. Ortiz
Division Administrator



EQUAL RIGHTS DIVISION
201 East Washington Avenue, Room A300
P.O. Box 8928
Madison, WI 53708
Telephone: (608) 266-6860
Fax: (608) 267-4592
TTY: (608) 264-8752
<http://www.dwd.state.wi.us/>

State of Wisconsin
Department of Workforce Development

DEPARTMENTAL ORDER

ROBERT J. NEBEL, ASSISTANT DIRECTOR OF PUBLIC WORKS
DANE COUNTY PUBLIC WORKS
1919 ALLIANT ENERGY CTR WAY
MADISON, WI 53713

RE: DANE COUNTY PUBLIC SAFETY COMMUNICATIONS INFRASTRUCTURE UPGRADE
COUNTY OF DANE, CITY OF MADISON, WI
Determination No. 200901609 Project No. 109055

The application which you filed or was filed on your behalf, by the person copied below, for a prevailing wage rate determination applicable to the above-referenced project has been received.

A survey was conducted to determine the prevailing wage rate for the trade(s) or occupation(s) needed to complete the project. The findings of the survey are set forth in the enclosed determination.

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 in which the project is located, you have the right to request the department to conduct an administrative review regarding such wage rate.

Your request must be made, in writing, within 30 days from the date indicated below and at least 10 days before the date a construction contract(s) is to be awarded or negotiated. Your request must also include wage rate information on at least three (3) similar projects located in the city, village or town where the proposed project is located on which some work was performed by the contested trade(s) or occupation(s) during the current survey period and which was previously considered by the department in issuing the enclosed determination. See s. DWD 290.10 of the Wisconsin Administrative Code and either s. 66.0903 (3)(br) or s. 103.49 (3)(c), Stats. for a complete explanation of the administrative review process.

Now, therefore, it is hereby ORDERED that the prevailing wage rates set forth in the enclosed determination shall only be applicable to the above referenced project. This ORDER shall be deemed a FINAL ORDER of this department unless a timely request for an administrative review is filed with the department or a construction contract(s) is not awarded or negotiated before the determination's expiration date.

DATED

11/09/2009

Enclosures

FOR THE DEPARTMENT

A handwritten signature in black ink that reads "Rita Ruona". The signature is written in a cursive style and is positioned above a horizontal line.

Rita Ruona, Investigator
Labor Standards Bureau
Construction Wage Standards Section
(608) 266-1898

PREVAILING WAGE RATE DETERMINATION

Issued by the State of Wisconsin
Department of Workforce Development
Pursuant to s. 66.0903, Stats.
Issued On: 11/09/2009

DETERMINATION NUMBER: 200901609

EXPIRATION DATE: Prime Contracts MUST Be Awarded Or Negotiated On Or Before 5/07/2010. If NOT, You MUST Reapply.

DESCRIPTION OF PROJECT: DANE COUNTY PUBLIC SAFETY COMMUNICATIONS
INFRASTRUCTURE UPGRADE
PROJECT NO: 109055

LOCATION OF PROJECT: COUNTY OF DANE, CITY OF MADISON, WI

CONTRACTING AGENCY: DANE COUNTY PUBLIC WORKS

CLASSIFICATION: Contractors are required to call the Department of Workforce Development if there are any questions regarding the proper trade or classification to be used for any worker on a public works project.

OVERTIME: Time and one-half must be paid for all hours worked over 10 hours per day and 40 hours per calendar week and for all hours worked on Saturday, Sunday and the following six (6) 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.

FUTURE INCREASE: If indicated for a specific trade or occupation, the full amount of such increase MUST be added to the "TOTAL" indicated for such trade or occupation on the date(s) such increase(s) becomes effective.

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.

SUBJOURNEY: Wage rates may be available for some of the classifications indicated below with the exception of laborers, truck drivers and heavy equipment operators. Any employer that desires to use any subjourney classification on this project MUST request the applicable wage rate from this department PRIOR to the date such classification is used on this project. Form ERD-10880 is available for this purpose.

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.

Fringe Benefits Must Be Paid On <u>All</u> Hours Worked	HOURLY BASIC RATE OF PAY	HOURLY FRINGE BENEFITS	TOTAL
<u>TRADE OR OCCUPATION</u>	\$	\$	\$
Acoustic Ceiling Tile Installer Future Increase(s): Add \$2.25/hr on 6/1/2009; Add \$2.25/hr on 5/31/2010.	27.51	13.48	40.99
Boilermaker	30.69	16.87	47.56
Bricklayer, Blocklayer or Stonemason Future Increase(s): Add \$1.90 06/01/2009; Add \$1.95 05/31/2010	30.61	14.10	44.71
Cabinet Installer	24.10	0.00	24.10
Carpenter Future Increase(s): Add \$2.25/hr on 6/1/2009; Add \$2.25/hr on 5/31/2010.	27.51	13.48	40.99
Carpet Layer or Soft Floor Coverer	27.51	13.48	40.99

Fringe Benefits Must Be Paid On <u>All</u> Hours Worked			
<u>TRADE OR OCCUPATION</u>	<u>HOURLY BASIC RATE OF PAY</u>	<u>HOURLY FRINGE BENEFITS</u>	<u>TOTAL</u>
	\$	\$	\$
Future Increase(s): Add \$2.25/hr on 6/1/2009; Add \$2.25/hr on 5/31/2010.			
Cement Finisher	28.43	12.94	41.37
Drywall Taper or Finisher	25.30	12.15	37.45
Future Increase(s): Add \$1.60/hr on 6/1/09			
Electrician	31.00	16.80	47.80
Future Increase(s): Add \$1.70/hr on 6/1/2009; Add \$1.70/hr on 6/1/2010.			
Elevator Constructor	42.73	16.47	59.20
Fence Erector	17.35	2.32	19.67
Fire Sprinkler Fitter	35.69	14.27	49.96
Glazier	34.48	7.17	41.65
Heat or Frost Insulator	30.63	16.66	47.29
Insulator (Batt or Blown)	22.07	11.30	33.37
Ironworker	30.30	15.77	46.07
Future Increase(s): Add \$2/hr on 6/1/2009; Add \$2/hr on 6/1/2010.			
Lather	26.11	12.86	38.97
Line Constructor (Electrical)	33.08	14.68	47.76
Marble Finisher	25.28	14.10	39.38
Marble Mason	31.60	14.10	45.70
Metal Building Erector	29.30	14.71	44.01
Millwright	29.11	13.48	42.59
Future Increase(s): Add \$2.25/hr on 6/1/2009; Add \$2.25/hr on 5/31/2010.			
Overhead Door Installer	25.04	13.01	38.05
Painter	25.00	12.15	37.15
Future Increase(s): Add \$1.60 on 6/1/09			
Premium Pay: Add \$.25/hr. sandblasting; Add \$.40/hr. paperhanging; Add \$1.00/hr. spray/structural steel.			
Pavement Marking Operator	23.40	6.15	29.55
Piledriver	28.01	13.48	41.49
Future Increase(s): Add \$2.25/hr on 6/1/2009; Add \$2.25/hr on 5/31/2010.			
Pipeline Fuser or Welder (Gas or Utility)	29.58	14.64	44.22
Plasterer	25.28	12.91	38.19
Plumber	34.78	12.76	47.54
Refrigeration Mechanic	36.55	13.41	49.96
Future Increase(s): Add \$2.85/hr on 6/01/2009.			
Roofer or Waterproofer	27.85	7.51	35.36
Sheet Metal Worker	32.01	17.79	49.80
Steamfitter	36.55	13.41	49.96
Future Increase(s): Add \$2.85/hr on 6/01/2009.			
Teledata Technician or Installer	21.08	10.68	31.76
Future Increase(s): Add \$.90 on 6/1/09.			
Temperature Control Installer	35.25	11.64	46.89
Terrazzo Finisher	27.98	13.20	41.18
Terrazzo Mechanic	29.46	13.41	42.87
Tile Finisher	22.93	13.45	36.38
Future Increase(s): Add \$1.65/hr on 6/01/2009; Add \$1.65/hr on 5/31/2010.			
Tile Setter	28.66	13.45	42.11

Fringe Benefits Must Be Paid On All Hours Worked

<u>TRADE OR OCCUPATION</u>	<u>HOURLY BASIC RATE OF PAY</u>	<u>HOURLY FRINGE BENEFITS</u>	<u>TOTAL</u>
	\$	\$	\$

Future Increase(s): Add \$1.65 06/01/2009; Add \$1.65 05/31/2010			
Tuckpointer, Caulker or Cleaner	30.61	14.10	44.71
Future Increase(s): Add \$1.90 6/01/2009; Add \$1.95 05/31/2010			
Underwater Diver (Except on Great Lakes)	33.50	11.84	45.34
Well Driller or Pump Installer	22.52	13.68	36.20
Siding Installer	24.75	9.18	33.93
Heavy Equipment Operator - ELECTRICAL LINE CONSTRUCTION ONLY	25.22	12.05	37.27
Light Equipment Operator -ELECTRICAL LINE CONSTRUCTION ONLY	29.12	16.00	45.12
Heavy Truck Driver - ELECTRICAL LINE CONSTRUCTION ONLY	16.00	8.00	24.00
Light Truck Driver - ELECTRICAL LINE CONSTRUCTION ONLY	21.50	11.00	32.50
Groundman - ELECTRICAL LINE CONSTRUCTION ONLY	18.19	10.04	28.23

TRUCK DRIVERS

Single Axle or Two Axle	17.00	0.66	17.66
Three or More Axle	17.50	11.83	29.33
Articulated, Euclid, Dumptor, Off Road Material Hauler	29.89	16.41	46.30
Future Increase(s): Add \$1.75/hr on 6/1/2009; Add \$1.80/hr on 6/1/2010.			
Pavement Marking Vehicle	20.06	11.55	31.61
Truck Mechanic	19.00	11.14	30.14

LABORERS

General Laborer	22.59	11.75	34.34
Future Increase(s): Add \$1.60/hr on 6/1/2009; Add \$1.65/hr on 5/31/2010			
Premium Pay: Add \$1.00/hr for certified welder; Add \$.25/hr for mason tender			
Asbestos Abatement Worker	22.06	12.40	34.46
Landscaper	23.25	5.38	28.63
Gas or Utility Pipeline Laborer (Other Than Sewer and Water)	24.67	11.87	36.54
Fiber Optic Laborer (Outside, Other Than Concrete Encased)	17.06	12.65	29.71
Railroad Track Laborer	20.96	11.95	32.91

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

Crane; Backhoe (Track Type); Tractor or Truck Mounted Hydraulic Backhoe; Gradall (Cruz-Aire Type); Mechanic or Welder; Bulldozer or Endloader; Grader or Motor Patrol; Scraper (Self Propelled or Tractor Drawn) 5cu yards or more capacity; Power Subgrader; Asphalt Milling Machine; Boring Machine (Horizontal, Vertical or Directional); Air Track, Rotary or Percussion Drilling Machine; Trencher; Post Hole Digger or Driver; Tug or Launch (not performing work on the Great Lakes)	28.59	16.45	45.04
Farm or Industrial Type Tractor; Greaser; Compactor (Self-Propelled); Broom or Sweeper; Environmental Burner	29.89	16.41	46.30
Future Increase(s): Add \$1.75/hr on 6/1/2009; Add \$1.80/hr on 6/1/2010.			
Crusher, Screening or Wash Plant; Air Compressor (400 CFM or Over); Pump (3 Inch or Over) or Well Points; Refrigeration Plant or Freeze Machine;	26.52	17.08	43.60

Fringe Benefits Must Be Paid On All Hours Worked

<u>TRADE OR OCCUPATION</u>	<u>HOURLY BASIC RATE OF PAY</u>	<u>HOURLY FRINGE BENEFITS</u>	<u>TOTAL</u>
	\$	\$	\$
Skid Steer Loader (With or Without Attachments); Skid Rig; Stump Chipper; Mulcher; Vibratory Hammer or Extractor			
HEAVY EQUIPMENT OPERATORS EXCLUDING SITE PREPARATION, UTILITY, PAVING AND LANDSCAPING WORK			
Crane, Tower Crane or Derrick, With or Without Attachments, With a Lifting Capacity of Over 100 Tons; Crane, Tower Crane or Derrick, With Boom, Leads and/or Jib Lengths Measuring 176 Feet or Over Future Increase(s): Add \$2.00/hr on 6/1/2009; Add \$2.05 on 6/1/2010. Premium Pay: Add \$.50/hr for cranes with lifting capacity over 200 ton; Add \$1.00/hr. at 300 ton; Add \$1.50/hr at 400 ton; Add \$2.00/hr at 500 ton.	32.12	16.41	48.53
Crane, Tower Crane or Derrick, With or Without Attachments, With a Lifting Capacity of 100 Tons or Under; Crane, Tower Crane or Derrick, With Boom, Leads and/or Jib Lengths Measuring 175 Feet or Under; Backhoe (Track Type) Having a Mfgr.'s Rated Capacity of 130,000 Lbs. or Over; Traveling Crane (Bridge Type); Caisson Rig; Pile Driver; Dredge (Not Performing Work on the Great Lakes) Future Increase(s): Add \$2.00/hr on 6/1/2009; Add \$2.05/hr on 6/1/2010. Premium Pay: Add \$.25/hr for cranes with lifting capacity of 45 ton or over.	31.12	16.41	47.53
Crane (Go-Devil Type) or Truck Mounted Hydraulic Crane (10 Tons or Under); Backhoe (Track Type) Having a Mfgr.'s Rated Capacity of Under 130,000 Lbs.; Tractor or Truck Mounted Hydraulic Backhoe; Gradall (Cruz-Aire Type); Mechanic or Welder; Bulldozer or Endloader; Grader or Motor Patrol; Scraper (Self Propelled or Tractor Drawn) 5 cu yards or more capacity; Concrete Pump, Grout Pump or Concrete Conveyor (Rotec or Bidwell Type); Concrete Breaker (Manual or Remote); Concrete Batch Plant; Power Subgrader; Concrete Spreader; Concrete Paver; Concrete Grinder or Planing Machine; Concrete Conveyor System; Concrete Slipform Placer; Curb and Gutter Machine; Roller (Over 5 Ton); Shouldering Machine; Boring Machine (Horizontal, Vertical or Directional); Air Track, Rotary or Percussion Drilling Machine; Straddle Carrier or Travel Lift; Forklift (Machinery Moving or Steel Erection); Manhoist or Elevator; Material or Stack Hoist; Trencher; Sideboom; Hydro-Blaster (10,000 PSI or Over); Post Hole Digger or Driver; Railroad Track Rail Leveling Machine, Tie Placer, Extractor, Tamper, Stone Leveler or Rehabilitation Equipment Future Increase(s): Add \$1.75/hr on 6/1/2009; Add \$1.80/hr on 6/1/2010.	30.42	16.41	46.83
Farm or Industrial Type Tractor; Greaser; Compactor (Self-Propelled); Concrete Saw (Vermeer Type); Concrete Bump Cutter or Grooving Machine; Tining or Curing Machine; Roller (5 Tons or Under); Broom or Sweeper; Hoist (Tugger); Environmental Burner	23.40	6.15	29.55
Crusher, Screening or Wash Plant; Air, Electric or Hydraulic Jacking System; Air Compressor (400 CFM or Over); Generator (150 KW or Over); Pump (3 Inch or Over) or Well Points; Refrigeration Plant or Freeze Machine; Skid Steer Loader (With or Without Attachments); Robotic Tool Carrier (With or Without Attachments); Skid Rig; Stump Chipper; Mulcher; Vibratory Hammer or Extractor	30.60	7.73	38.33
Oiler; Forklift Future Increase(s): Add \$1.75/hr on 6/1/2009; Add \$1.80/hr on 6/1/2010.	27.19	16.41	43.60
Gas or Utility Pipeline, Except Sewer and Water (Primary Equipment)	34.01	17.23	51.24
Gas or Utility Pipeline, Except Sewer and Water (Secondary Equipment)	27.12	15.80	42.92

Fringe Benefits Must Be Paid On All Hours Worked

<u>TRADE OR OCCUPATION</u>	<u>HOURLY BASIC RATE OF PAY</u>	<u>HOURLY FRINGE BENEFITS</u>	<u>TOTAL</u>
	\$	\$	\$
----- Future Increase(s): Add \$1.60/hr on 6/1/2009; Add \$1.60/hr on 6/1/2010; Add \$1.60/hr on 6/1/2011. -----			
Fiber Optic Cable Equipment	21.84	14.55	36.39

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 most 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) 266-1898.

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

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

Any contractor, subcontractor or agent thereof, 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 determined under sub.(3), shall be liable to any affected employe in the amount of his or her unpaid wages or his or her unpaid overtime compensation and in an additional equal amount as liquidated damages. An action to recover the liability may be maintained in any court of competent jurisdiction by any employe for and in behalf of that employe and other employes similarly situated. No employe may be a party plaintiff to any such action unless the employe consents in writing to become such 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.

**Consolidated List of Debarred Contractors
Prepared and Issued By
State of Wisconsin
Department of Workforce Development**

This list has been prepared in accordance with the provisions of s. 66.0903(12) and s. 103.49(7), 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 or local governmental unit may knowingly solicit bids from, negotiate with or award any contracts to or approve or allow any subcontractors 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>
Bechtisao, Joel	See Tri-State Traffic Services, Inc.					
Custom Heating & Air LLC	283 Tony Lane, Green Bay, WI 54304	12/1/06	11/30/09	1, 2 and 4	2003 to 2004	None
D. C. Nevels Trucking, Inc. or D. C. Nevels Trucking	3246 North Sherman Blvd., Milwaukee, WI 53216	6/1/05	5/31/08	1, 2 and 4	2000-2002	None
Gibraltar Construction LLC	N60 W15080 Bobolink Ave., Menomonee Falls, WI 53051	12/1/06	4/30/07	1	2005	None
HGI Painting	P. O. Box 3481, Janesville, WI 53545	11/1/04	10/31/07	1, 2 and 4	2001, 2002 and 2003	None
Hedding, Matt	C/O HGI Painting, P. O. Box 3481, Janesville, WI 53545	11/1/04	10/31/07	1, 2 and 4	2001, 2002 and 2003	None
Joseph Stoller Company	N8426 Hwy 42	2/1/2007	1/31/2010	1, 2	2004 and 2005	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>
Keiver, David	See Custom Heating & Air LLC	12/1/06	11/30/09	1, 2 and 4	2003 and 2004	None
Maria, Steve	See Gibraltar Construction LLC					
Nevels, Betty	See D. C. Nevels Truckng, Inc.					
Nevels, Donald	See D. C. Nevels Trucking, Inc.					
Rick's Painting & Drywall	P. O. Box 2316, Eagle River, WI 54521	3/1/03	2/28/06	1	5/8/00 to 4/30/01	None
Stoller Enterprises LLC	N8426 Hwy 42, Algoma, WI 54201-9552	2/1/2007	1/31/2010	1 and 2	2005 to 2006	None
Stoller, Joseph	See Joseph Stoller Company					
Stoller, Patrick J.	See Stoller Enterprises LLC					
Strobel Construction, Inc..	P. O. Box 2316, Eagle River, WI 54521	3/1/03	2/28/06	1	5/8/00 to 4/30/01	None
Strobel, Diane	See Strobel Construction, Inc.					
Strobel, Rick	See Strobel Construction, Inc.					
Tri-State Traffic Services, Inc.	12555 West Burleigh Road #3, Brookfield, WI 53005	12/1/06	11/30/07	1, 2 and 4	2003-2004	None

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

SECTION 01 00 00
BASIC REQUIREMENTS

PART 1 GENERAL

1.1 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. Coordination
 7. Cutting and Patching
 8. Conferences
 9. Progress Meetings
 10. Submittal Procedures
 11. Proposed Products List
 12. Shop Drawings
 13. Product Data
 14. Samples
 15. Manufacturers' Instructions
 16. Manufacturers' Certificates
 17. Quality Assurance / Quality Control of Installation
 18. References
 19. Interior Enclosures
 20. Protection of Installed Work
 21. Parking
 22. Staging Areas
 23. Occupancy During Construction and Conduct of Work
 24. Protection
 25. Progress Cleaning
 26. Products
 27. Transportation, Handling, Storage and Protection
 28. Product Options
 29. Substitutions
 30. Starting Systems
 31. Demonstration and Instructions
 32. Contract Closeout Procedures
 33. Final Cleaning
 34. Adjusting
 35. Operation and Maintenance Data
 36. Spare Parts and Maintenance Materials
 37. Record Drawings and Specifications

1.2 SUMMARY OF THE WORK

- A. Project Description: Perform the Work as specified and detailed in Construction Documents package. Contractor to provide
- B. Work by Owner: Not applicable.
- C. Permits: Prior to commencement of the Work, Contractor to secure any and all necessary permits for completion of the Work and facility occupancy.

1.3 CONTRACTOR USE OF PREMISES

- A. Limit use of premises to allow work by Contractors or Subcontractors and access by Owner.

1.4 APPLICATIONS FOR PAYMENT

- A. 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.

1.5 ALTERNATES

- A. Alternates quoted on Bid Form shall be reviewed and accepted or rejected at the Owner's option.
- B. Coordinate related work and modify surrounding work as required.
- C. Schedule of Alternates:
 - 1. Alternate Bid 1.
 - a. Provide credit for deleting plate to plate heat exchanger HX-1 and all associated piping and controls to that unit. Replace heat recovery chillers CH-1 and CH-2 with normal chillers at the same conditions as scheduled for the heat recovery chillers.
 - 2. Alternate Bid 2.
 - a. Provide a price addition for providing variable frequency drives (VFD) on each existing heating pumps (P-1 and P-2) located on the second floor which serve the first floor heating water system. Provide piping and controls to operate the pumps using the VFDs. The two pumps are 7.5 horse power each, 460 volt 3 phase. Do not provide a bypass for the VFDs.

1.6 COORDINATION

- A. Schedule of Work shall be submitted to Project Engineer and Architect prior to start of the Project. Schedule should show tentative dates for milestones and expected completion.
- B. Coordinate scheduling, submittals, and work of various sections of Specifications to assure efficient and orderly sequence of installation of interdependent construction elements.
- C. Verify utility requirement characteristics of operating equipment are compatible with building utilities.
- D. Coordinate space requirements and installation of mechanical and electrical work that are indicated diagrammatically on Drawings.

1.7 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.

1.8 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.

1.9 PROGRESS MEETINGS

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

1.10 SUBMITTAL PROCEDURES

- A. Submittal form to identify Project, Contractor, Subcontractor or supplier; and pertinent Construction Documents references.

- B. Apply Contractor's stamp, signed or initialed, certifying that review, verification of Products required, field dimensions, adjacent construction work, and coordination of information is in accordance with requirements of the Work and Construction Documents.
- C. Identify variations from Construction Documents and Product or system limitations that may be detrimental to successful performance of completing the Work.
- D. Revise and resubmit submittals as required; identify all changes made since previous submittal.

1.11 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.

1.12 SHOP DRAWINGS

- A. Submit number of copies that Contractor requires, plus two (2) copies that shall be retained by Public Works Project Engineer.

1.13 PRODUCT DATA

- A. Submit number of copies that Contractor requires, plus two (2) copies that shall be retained by Public Works Project Engineer.
- B. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturer's standard data to provide information unique to this Project.

1.14 SAMPLES

- A. Submit samples to illustrate functional and aesthetic characteristics of the Product.
- B. Submit samples of finishes from the full range of manufacturers' standard colors, textures, and patterns for Public Works Project Engineer's selection.

1.15 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.

1.16 MANUFACTURERS' CERTIFICATES

- A. When specified in individual Specification sections, submit manufacturers' certificate to Public Works Project 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.

1.17 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.

1.18 REFERENCES

- A. Conform to reference standard by date of issue current as of date for receiving bids.
- B. Should specified reference standard conflict with Construction Documents, request clarification from Public Works Project Engineer before proceeding.

1.19 INTERIOR ENCLOSURES

- A. Provide temporary partitions as required to separate work areas from Owner occupied areas, to prevent distribution of dust and moisture into Owner occupied areas, and to prevent damage to existing materials and equipment.

1.20 PROTECTION OF INSTALLED WORK

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

1.21 PARKING

- A. Parking at the Work site is limited. Parking arrangements for one spot shall be made available for Contractor.
- B. Freight loading zone located on Wilson St. shall be used for deliveries of materials and equipment.

1.22 STAGING AREAS

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

1.23 OCCUPANCY DURING CONSTRUCTION AND CONDUCT OF WORK

- A. Areas of existing facility will be occupied during period when the Work is in progress. Work may be done during normal business hours (7:00 am to 4:30 pm), but confer with Owner, schedule work and store materials so as to interfere as little as possible with normal use of premises. Notify Owner when coring or similar noise making work is to be done and obtain Owner's written approval of schedule. If schedule is not convenient for Owner, reschedule and resubmit new times for Owner approval. Coring of floor along with other noisy work may have to be done on second and third shifts. No additional compensation will be granted for work completed during non-normal hours.
- B. Work shall be done and temporary facilities furnished so as not to interfere with access to any occupied area and so as to cause least possible interference with normal operation of facility or any essential service thereof.
- C. Contractor shall, at all times, provide approved, safe walkways and facility entrances for use by Owner, employees and public.
- D. Contractor shall provide adequate protection for all parts of facility, its contents and occupants wherever the Work under this contract is to be performed.
- E. Each Contractor shall arrange with Owner to make necessary alterations, do new work, make connections to all utilities, etc., at such times as will not cause interruption of utility services to facility. Contractor doing this work shall protect, cap, cut off and / or replace and relocate existing pipes, electrical work and other active utilities encountered which may interfere with new construction work.
- F. New work in extension of existing work shall correspond in all respects with that to which it connects or similar existing work unless otherwise indicated or specified.
 - 1. Existing work shall be cut, altered, removed or replaced as necessary for performance of contract obligations.
 - 2. Work remaining in place, damaged or defaced by reason of work done under this contract shall be restored equal to its condition at time of Award of Contract.
 - 3. If removal of work exposes discolored or unfinished surfaces or work out of alignment, such surfaces shall be refinished or materials replaced as necessary to make continuous work uniform and harmonious.

1.24 PROTECTION

- A. Contractor shall protect from injury all trees, shrubs, hedges, walks and driveways and pay for any damage to same resulting from insufficient or improper protection.
- B. Guard Light: Contractor shall provide and maintain guard lights at all barricades, railings, obstructions in streets, roads or sidewalks and at all trenches adjacent to public walks or roads.

1.25 PROGRESS CLEANING

- A. Maintain areas free of waste materials, debris, and rubbish. Maintain site in clean and orderly condition.

1.26 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.

1.27 TRANSPORTATION, HANDLING, STORAGE AND PROTECTION

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

1.28 PRODUCT OPTIONS

- 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. Should bidder choose to bid materials other than those specified, bidder shall submit said materials specifications to Department of Public Works, Highway & Transportation for approval at least seven (7) days prior to Bid Opening.
- B. Products and materials that are not specified, but have been approved for use by Public Works Project Engineer shall be identified in addenda to all bidding contractors.
- C. Requests for material or product substitutions submitted after Bid Opening may be considered. Dane County reserves right to approve or reject substitutions based on Specification requirements and intended use.

1.29 SUBSTITUTIONS

- A. Public Works Project Engineer shall consider requests for Substitutions only within thirty (30) days after date of Public Works Contract.
- B. Document each request with complete data substantiating compliance of proposed Substitution with Construction Documents.
- C. Submit three (3) copies of requests for Substitution for consideration. Limit each request to one (1) proposed Substitution.
- D. Substitutions shall not change contract price established at Bid Opening.

1.30 STARTING SYSTEMS

- A. Provide written notification 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.

1.31 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.
- C. Owner may choose to videotape demonstration session; demonstration and demonstrator shall be to level of satisfaction of Owner.

1.32 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 Public Works Project Engineer's inspection.
- B. Submit final Application for Payment identifying total adjusted Contract Sum / Price, previous payments, and amount remaining due.

1.33 FINAL CLEANING

- A. Execute final cleaning prior to final inspection.
- B. Clean interior and exterior surfaces exposed to view.
- C. Remove waste and surplus materials, rubbish, and construction facilities from site.

1.34 ADJUSTING

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

1.35 OPERATION AND MAINTENANCE DATA

- A. Provide operation and maintenance data for all mechanical and electrical equipment supplied and installed in project.

1.36 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.

1.37 RECORD 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 Engineer with original tracings of drawings and prints of specifications in reproducible format, one set of Drawings and Specifications and one set of record drawings in AutoCAD 2007 (or lower) format and entire record specification in Word 2000 (or lower) format on CD.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

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 Engineer and Architect / Engineer, Waste Management Plan (WMP) for this project. Outlined in RECYCLING section of this specification are examples of materials that can be recycled or reused as well as recommendations for waste sorting methods.

1.3 WASTE MANAGEMENT PLAN

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

g. Destinations.

1.4 REUSE

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

1.5 RECYCLING

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

1.6 MATERIALS SORTING AND STORAGE ON SITE

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

1.7 LISTS OF RECYCLING FACILITIES PROCESSORS AND HAULERS

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

1.8 WASTE MANAGEMENT PLAN FORM

A. Contractor Information:

Name: _____

Address: _____

Phone No.: _____ Recycling Coordinator: _____

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

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

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

Section 01 53 29 - Interim Life Safety Program**PART 1 - GENERAL****1.01 RELATED DOCUMENTS**

- A. Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 01 specification sections, apply to the work of this section.
- B. Division 01 Section "Infection Control Procedures."
- C. Division 01 Section "Indoor Air Quality Control Procedures."

1.02 DESCRIPTION OF POLICY

To ensure a safe environment during any period of construction, implementation of the Owner's Interim Life Safety Program (ILSP) is required in or adjacent to all construction areas. ILSP applies to all personnel, including construction workers, must be implemented upon Project development, and must be continuously enforced through Project completion.

1.03 SUBMITTALS

For review of the authorities having jurisdiction, submit a policy in written form indicating the criteria to be used for evaluating various deficiencies and construction hazards and to determine when and to what extent one or more of the interim life safety measures apply.

- 1. Submit a matrix in graphic form illustrating how the ILSP will be implemented.
- 2. Submit floor plans indicating the interim life safety measures for each phase of the Work.

1.04 PROCEDURE

- A. Before construction begins the Contractor and Owner shall develop the ILSP.
- B. All employees affected by the construction will be informed of changes by the Contractor.
- C. Monitoring of the construction site will be the responsibility of the Contractor's designated Director of Plant Operations, Safety Director and/or the Project Coordinator. The Project Coordinator shall be responsible for completing all daily and monthly logs.

- 1 D. Interim life safety measures consist of the following:
- 2 1. Control of odors, fumes, noise, mist, vibration, dust,
3 insects, or other environmental conditions that may
4 interfere with workers' safety.
 - 5 2. Ensuring free and unobstructed egress. Personnel shall
6 receive training if alternative exits must be designated.
 - 7 3. Ensuring free and unobstructed access to emergency
8 departments/services and for emergency forces.
 - 9 4. Ensuring fire alarm, detection, and suppression systems are
10 not impaired. A temporary, but equivalent, system shall be
11 provided when any fire system is impaired. Temporary
12 systems must be inspected and tested monthly during
13 construction period.
 - 14 5. Ensuring temporary construction partitions are smoke tight
15 and built of noncombustible materials.
 - 16 6. Providing additional fire fighting equipment and use
17 training for construction personnel.
 - 18 7. Smoking shall be prohibited in or adjacent to all
19 construction areas. This shall be at strictly enforced.
 - 20 8. Developing and enforcing storage, housekeeping, and debris
21 removal policies and procedures that reduce the flammable
22 and combustible fire load to the lowest level necessary for
23 daily operations.
 - 24 9. Conducting a minimum of two fire drills per shift per
25 quarter within construction affected area.
 - 26 10. Provide hazard surveillance of buildings, grounds, and
27 equipment with special attention to excavations,
28 construction areas, construction storage and field offices.
 - 29 11. Notifying training personnel when structural or
30 compartmentalization features of fire safety are
31 compromised.
 - 32 12. Conducting monthly construction meetings to ensure awareness
33 of any Life Safety Code deficiencies, construction hazards,
34 and these Interim Life Safety Measures.

35
36
37 **PART 2 - PRODUCTS** (Not Used)

38
39
40 **PART 3 - EXECUTION**

41
42 **3.01 REPORTING, GENERAL**

- 43
44 A. The Contractor shall be responsible for administering ILSP with
45 the construction area. The Contractor shall be responsible for
46 maintaining all ILSP reports as required herein and providing
47 evidence of such to Owner.
48
49

- 1 B. The following interim life safety reports shall be prepared by
 2 the Contractor and a record of such kept on site at all times in
 3 a conspicuous location. Reports that require Owner sign off
 4 prior to associated activity shall be prepared at least 48 hours
 5 prior to construction activity start time.
 6 1. Daily interim life safety site inspection report bi-
 7 quarterly.
 8 2. Construction site fire drill report.
 9 3. Utility disruption request.
 10 4. Welding and burn permit.
 11 5. Monthly life safety construction meeting report.
 12
 13 C. Any Subcontractor that fails to comply with required reporting
 14 shall be asked to discontinue work until all reporting is
 15 updated.
 16
 17

18 **3.02 ILSP INSPECTION REPORT**
 19

- 20 A. The following report shall be completed at the beginning of each
 21 day's construction activity by the Contractor Project
 22 Coordinator. Check off each item in the appropriate box upon
 23 completing it.
 24 1. Verify controls have been provided to reduce or
 25 Remove odors, fumes, vibration, dust or other
 26 equipment conditions that could be harmful to
 27 workers or employees.
 28 2. Verify exits provide free and unobstructed egress.
 29 Alternate exits are identified and personnel are
 30 notified as required.
 31 3. Verify fire alarm, detection and suppression systems
 32 are operable.
 33 4. Verify equivalent protection is provided during
 34 interruption of fire system.
 35 5. Verify temporary construction partitions are
 36 maintained and are smoke tight per construction
 37 requirements within specifications.
 38 6. Verify required fire fighting equipment is on site,
 39 operable and construction personnel are informed of
 40 location and proper use.
 41 7. Verify personnel are informed of no smoking
 42 policy within construction area and within
 43 City County building.
 44 8. Housekeeping of construction site has been reviewed
 45 and excessive debris has been legally removed.
 46 9. Verify fire drills are up to date and required
 47 drills are scheduled.
 48 10. Verify construction personnel have not compromised
 49 structural and/or compartmentation features of
 50 fire safety.
 51

52 ISLP reviewed by: _____ Date: _____
 53

54 Note: If any of the above eleven items are found to be not in compliance, no-
 55 tify the Contractor's Safety Director immediately.
 56
 57

1 CONSTRUCTION SITE FIRE DRILL REPORT

2
3 Area of construction: _____

4
5 Initiated by: _____

6
7 State any problems discovered during drill on back of report or collective
8 action taken.

9
10

		SHIFT					
		1ST		2ND*		3RD*	
OTR Month		Date	Time	Date	Time	Date	Time
1ST	JAN						
	FEB						
	MAR						
2ND	APR						
	MAY						
	JUN						
3RD	JUL						
	AUG						
	SEP						
4TH	OCT						
	NOV						
	DEC						

11
12 * Note: 2nd and 3rd shift drills not required if construction area is not
13 operating multiple shifts.

14
15
16
17

* * *

1 **Section 01 56 39 - Protection of Existing Trees**
 2
 3

4 **PART 1 - GENERAL**
 5

6 **1.01 DESCRIPTION**
 7

8 Work Included:

9 Protect existing trees and shrubs not designated for removal.
 10
 11

12 **1.02 GUARANTEE**
 13

- 14 1. If a tree or shrub mass which is to remain is destroyed or
 15 damaged so that, in the judgment of the Landscape Architect, it
 16 needs to be replaced, it shall be removed at Contractor's
 17 expense. Damages will be assessed at the rate of One Hundred
 18 Fifty Dollars (\$150.00) per inch of circumference.
 19 2. If a tree or shrub mass which is to remain is not properly
 20 protected, or if improper activity occurs within the protected
 21 zone, as determined by the Landscape Architect, a non-compliance
 22 fine shall be levied against the Contractor. Damages will be
 23 assessed at the rate of Twenty Dollars (\$20.00) per inch of
 24 circumference, per tree, for each day and/or site visit where
 25 improper tree protection is identified.
 26 3. Tree measurements shall be taken at 12 inches above grade for
 27 trees with a diameter of 8 inches or less, and at D.B.H.
 28 (Diameter at Breast Height) for trees with a diameter of greater
 29 than 8 inches.
 30
 31

32 **PART 2 - PRODUCTS**
 33

34 **2.01 TREE PROTECTION MATERIALS**
 35

- 36 A. Barricade: Utility type fencing, 6 feet high, as approved by
 37 Landscape Architect.
 38 B. Posts: Metal or wood, sufficient to hold fabric plumb and taut,
 39 as approved by Landscape Architect.
 40
 41
 42
 43

44 **PART 3 - EXECUTION**
 45

46 **3.01 CONSTRUCTION REQUIREMENTS**
 47

- 48 A. Protect existing trees and shrub masses from damage or injury.
 49 B. Permit no compaction, material/vehicle storage, refuse disposal,
 50 stockpiling or other adverse activities within the protected
 51 zone.
 52 C. Do not change soil elevation within dripline.
 53 D. Exercise extreme care in removing concrete or asphalt within
 54 dripline. Paving pieces shall be lifted rather than dragged.
 55 Protect surface roots immediately with 4" layer of bark mulch.
 56
 57
 58
 59

- 1 E. At the start of construction, irrigate trees by means of
- 2 subsurface pressure injection. Soil adjacent to tree shall be
- 3 moist to 18" depth.
- 4
- 5 G. Work within dripline shall only be as directed by Landscape
- 6 Architect
- 7 1. Trenching, grading or excavation within dripline shall be
- 8 done by hand.
- 9 2. Protect exposed roots with wet burlap.

10

11

12 **3.02 BARRICADES**

13

- 14 A. Install barricades around all trees and shrub masses to remain.
- 15 Barricades to remain throughout the duration of construction.
- 16
- 17 B. Locate barricade as directed by the Landscape Architect.
- 18
- 19 C. Locate roots before setting posts. Prevent damage to roots.
- 20
- 21 D. Space posts approximately 4' apart, or as required by the
- 22 barrier system, and securely attach fabric.
- 23
- 24 E. Barricade shall be plumb, taut and sturdy.
- 25
- 26 F. Repair sagging or damaged barricades immediately throughout the
- 27 construction process.
- 28
- 29 G. Remove barricades upon completion of work.
- 30

31 * * *

32

Section 01 81 19 - Indoor Air Quality Control**PART 1 - GENERAL****1.01 SECTION INCLUDES**

- A. This section specifies administrative and procedural requirements for controlling indoor air quality (IAQ) throughout the duration of the construction process in new construction, protecting the ventilation systems, and reducing construction contaminants in accordance with the United States Green Building Council's (USGBC) LEED™ Rating System, Version 2.2. LEED is a registered trademark of the USGBC.

1.02 IAQ MANAGEMENT PLAN

- A. An indoor air quality (IAQ) construction management plan is required.
- B. The IAQ construction management plan shall be consistent with requirements set forth in the November 1995 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA) guide called "IAQ Guideline for Occupied Buildings Under Construction."
- C. Contractors shall follow this IAQ construction management plan as well as all OSHA, Federal, State, and local laws and guidelines during construction. If any of these laws or guidelines conflict with the procedures and requirements specified in this IAQ construction management plan, the Contractor shall notify the Architect before proceeding with the Work.

1.03 SUBMITTALS

Refer to Division 1 Sections "Submittal Procedures" for applicable submittal requirements.

PART 2 - PRODUCTS

NOT USED

PART 3 - EXECUTION

NOT USED

* * *

MACHINE-READABLE PROJECT INFORMATION TRANSFER AGREEMENT



Agreement made as of the date of: _____

Between Venture Architects (the Architect)

And _____ (the Recipient)

For the transfer of the following Project Design Information, being delivered in machine-readable electronic format, from the Architect to the Recipient.

File Name:	Content:	Medium	File Format	File Date & Time

For the benefit of: _____ Venture Project No.: _____
(Project Name)

For the purpose of: _____

1. Nature of this transfer: The delivery, by the Architect, of the above listed design information, in machine-readable electronic format, is in behalf of and for the benefit of the Owner for whom the design services have been performed and for the convenience of the Recipient. Under no circumstances shall the transfer of the Drawings, Specifications, electronic data or other instruments of service be deemed to be a sale by the Architect, and the Architect makes no warranties, express or implied, of Merchantability or of fitness for a particular purpose. Nothing in this transfer should be construed to provide any right of the contractor to rely on the information provided or that the use of this electronic information implies the review and approval by the Architect of any drawing based on the information. It is the professional opinion of the Architect that this electronic information provides design information current as of the date of its release. Any use of this information is at the sole risk and liability of the Recipient who also is responsible for updating the information to reflect any changes in the design following the preparation date of this information.

2. Governing Documents: If there is a discrepancy between the electronic files and the hard copies of the Contract Documents, the hard copies shall govern.

3. Acceptance Period: Because data stored in electronic media format can deteriorate or be modified inadvertently or otherwise without authorization of the Architect, the Recipient agrees that it will perform acceptance tests or procedures within 30 days, after which the Recipient shall be deemed to have accepted the data thus transferred. The Architect will correct errors detected within the 30-day acceptance period. The Architect shall not be responsible to maintain documents stored in electronic media format after acceptance by the Recipient.

4. Authorization of use: The Contractor, Subcontractors, Sub-subcontractors, and material or equipment suppliers are authorized to use and reproduce applicable portions of the Drawings, Specifications, and other documents prepared by the Architect and its Consultants appropriate to and for use in the execution of their Work under the Contract Documents for the above referenced Project. All copies made under this authorization shall bear the statutory copyright notice, if any, shown on the Drawings, Specifications, and other documents prepared by the Architect and its Consultants. Title and copyrights to the above referenced materials and any copies made by the Recipient remain with the Architect. Such materials are not intended or represented to be suitable for reuse by the Recipient or others on extensions of the Project or on any other project. Any such reuse or modification without written verification or adaptation by the Architect, as appropriate for the specific purpose intended, will be at the Recipient's sole risk and without liability or legal exposure to the Architect or to its Consultants. The Recipient shall indemnify and hold harmless the Architect and its Consultants from all claims, damages, losses, and expense, including attorneys' fees arising out of or resulting from the Recipient's use or modification of the above referenced materials.

5. Long-term Usability: The Architect makes no representations as to long-term compatibility, usability, or readability of documents resulting from the use of software application packages, operating systems, or computer hardware differing from those used by the Architect at the beginning of this Project. The Architect makes no representations as to long-term compatibility, usability, or readability of documents resulting from the failure of electronic media beyond the acceptance period.

6. Transfer fee: The Recipient agrees to pay the Architect a transfer fee of _____ as reimbursement for the Architect's expenses incurred in preparing and delivering the above referenced materials.

Agreed by: _____

Acceptance Date: _____

(Signature)

(Signature)

Title: _____

Title: _____

Venture Architects

Company: _____

Section 02 41 19 - Selective Demolition**PART 1 - GENERAL****1.01 DESCRIPTION**

- A. Work Included:
1. Labor and materials required for all selective demolition.
 2. See Drawings for detailed explanation of demolition.
- B. Work Not Included:
Removal of work stations by Owner's Vendors.

1.02 QUALITY ASSURANCE

Use adequate numbers of skilled workers who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

1.03 CONDITION OF PREMISES

- A. Examine building as to type of construction, its condition and items which are to be salvage and stored for reuse in current project.
- B. Accept premises as found.
- C. Assume risk regarding damage or loss whether by reason of fire, theft or other casualty or happening from and after notification of acceptance of proposal. No such damage or loss shall relieve Contractor from contract obligation to complete work.

1.04 MAINTAINING TRAFFIC

- A. Do not close or obstruct flow of building traffic or normal building operations.
- B. Conduct operations with minimum interference with roads, streets, driveways, alleys, sidewalks and other facilities.
- C. Maintain Code compliant exiting at all times.

PART 2 - PRODUCTS

NOT APPLICABLE

1 **PART 3 - EXECUTION**

2
3 **3.01 PREPARATION**

4
5 A. Continuous Operations:

- 6 1. The Communications Center is to remain fully operational
7 throughout the demolition and construction process 24 hours
8 per day / 7 day per week.
9 2. Schedule all work with Owner prior to demolition.
10 3. See Phasing Diagrams on Drawing A1.2 .

11
12 B. Protection:

- 13 1. Protect from damage all portions of building not scheduled
14 to be demolished.
15 2. Repair damage done to Owner's or other's property by reason
16 of required work.
17 3. Remove all protection when work is complete and when
18 authorized to do so by the Architect.
19 4. Protect existing trees and shrubs. See Section 01 56 39.

20
21 C. Dust Barriers:

- 22 1. The Contractor shall, at all times, conduct operations in a
23 manner to exclude dust and elements from occupied portions
24 of building.
25 2. Provide dust-tight enclosures consisting of 2 x 4 wood studs
26 spaced 16" o/c with top and bottom wood plates. Extend wall
27 tightly to ceiling, or to deck, if ceiling is not present.
28 3. Dust barrier shall be 5/8" gypsum board screw attached to
29 studs with drywall screws spaced 12" o/c. Tape and finish
30 all joints. Place full depth sound attenuation batts between
31 studs. Caulk along floor and ceiling. Provide flush
32 lockable door acceptable to Owner. Weatherstrip door to
33 prevent dust passage. Paint gypsum board and door in a color
34 acceptable to Owner. Use other means necessary to prevent
35 dust becoming a nuisance to staff and the public.

36
37 D. HVAC Filters:

- 38 Provide filters for HVAC system grilles to prevent dust and
39 other contaminants from migrating to occupied areas of building
40 by means of the HVAC system. Coordinate with Division B15.
41
42

43 **3.02 DEMOLITION**

- 44
45 A. Personal property and equipment will remain property of Owner,
46 and will be moved by this Contractor at the direction of the
47 Owner.
48

- 49 B. By careful study of the Contract Documents, determine the
50 location and extent of demolition to be performed. Carefully
51 identify limits of selective demolition.
52

- 53 C. Prepare and follow an organized plan for demolition and removal
54 of items. Carry out demolition work in accordance with Phasing
55 Diagrams shown on Drawings.

- 56 1. Completely remove items scheduled to be demolished, leaving
57 surfaces clean, solid and ready to receive new materials
58 specified elsewhere.

1 2. In all activities, comply with pertinent regulations of
2 governmental agencies having jurisdiction.

- 3
4 D. Execute work in an orderly and careful manner with due
5 consideration for building occupants and the public.
6
7 E. Carefully remove items to be salvaged for reuse or returned to
8 Owner without damaging the items and store where directed.
9 Package, wrap or provide other means of protection for items to
10 prevent damage and loss of parts during period of storage.
11
12 F. The Communications Center is to remain fully operational
13 throughout the demolition and construction process, 24 hours per
14 day / 7 days per week.
15
16 G. Contractor shall work with Owner to minimize disturbances and
17 schedule "noisy" work times as acceptable.
18

19 **3.03 UTILITIES**

20
21 See Electrical, Telecommunications and HVAC Drawings and
22 Specifications for temporary utilities, permanent utilities and
23 continuous 24/7 operations.
24

25 **3.04 DEBRIS**

- 26
27 B. Demolished materials which are not scheduled to be salvaged and
28 reinstalled or returned to Owner shall be considered to be
29 property of the Contractor and shall be removed from the site.
30
31 C. All materials, rubbish and debris shall be promptly removed from
32 the building and from the premises as it accumulates.
33
34 D. Do not store materials or permit debris to accumulate on site.
35
36 E. If Contractor fails to remove debris promptly, Architect
37 reserves the right to have it removed at Contractor's expense.
38
39

40 **3.05 REPLACEMENTS**

41
42 In the event of demolition of items not schedule to be demolished,
43 promptly replace such items to the approval of the Architect at no
44 additional cost to the Owner.
45
46

47 **3.06 CLEANING**

- 48 A. Upon completion of work, remove all tools, materials, apparatus
49 and rubbish.
50
51 B. Leave premises neat, clean and orderly.
52
53
54
55
56

57 * * *

Section 03 30 00 - Cast-In-Place Concrete**PART 1 - GENERAL****1.01 DESCRIPTION**

Work Included:

Patch concrete floors and other miscellaneous concrete work.

1.02 QUALITY ASSURANCE

- A. Applicable Specifications The latest issue of the following specifications, test methods and recommended practices shall govern, except where superseded by particular requirements of this specification.
- B. Standards: American Society for Testing Materials:
1. Specifications for Ready-Mixed Concrete: ASTM C 94.
 2. Specifications for Portland Cement: ASTM C 150.
 3. Specifications for Blended hydraulic Cements: ASTM C 595.
 4. Specifications for Concrete Aggregates: ASTM C 33.
 5. Specifications for Air-Entraining Admixtures for Concrete: ASTM C 260.
- C. American Concrete Institute:
1. Recommended Practice for Selecting Proportions for Concrete: ACI 211.1.

1.03 PROTECTION OF FINISHED WORK

- A. While installing concrete work, protect adjacent surfaces against damage or soiling.
- B. Repair other work damaged as a result of concrete work.

PART 2 - PRODUCTS**2.01 MATERIALS**

- A. Sub-beds: Frost resistant, well graded, clean, angular/fractured, crushed stone or gravel (not sand), free of silt, clay, loam, friable or soluble materials, and organic matter; tested in accordance with ANSI/ASTM C136 within the following limits:
1. Not more than 5% shall pass the No. 200 sieve.
 - a. Slab on grade subgrade: ASTM C33, Size 67.
- B. Concrete Aggregates
1. In general, shall comply with ASTM 33.
 2. Fine natural sand, clean, hard, strong, durable, uncoated grains, free from all injurious, deleterious substances passing No. 4 sieve.
 3. Coarse gravel or crushed stone, clean, hard, strong, durable, uncoated pieces free from deleterious substances. 1-1/2" maximum size aggregate shall conform to gradation for size No. 4 and 3/4" aggregate to size No. 67 in Table II of ASTM C 33. When 1-1/2" size is used, it shall be proportioned with 3/4" aggregate so as to produce gradation

conforming to size No. 467 in Table II of ASTM C 33.

C. Portland Cement:

1. Standard Portland Cement, ASTM C 150, Type I.
2. High Early-Strength Portland Cement, ASTM C 150, Type III.

D. Curing Compound:

- Liquid type, membrane forming curing compound complying with ASTM C 309, Type 1
 Colorless, protective coating complying with ASTM C 309, Type I.
 Leave finish surface that will permit adhesion of finish flooring materials.
- Euclid Chemical Company "Floor Coat"
 - MBT "Masterkure N-Seal VOC"
 - approved concrete

E. Under-Slab Vapor Barrier/Retarder:

1. Meet or exceed the requirements of ASTM E-1745 Class "B", ASTM E-154, ASTM E-96, with water vapor permeance of 0.03 perms or less.
2. Provide manufacturer product literature and samples to engineer for review.
3. Material: 10 mil or thicker high performance rubber modified HDPE, LDPE or LLDPE, polyethylene film reinforced with heavy-duty polyester or fiberglass cord grid or non-woven geotextile; or 15 mil polyolefin non-reinforced film, with virgin resins and no recycled materials.
 - a. "Griffolyn T-85", (10 mil) (Griffolyn Div., Reef Industries).
 - b. "Moistop Ultra-A (15 mil)" film, (Fortifiber Corp., Los Angeles, CA).
 - c. "Griffolyn (15 mil)" film, (Griffolyn Div., Reef Industries).
 - d. "Stego Wrap (15 mil)" film, (Stego Industries, CA)
 - e. "Vapor Block 15" (15 mil) film, (Raven Industries, South Dakota).
 - f. "Perminator (15 mil)" film, (W.R. Meadows, IL.)
 - g. Approved equal.
4. Accessories: Seam tape, repair tape, mastic, detail strips and pipe boots supplied by manufacturer.

F. Reinforcing Steel:

1. Bars conform to ASTM A 615 Grade 60
2. Welded wire fabric ASTM A 185 -
 - a. 6" x 6" - W1.4 x W1.4 WWF for slabs 5" thick or less.
 - b. 6" x 6" - W2.9 x W2.9 WWF for slabs greater than 5" thick.

G. Water: potable

H. Bonding Compound: Polyvinyl acetate or acrylic base, re-wettable type, for cosmetic nonstructural repairs.

- "Euco Weld" (Euclid Chemical)
- "Weldcrete" (Larsen Co.)

1 **2.02 MIXES**

2
3 **CONCRETE MIX**

- 4
5 A. Ready-mixed concrete is subject to following:
6 1. Concrete must meet all requirements of ASTM C 94 and those
7 herein specified for materials, proportioning, mixing and
8 other details of manufacture, quality and delivery.
9 2. Submit suitable evidence as to experience, equipment and
10 capacity of plant to Architect for approval.
11
12 B. Mix Proportioning: Furnish ready-mixed concrete in accordance
13 with the following schedule.
14

15	16	17	18	19	20	21
Type of	Min. Comp.	Max.	Max.	Min.		
Construction	Strength	Slump	Agg.	Cement	Air	
	at 28 day	In.	In.	Lbs/	Entrained	
	PSI			C.Y.		
22	23	24	25	26	27	28
Interior Toppings and Slabs	4000	2-4	0.75	540	No	
Misc. Non-Sched. Concrete Work	3000	2-4	0.75	470	No	

29 **PART 3 - EXECUTION**

30
31 **3.01 PLACING OF SUB-BEDS**

- 32
33 A. Drainage Fill: Use as final 6" minimum layer for granular sub-
34 beds under interior floor slabs.
35
36 B. Compact each layer of backfill or fill material to 95% maximum
37 dry density.
38
39

40 **3.02 PLACING OF REINFORCING**

41
42 Placing of reinforcing shall be in strict accordance with Concrete
43 Reinforcing Steel Institute SPECIFICATIONS FOR PLACING OF REINFORCEMENTS.
44

45 **3.02 PREPARATION**

46 Before Placing Concrete:

- 47 - Remove all dirt, chips and other debris from forms or place to receive
48 concrete.
49
50

1 **3.03 PLACING OF CONCRETE**

- 2
- 3 A. Handle concrete in a manner to prevent separation or loss of
- 4 ingredients.
- 5
- 6 B. Consistency of concrete to be such that it will be:
- 7 1. Uniform throughout with mortar clinging to course aggregate.
- 8 2. Plastic enough that concrete will work readily into corners and
- 9 angles of the forms and around reinforcement without excessive
- 10 puddling or spading and without segregation on surface while
- 11 transporting or placing.
- 12 3. Of sufficient mortar content in the mass to fill all voids,
- 13 prevent harshness or honeycombing in the structure provide
- 14 uniform distribution of course aggregate.
- 15
- 16 C. Place concrete over gravel sub-beds as required to bring floors to
- 17 proper level.
- 18
- 19 D. Moisture Barrier Membrane:
- 20 Place over gravel subgrade which has been suitably smoothed so as to
- 21 prevent perforation, install one (1) ply of specified membrane lapping
- 22 all edges 6" with top lap placed in direction of spreading concrete.
- 23
- 24 E. Slabs:
- 25 1. Slabs on Gravel Beds:
- 26 a. Make sure all underslab work is completed.
- 27 b. Check gravel sub-bed for compactness, proper levels and
- 28 pitches to drains as required.
- 29 c. Place moisture barrier membrane over sub-bed.
- 30 d. Pour slabs to required levels and thickness in one (1)
- 31 monolithic operation with joints as required.
- 32
- 33 F. Finishes:
- 34 All patched slabs shall be finished to match existing adjacent slab
- 35 surfaces.
- 36
- 37

38 * * *

Section 03 54 13 - Gypsum Cement Underlayment

PART 1 - GENERAL

1.01 DESCRIPTION

A. Work Included:

1. Commercial Topping floor underlayment
2. Floor Primer
3. Surface sealer for installation of glue-down floor coverings.

B. Allowance:

Include in Base Bid an allowance to provide (furnish and install) 1,500 square feet of Gypsum Cement Underlayment.

1.03 QUALITY ASSURANCE

Installer's Qualifications: Installation of Commercial Topping shall be by an applicator authorized by the underlayment manufacturer using manufacturer's approved mixing and pumping equipment.

1.04 DELIVERY, STORAGE AND HANDLING

General Requirements: Materials shall be delivered in their original, unopened packages, and protected from exposure to the elements. Damaged or deteriorated materials shall be removed from the premises.

1.05 SITE CONDITIONS

Environmental Requirements: Before, during and after installation of Commercial Topping, building interior shall be enclosed and maintained at a temperature above 50 degrees F.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

Approved Manufacturers:

In order to establish a standard of quality, this specification is based on self-leveling commercial topping as manufactured by:

- Maxxon Corporation, Hamel, MN, "Commercial Topping"

Equal products by the following manufacturers which meet the requirements of this specification are also approved:

- USG, "Levelrock 4500"

Equal products may be submitted for approval no less than ten days prior to bid date. Submittal shall include the name of the specific product being submitted for approval and shall include all information specific to that product necessary to prove compliance with the specified requirements.

2.02 MATERIALS

- A. Sand Aggregate: Sand shall be 1/8 inch (3 mm) or less, washed masonry or plaster sand, meeting requirements of Maxxon Corporation Sand Specification 101.
- B. Mix Water: Potable, free from impurities.
- C. Subfloor Primer:
 - Maxxon Floor Primer
 - Levelrock Brand Primer
- D. Sealer:
 - Maxxon Overspray
 - USG, "Levelrock Concrete Primer"

2.03 MIX DESIGNS

Commercial Topping mix proportions and methods shall be in strict accordance with product manufacturer recommendations.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Condition and Cleaning of Subfloor: Subfloor shall be structurally sound. General Contractor shall clean subfloor to remove mud, oil, grease and other contaminating factors before arrival of the Commercial Topping underlayment crew.
- B. Leak Prevention: Fill cracks and voids with a quick setting patching or caulking material where leakage of Commercial Topping could occur.
- C. Priming Subfloor: Prime concrete subfloor using the Floor Primer. Priming instructions vary according to the porosity of the concrete, multiple coats may be necessary.
- D. Expansion Joints: Allow joints to continue through the Commercial Topping at the same width.

3.02 APPLICATION OF CEMENTITIOUS UNDERLAYMENT

- A. Scheduling: Install after drywall installation unless tenant finish requirements identify partitioning after the pour.
- B. Application: Place Commercial Topping at 3/8 inch minimum over concrete. Spread and screed Commercial Topping to a smooth surface. Except at authorized joints, place Commercial Topping as continuously as possible until application is complete so that no Commercial Topping slurry is placed against Commercial Topping

product that has obtained its initial set. Featheredging may be accomplished in low traffic areas.

- C. Drying: Provide continuous ventilation and adequate heat to rapidly remove moisture from the area until the Commercial Topping is dry. To test for dryness, tape a 24 inch by 24 inch section of plastic or high density rubber mat to the surface of the underlayment. After 48-72 hours, if no condensation occurs, the underlayment shall be considered dry. Perform dryness test 5 to 7 days after pour.

3.03 PREPARATION FOR INSTALLATION OF GLUE DOWN FLOOR GOODS

- A. Sealing: Seal all areas that receive glue down floor goods using underlayment manufacturer's approved sealer applied in accordance with manufacturer's specifications. Any floor areas where the surface has been damaged shall be cleaned and sealed regardless of floor covering to be used. Where floor goods manufacturers require special adhesive or installation systems, the flooring manufacturer's requirements supersede these recommendations.
- B. Floor Goods Procedures: Follow underlayment manufacturer's recommended procedures as a guideline for attaching finished floor goods to underlayments.

3.04 FIELD QUALITY CONTROL

- A. Slump Test: Commercial Topping mix shall be tested for slump as it's being pumped using a 2 inch by 4 inch cylinder resulting in a patty size of 9 inches plus or minus 1 inch diameter.
- B. Field Samples: At least one set of 3 molded cube samples shall be taken from each day's pour during the Commercial Topping application. Cubes shall be tested as recommended by the underlayment manufacturer in accordance with modified ASTM C 472. Test results shall be available to architect and/or contractor upon request from applicator.

3.05 PROTECTION

Protection From Heavy Loads: During construction, place temporary wood planking over Commercial Topping wherever it will be subject to heavy wheeled or concentrated loads.

Section 04 20 00 - Unit Masonry

PART 1 - GENERAL**1.01 DESCRIPTION**

- A. Work Included: Labor and materials required to complete masonry work.
- B. Related Work Specified Elsewhere:
1. Hollow Metal Doors and Frames - Section 08 11 00
 2. Gypsum Board Assemblies - Section 09 21 16
 3. Painting - Section 09 90 00

1.02 QUALITY ASSURANCE

- A. Standards:
- Masonry materials and masonry construction shall comply with the latest edition of:
1. National Concrete Masonry Association (NCMA)
 - a. Specification for the design and construction of load-bearing concrete masonry.
 2. American Concrete Institute ACI 531 - Building code Requirements for Concrete Masonry Structures.
- C. Standards: latest revision.
- ASTM C 150 - Standard Specification for Portland Cement.
- ASTM C 33 - Standard Specification for Concrete Aggregates.
- ASTM C 90 - Standard Specification for Hollow Load-Bearing Concrete Masonry Units.
- ASTM C 270 - Standard Specification for Mortar for Unit Masonry.
- ASTM C 207 - Standard Specification for Hydrated Lime for Masonry Purposes.
- ASTM C 331 - Standard Specification for Lightweight Aggregates for Concrete Masonry Units.
- D. The specified compressive strength f'm for concrete masonry units (CMU) shall be verified by the block supplier by prism tests in accordance with NCMA specification, ASTM C 39 and ASTM E 447.

1.03 SUBMITTALS

- A. Materials list of items proposed to be provided under this Section.
- B. Manufacturer's specifications and other data needed to prove compliance with the specified requirements.
- C. Portland Cement: Submit name of product to Architect.
- D. Concrete masonry units: Submit manufacturer's certificate of compliance for concrete block density and strength upon request.

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1.04 PRODUCT DELIVERY HANDLING AND STORAGE

- A. Deliver, handle and store materials so as to prevent inclusion of foreign materials and damage by water or breakage.
- B. Deliver packaged materials and store in original packages until ready for use. Packages or materials showing evidence of water or other damage will be rejected.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Masonry Horizontal Wall Reinforcing: electrically welded side and cross rods, ladder or truss type with galvanized side and cross rods. Hot Dip Galvanizing shall conform to ASTM A153, Class B-2 (1.5 oz. per square foot, average).
 - 1. Standard type with No. 9 gauge side and cross rods.
 - 2. Provide special fabricated units for corners and wall intersections.
 - 3. Approved Manufacturers:
 - Dur-O-Wall, Inc., "Dur-O-Wal"
 - Heckmann, "No. 1100" and "No. 1200"
 - Hohmann and Barnard, Inc., "Lox All"
- B. Reinforcing Steel: ASTM A 615, Grade 60.
- C. Water shall be clean and free from deleterious material, suitable for drinking and range from 50 to 70 degrees F.
- D. Portland Cement to comply with Standard Specifications of the American Society for Testing Materials, C 150, Type I. Cement shall be standard product name of which shall be submitted to Architect for approval.
- E. Lime: Hydrated lime conforming to standard specifications of the ASTM C 207, Type S.
- F. Sand for Mortar: Clean, sharp, free from loam, silt, vegetable matter, salts and other injurious substances, and shall conform to ASTM C144, except that sand for mortar in 1/4 inch wide joints shall pass a No. 16 sieve. Sand is further subject to approval of the Architect, based on mortar color desired and obtainable by use of local sands readily available, and shall be from one source.
- G. Calcium Chloride: Calcium chloride or admixtures containing chloride salts are not permitted.
- H. Concrete Block:
 - 1. Load bearing concrete block shall be load bearing of quality, make, weight, density and strength conforming to ASTM C 90.
 - 2. Moisture in units shall not exceed 30 percent maximum absorption value of units when delivered and shall be free of any deleterious matter.
 - 3. Aggregates:

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- Lightweight Aggregate: Conform to ASTM C 331.

- 1 4. All block shall have lightweight aggregate and be of
 2 thickness necessary to achieve required fire rating.
 3 5. Exposed block for room interiors shall be smooth faced, made
 4 with fine aggregate to produce an overall smooth, dense
 5 surface free from damaged faces and edges.
 6 6. Provide special units required for all lintels, corners,
 7 jambs, caps sills, ornamental work, etc., and for proper
 8 bonding to adjoining work.
 9 7. All blocks shall be to modular dimensions.
 10 8. Unless otherwise noted in Structural Drawings, net area
 11 compressive strength of masonry unit shall equal 2800 psi
 12 Type M or S mortar, and 3050 psi for type N mortar.
 13
 14 I. Partition Top Joint Filler:
 15 1. Non-Fire Rated Partitions: Sponge neoprene or PVC,
 16 rectangular, 1" less than width of wall, 3/8" thick.
 17 2. Fire Rated Partitions: "Thermafiber" Safing Insulation.
 18
 19 J. Sealant: For sealing joints where partitions meet roof
 20 construction. Moisture cured polyurethane sealant or silicone
 21 construction sealant.
 22 - Tremco "Dymonic"
 23 - G.E. "Silpruf"
 24
 25

26 2.02 MIXES

- 27
 28 A. Mix mortar in accordance with the proportion requirements of
 29 Brick Institute of America Standard Specification for Portland
 30 Cements-Lime Mortar for Brick Masonry; M1-72.
 31
 32 B. Mortar Types:
 33
 34 Type N - For non-structural walls and interior partitions.
 35 1. One (1) part Portland Cement
 36 2. One (1) part Hydrated Lime
 37 3. Sand: Not less than 2-1/4 and not more than 3 times the sum
 38 of the volumes of cement and lime used.
 39
 40 C. At Contractor's option, an approved brand of masonry cement
 41 mortar, conforming to F.S. SS-C-181B and ASTM C 91 may be
 42 substituted for the above mortars.
 43
 44 D. Grout:
 45 1. For filling cores of concrete block:
 46 a. One (1) part Portland Cement;
 47 b. Two and one-half (2-1/2) parts sand;
 48 c. Two (2) parts graded pea gravel passing 1/4" screen.
 49 d. Slump: 9" + or - 1".
 50 e. Compressive Strength: 3000 psi minimum at 28 days.
 51 2. Mix as submitted by concrete supplier.
 52 3. Non-Shrinking Mortar:
 53 - Master Builder's Company, "Masterflow 713 Plus".
 54 4. Mix shall be verified for strength by testing agency and
 55 adjusted as required.
 56
 57

- 1 E. Mixing:
- 2 1. All materials for mortars shall be measured by volume; sand
- 3 and cement mixed dry, lime putty added and water added to
- 4 bring to proper consistency for use.
- 5 2. Masonry cement mortars shall be mixed in strict accordance
- 6 with manufacturer's instructions.
- 7 3. No mortars that have stood more than two (2) hours shall be
- 8 used.
- 9 4. Mortar that has stiffened within above time limit may be
- 10 retempered.
- 11
- 12

13 **PART 3 - EXECUTION**

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15 **3.01 INSTALLATION**

16

- 17 A. General:
- 18 1. Lay work true to dimension, plumb, square and in bond
- 19 accurately. All courses shall be level with joints of
- 20 uniform width.
- 21 2. No joints shall exceed size specified.
- 22 3. Block shall be cut accurately to fit around pipes, ducts,
- 23 openings, etc., and all voids slushed full.
- 24 4. Provide all scaffolds, staging, hoists, etc., required for
- 25 proper execution of work.
- 26
- 27 B. Block:
- 28 1. Set block in full bed of mortar not over 3/8" thick and
- 29 butter all vertical joints on walls and webs.
- 30 2. Lay block for interior partition walls in running bond,
- 31 unless otherwise noted.
- 32 4. Provide control joints spaced no greater than 30' o/c in
- 33 interior CMU walls.
- 34 5. Tool all joints as directed by Architect.
- 35 6. Do all necessary cutting with masonry saw.
- 36 7. Where noted, provide 100 percent solid blocks.
- 37 8. Fill lintels, bond beams, etc., with concrete and reinforced
- 38 with rods as required to carry superimposed loads.
- 39 9. Fill hollow metal frames with mortar as wall is laid up.
- 40 10. Bond intersections of block walls to concrete with partition
- 41 anchors.
- 42 11. Bond beams shall be of special lintel blocks filled with
- 43 concrete and reinforced.
- 44
- 45 C. Masonry Wall Reinforcing: Continuously reinforce masonry walls
- 46 with specified reinforcing of proper width for wall thickness
- 47 and in accordance with manufacturer's recommendations.
- 48 1. Reinforce top course of all walls and first two (2) courses
- 49 above and first course below all openings. Reinforcement
- 50 shall extend 24" each side of opening.
- 51 2. Reinforce balance of wall every second block course (16" o/c
- 52 vertically).
- 53 3. At corners and intersections, use special corners or "T"
- 54 assemblies.
- 55
- 56 D. Where walls and partitions meet concrete slabs, beams, girders,
- 57 tees and other precast construction, fill joint with specified
- 58 compressible filler and seal with moisture cured urethane
- 59 sealant.
- 60
- 61

- 1 E. Lintels:
 - 2 1. Steel lintels will be furnished by Steel Contractor but set
 - 3 by Mason Contractor.
 - 4 2. All lintels, not otherwise shown, shall be reinforced
 - 5 precast of lightweight aggregate or special lintel blocks
 - 6 filled with concrete and reinforced as required.
 - 7
- 8 F. Chases, Recesses, Etc.,: This Contractor to construct all
- 9 chases, recesses, etc., as may be required by work of other
- 10 Contractors or as may be directed by Architect.
- 11
- 12 G. Building Expansion Joints:
 - 13 1. Construct expansion joints in masonry walls.
 - 14 2. Install premolded joint filler using adhesive recommended by
 - 15 manufacturer.
 - 16 3. Joints will be sealed under Section 07 90 00.
 - 17
- 18 H. Built-In Work:
 - 19 1. Consult other trades in advance and make provisions for
 - 20 installation of their work in order to avoid cutting and
 - 21 patching.
 - 22 2. Build in anchors as required.
 - 23 3. Set steel lintels in beds of mortar.
 - 24 4. Fill solid with mortar around metal door frames.
 - 25
- 26 I. Cutting and Patching:
 - 27 1. Do all cutting and patching of work in this section as per
 - 28 General Conditions and Division 01.
 - 29 2. Where new work connects with existing, this Contractor shall
 - 30 do all necessary cutting, fitting and patching, removing of
 - 31 work in his line, cutting all openings called for on
 - 32 Drawings or as required to make satisfactory connection with
 - 33 work to be performed under this specification.
 - 34

35 **3.02 TOLERANCES FOR CONSTRUCTION**

- 36
- 37 A. Variations from the plumb in the lines and surfaces of columns,
- 38 walls and arrises shall not exceed 1/4 inch in 10 feet, 3/8 inch
- 39 in a story height or 20 feet, maximum, or 1/2 inch in 40 feet or
- 40 more. Variation from plumb for external corners, expansion
- 41 joints and other conspicuous lines shall not exceed 1/4 inch in
- 42 any story or 20 feet, maximum, or 1/2 inch in 40 feet or more.
- 43
- 44 B. Variation from the level of the grades for exposed lintels,
- 45 sills, parapets, horizontal grooves and other conspicuous lines
- 46 shall not exceed 1/4 inch in any bay or 20 feet, or 1/2 inch in
- 47 40 feet or more.
- 48
- 49 C. Variation of the linear building line from an established
- 50 position in plan and related portion of columns, walls and
- 51 partitions shall not exceed 1/2 inch in any bay or 20 feet,
- 52 maximum, or 3/4 inch in 40 feet or more.
- 53
- 54 D. Variation in cross-sectional thickness of walls shall not exceed
- 55 plus or minus 1/8 inch from the dimensions indicated on the
- 56 drawings.
- 57
- 58
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1 **3.03 MASONRY CLEANING AND POINTING**

- 2
- 3 A. Do all work in as clean a manner as possible. Remove excess
- 4 material and mortar droppings daily. Remove mortar droppings on
- 5 connecting or adjoining work before final set.
- 6
- 7 B. Exposed Masonry: At completion of work, point holes in joints
- 8 of exposed exterior masonry surfaces, completely fill with
- 9 mortar, tool properly. After pointing has set and hardened,
- 10 clean surfaces of all excess mortar.
- 11
- 12 C. Clean concrete masonry units which remain exposed in finished
- 13 work using industry accepted methods.
- 14
- 15 D. Remove and replace defective materials and correct defective
- 16 workmanship.
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* * *

Section 05 50 00 - Miscellaneous Metals**PART 1 - GENERAL****1.01 DESCRIPTION**

- A. Work Included:
All work of steel, iron and other metals not specifically excluded and such items shown on the Drawings as are called for in any of the following articles.
- B. Related Work Specified Elsewhere:
1. Unit Masonry - Section 04 20 00
- C. Items furnished but not installed:
Provide items fabricated from structural steel sections, plates, bars, rods, etc. required for erection of various items.

1.02 QUALITY ASSURANCE

- A. Standards:
ASTM A 36 - Standard Specification for Structural Steel
ASTM A 283 - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates of Structural Quality
ASTM A 53 - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless
ASTM A 307 - Standard Specification for Carbon Steel Externally and Internally Threaded Standard Fasteners
- B. All welding shall be done by certified welders.
- C. Levels, Locations and Responsibilities: This Contractor shall be responsible for locations and levels of all work of this Section, except such parts as may be delivered to others and set by them. In such cases, this Contractor shall assist others in properly locating said parts.

1.03 SUBMITTALS

- A. Submit the following:
1. Materials list of items proposed to be provided in this Section.
 2. Shop Drawings in sufficient detail to show fabrication, installation, anchorage and interface of the work of this Section with the work of adjacent trades.

PART 2 - PRODUCTS**2.01 MATERIALS**

A. Metals in General:

1. Metals shall be free from defects impairing strength, durability or appearance and of best commercial quality for purposes specified.
2. Metals shall be made with structural properties to sustain safety or withstand strain and stresses to which normally subjected, true to detail, clean, straight, with sharply defined profiles, curved work to true radii and, unless otherwise particularly noted, with smooth finished surfaces.
3. Fastenings: All exposed fastenings shall be of same materials, color and finish as metal to which applied, unless otherwise noted.

B. Gauges herein specified refer to U.S. Standard for sheet steel, plate, iron, and steel. Gauge thickness specified are minimum.

C. Steel:

1. Structural Steel: ASTM A 36
2. Architectural, Miscellaneous Steel, (unless otherwise particularly specified): Mild Steel ASTM A 283
3. Steel Pipe: ASTM A500, Grade B
4. Bolts and Nuts: ASTM A 307
5. Welding Rods: ASTM A 233

D. Cast Iron: All castings shall be of soft grey iron.

E. Stainless Steel: ASTM A 167, Type 302

F. Aluminum: Extrusions alloy and temper as required for finish specified.

H. Liquid Galvanizing Repair Compound:

- "ZRC Galvilite", ZRC Worldwide,
Marshfield, MA. (800) 831-3275

I. Paint: Shop coat red zinc oxide primer.

2.02 PIPE RAILINGS

A. Standard steel pipe, 1-1/2" O.D. welded construction with all welds ground smooth.

B. Handrails at wall shall have 90 degrees elbow return with 1/4" clearance at wall. Mount on M.I. wall brackets spaced not to exceed 5'-0" o/c and secured with 3/8" toggle bolt or expansion unit.

- Brackets: Style "1705" as manufactured by R&B Wagner, Inc.,
Milwaukee, WI or approved equal

C. All rails receive one (1) shop coat paint.

D. Provide extension and modifications of existing pipe rails, as required.

2.03 STRUCTURAL REINFORCING AT DOORS AND WINDOWS

- 1
2
3 A. Furnish and install structural steel channels, angles, beams,
4 etc., required for reinforcing window, door and borrowed light
5 frames. Include all clips, bolts, etc., required for
6 installation.
7
8 B. Cooperate with window and door frame fabricator and erector for
9 proper installation.
10

2.04 LINTELS

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12
13 Loose structural steel lintels shall be furnished by this Contractor.
14
15

2.05 FABRICATION

- 16
17
18 A. General: Provide items in ample time not to delay job progress,
19 deliver to job at such time as required for proper coordination.
20
21 B. Fabrication: As far as possible, all work shall be fitted and
22 shop assembled ready for erection. Work shall be executed in
23 strict accordance with Drawings, details and approved Shop
24 Drawings. Exposed joints dressed flush and smooth.
25
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PART 3 - EXECUTION**3.01 INSTALLATION**

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31 A. Provide and set all hangers, rods, bars, plates, bolts, screws,
32 anchors, brackets, rivets, welds, lugs, etc., as required to
33 complete this work and to joint to work of others. When
34 exposed, to be same materials and finish as adjacent work.
35
36 B. Do all bracing, blocking, cutting, fitting, drilling, tapping,
37 leading, etc., as required to complete this work and joint to
38 work of others. When exposed, to be same materials and finish
39 as adjacent work.
40
41 C. Anchorage: Work to be built into masonry is to be provided with
42 suitable anchors, expansion shields, etc., as required for
43 proper anchorage.
44
45 D. Field Welding:
46 1. Grind off galvanizing or paint prior to welding.
47 2. Perform welding in compliance with AWS D1.1 and D1.4. Grind
48 weld flush.
49 3. Touch-up all galvanized field welded connections.
50 4. Repair damaged metal surfaces by cleaning and applying a
51 coat of liquid galvanizing repair compound to galvanized
52 surfaces. Touch up primer on painted surfaces using
53 compatible primer applied 3 mils thick.
54
55 E. Painting: All ferrous metal work furnished under this Contract
56 to receive one (1) shop coat of specified metal paint. Metal
57 that is to be painted shall be thoroughly cleaned of foreign
58 matter with surfaces put in proper condition for painting.
59 After erection, touch up all scratches, welds, etc., with same
60 material.

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F. Erection: Fabricate and install work square, plumb, straight, and true, accurately fitted with tight joints and intersections adequately reinforced and anchored in place. Exposed work shall be finished smooth with even, close joints and neat connections.

* * *

Section 06 09 00 - Rough and Finish Carpentry**PART 1 - GENERAL****1.01 DESCRIPTION**

- A. Work Included:
Labor and materials required to complete rough and finish carpentry work.
- B. Related Work Specified Elsewhere:
1. Millwork - Section 06 40 00
 2. Wood Doors - Section 08 14 00
 3. Finish Hardware - Section 08 70 00

1.02 QUALITY ASSURANCE

- A. Grading:
1. Lumber herein referred to shall conform to the American Lumber Standards, Simplified Practice Recommendations, R-16 latest edition.
 2. Grades shall conform to the grading rules of the Manufacturer's Association under whose rules the lumbers is produced.
- B. Lumber shall be kiln dried and well seasoned.
- C. All softwood plywood to conform to latest Product Standard, PS-1.
- D. Wood Preservative Treatment: Work shall be performed at a plant properly equipped to pressure treat wood with an arsenic and chromium-free wood preservative and which has been licensed by AWPB to pressure treat lumber and plywood under the AWPI Quality Control Program.
- E. Reference Standards:
Engineered Wood Association, "Residential & Commercial Design/Construction Guide", latest edition.

1.03 ALTERATIONS

Where new work connects with existing, this Contractor shall do all necessary cutting, fitting and patching and removal of existing work in Contractor's line as required to make satisfactory connection with the work of this Section and leave entire work in a finished and acceptable condition.

1.04 PRODUCT DELIVERY, HANDLING AND STORAGE

- A. Receive, check, store, give receipt for and be responsible for all finish hardware furnished under another section.
- B. Present Master Keys to Owner immediately upon receipt of hardware by contractor.

1 **PART 2 - PRODUCTS**

2
3 **2.01 GRADE STAMPS**

- 4
5 A. Identify lumber by grade stamp.
6
7 B. Identify plywood as to species, grade and glue type by the stamp
8 of the Engineered Wood Association.
9
10 C. Identify other materials of this Section by the appropriate
11 stamp of an approved agency.
12
13

14 **2.02 MATERIALS**

- 15
16 A. Lumber: Provide materials in the quantities needed for the Work
17 and meeting or exceeding the following standards of quality
18 unless noted otherwise on Drawings.
19 1. Wood blocking and nailers, 2" to 4" thick and up to 4" wide
20 shall be Hem-Fir or SPF (South), stud grade up to 10'
21 lengths, Construction or No. 2 Grade over 10' lengths.
22 2. Nailing strips, blocking, furring, etc., 2" to 4" thick, 6"
23 and wider, shall be Hem-Fir or SPF (South), stud grade up to
24 10' lengths, Construction or No. 2 grade over 10' lengths.
25
26 B. Plywood: Plywood, unless otherwise specified, shall be softwood
27 plywood.
28 1. All other plywood shall be "AD" or "BD".
29
30 C. Rough Hardware:
31 1. Provide nails, spikes, bolts, nuts, washers, metal
32 connectors, screws, etc., as required to complete work of
33 this Section.
34 2. All fasteners in contact with preservative treated lumber
35 shall be stainless steel or polymer-coated fasteners or
36 other material shown to have a high corrosion resistance to
37 the specified treated lumber.
38 3. Steel Items:
39 a. Comply with ASTM A 7 or ASTM A 36.
40 b. Use galvanized items at exterior locations.
41 4. Lag Bolts:
42 Comply with Federal Spec. FF-B-561.
43 5. Nails:
44 a. Use common except as otherwise noted.
45 b. Comply with Federal Spec. FF-N-1.
46 c. Use galvanized at exterior locations. Use stainless
47 steel or polymer coated fasteners in preservative
48 treated lumber.
49 6. Bolts: A307 with maximum thread length equal to 2 times bolt
50 diameter plus 1/2".
51
52 D. Wood Preservative Treatment:
53 1. All wood used in contact with ground or specified within
54 18" thereof; all blocking; nailers and framing materials in
55 contact with masonry, concrete and structural steel; and
56 nailers for metal flashings.
57 2. Pressure Treated with arsenic and chromium-free
58 preservative, Type B, as accepted by AWPA. Retention of
59 0.25 for above ground; 0.40 for ground and fresh water
60 contact;. Other retentions as recommended by manufacturer.
61

- 1 3. Drying: After treatment, all lumber and plywood 2" thick
2 (nominal) or less shall be dried to a moisture content of
3 19 percent or less.
4 4. Field Treatment of Cut Surfaces: All surfaces cut after
5 treatment shall have two (2) brush-on applications of one
6 to one (1:1) mixture of the preservative used for the
7 original treatment and solvent or other solution
8 recommended by preservative manufacturer.
9 5. Qualifications: Wood preservative treatment shall be
10 performed at a plant that is properly equipped to pressure
11 treat wood by the vacuum-pressure method and which has been
12 licensed by AWPB to pressure treat lumber and plywood under
13 the AWPI Quality Control Program.

- 14
15 E. Closet Poles:
16 - K&V "No. 770, 1-1/16" O.D. chrome finish with "No. 734" and
17 "No. 735" flanges.
18
19 F. Provide other materials, not specified, but required to complete
20 rough and finish carpentry work.
21
22

23 **PART 3 - EXECUTION**

24 **3.01 PREPARATION**

25
26
27 Follow AWI Articles 1700-G-3, 1700-G-4 and 1700-G-5 recommendations
28 for acclimation of millwork and wood trim to site conditions prior to
29 installation. Allow millwork a minimum of 72 hours to come to
30 equilibrium on site prior to installation. Allow factory finished
31 woodwork a minimum of one (1) week to acclimatize to site conditions.
32 Relative humidity shall not be less than 25% or more than 55% under
33 normal conditions. Relative humidity during time of installation
34 shall remain within the range to be maintained during occupancy.
35
36

37 **3.02 INSTALLATION**

- 38
39 A. Workmanship:
40 1. Finish work shall be erected plumb, true, square and in
41 accord with Drawings.
42 2. Scribing, mitering and joining shall be done accurately and
43 neatly. Intersecting molds at interior corners shall be
44 coped.
45 3. Drill holes in hardwoods for nails.
46 4. Finish work shall be blind nailed as far as possible.
47 Surface nails shall be set. Work shall be securely nailed
48 to studs, nailing blocks, etc.
49
50 B. Provide blocking as required for installation of plumbing
51 fixtures, window and door frames, built-in furniture and other
52 items requiring blocking.
53
54 C. Wood Doors:
55 1. Handle wood doors in accordance with recommendations of
56 WDMA I.S. 1-A, "Care and Installation at Job Site."
57 2. Condition doors to average temperature and humidity in area
58 of installation for not less than 48 hours prior to
59 installation. Store doors per recommendations of WDMA I.S.
60 1-A, "Care and Installation at Job Site."
61

- 1 3. Install in neat manner, free from hammer or tool marks,
2 open joints or slivers.
- 3 4. Set plumb, level, square and true. Install work after
4 building humidity is at acceptable level.
- 5 5. Remove and replace all doors found to be warped, twisted,
6 bowed, or otherwise damaged. Do not install doors which
7 cannot be properly fitted to frames.
- 8 6. Adjust prefinished doors and hardware and other moving or
9 operating parts to function smoothly and correctly.
- 10 7. If doors are to be field finished, the process must follow
11 the WDMA I.S. 1-A, "Care and Handling at Job Site"
12 instructions for field applied finishes.
- 13 8. Ensure that smoke gaskets are in-place before prefinished
14 door installation.
- 15 9. Protection: Replace cartons in which doors are shipped as
16 soon as doors are hung to provide protection until area is
17 free of construction traffic.
- 18
- 19 D. Woodwork attached to masonry, tile or other hard surfaces shall
20 be secured with screws or expansion bolts to provide a rigid,
21 permanent support. Countersink screws and bolts and plug holes
22 where exposed.
- 23
- 24 E. Hardware:
 - 25 1. Install hardware in accordance with manufacturer's
26 directions so it operates easily, quietly and properly.
 - 27 2. Fit hardware for doors so they will close without forcing
28 and so as to prevent any rattle.
 - 29 3. Make hardware cuts true and neat.
 - 30
- 31 F. Casework:
 - 32 1. Install open front plastic laminate "cubbies" in accordance
33 with AWI (Architectural Woodwork Institute) Section 1700-T-
34 5.
 - 35 2. Install cabinets plumb and level with all joints tight.
 - 36 3. Shim cabinets as required and trim with molding to match
37 cabinets.
 - 38 4. Secure to walls with countersunk screws concealed with
39 self-adhesive plastic cap or with chrome head screws with
40 grommet washers. Embed fasteners one inch minimum, in
41 framing or blocking.
 - 42 5. Install hardware and miscellaneous accessories as required.
 - 43 6. Clean cabinets and leave in proper operating order with all
44 doors, shelves and drawers aligned and plumb.
 - 45
 - 46
 - 47

* * *

Section 06 40 00 - Millwork**PART 1 - GENERAL****1.01 DESCRIPTION**

- A. Work Included: Labor and materials required to complete millwork including wood moldings and trim, custom plastic laminate casework, solid surfacing material fabrications and all other millwork.
- B. Related Work Specified Elsewhere:
1. Rough and Finish Carpentry - Section 06 09 00
 2. Wood Doors - Section 08 14 00
 3. Painting and Finishing - Section 09 90 00

1.02 QUALITY ASSURANCE

- A. Compressed Particle Board shall conform to requirements of AWI Section 200-G-3 and ANSI A208.1.
- B. Laminated Plastic decorative surfacing shall be NEMA quality melamine surfaced laminated plastic sheet.
- C. Millwork shall conform to requirements for Custom Grade work as defined in Architectural Woodwork Quality Standards, latest edition, as published by Architectural Woodwork Institute. This grade shall be considered as the minimum requirement. Contractor shall adhere to additional requirements of this Specification even though they may exceed the requirements of the specified AWI grade.
- D. Millworker shall have a reputation for doing satisfactory work on time and have successfully completed projects of similar size and comparable work.

1.03 SUBMITTALS

Submit the following:

1. Samples of plastic laminate in color and pattern scheduled.
2. Submit sample of PVC edge banding to Architect and receive approval for finish and color prior to fabricating plastic laminate work.
4. Shop drawings in sufficient detail to show fabrication, installation, anchorage and interface of the work of this Section with the work of adjacent trades.
5. Samples of cabinet hardware proposed to be used in the required finish.

1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Moisture in building and storage conditions must be suitable to receive millwork before delivery is made. Heat will be required in cold or humid weather. Coordinate with Section 06 09 00. AWI Section 1700-G-3, 1700-G-4 and 1700-G-5 recommendations for acclimation of wood trim to site conditions prior to installation. Allow millwork a minimum of 72 hours to come to

1 equilibrium on site prior to installation. Allow factory
 2 finished woodwork a minimum of one (1) week to acclimatize to
 3 site conditions. Relative humidity shall not be less than 25% or
 4 more than 55% under normal conditions. Relative humidity during
 5 time of installation shall remain within the range to be
 6 maintained during occupancy.

- 7
 8 B. All materials shall be protected and kept under cover both in
 9 transit and at the job site.

10
 11
 12 **PART 2 - PRODUCTS**

13
 14 **2.01 MATERIALS**

- 15
 16 A. Compressed Particle Board: Fabricated of virgin wood flakes
 17 bonded with urea type resins into smooth surfaced, dimensionally
 18 stable panels, medium density unless otherwise noted. Conform
 19 to requirements of AWI 200-G-2.

20
 21 B. Laminated Plastics:

- 22 1. Decorative plastic surfacing shall be melamine surfaced
 23 laminated plastic sheet General Purpose Grade and Post
 24 Forming Grade as required.
 25 - Formica
 26 - Nevamar
 27 - Wilsonart
 28 - Pionite
 29 2. Colors and patterns as selected by Architect. See Color and
 30 Material Schedule for selections.
 31 3. Backing panels shall be of similar material and thickness,
 32 but without decorative facing.
 33 6. PVC Edge Banding:
 34 a. Edges of case body members: 3mm
 35 b. Edges of shelves: 3mm

36
 37 C. Hardware:

- 38 1. Closet Poles:
 39 - K&V "No. 770, 1-1/16" O.D. chrome finish with "No. 734"
 40 and "No. 735" flanges.
 41 2. Coat Hooks:
 42 Aluminum coat hooks, Clear anodized finish.
 43 - Peter Pepper Products, Inc., Compton, CA, "2001AL"
 44 - Raymond Engineering, Inc., "#988
 45 - Emco Specialty Products, Kansas City, KS, "Model D10"
 46

- 47 D. Acrylic Solid Surfacing Material (SSM): Solid acrylic, non-
 48 porous surfacing material homogeneously composed of natural
 49 minerals and high performance acrylic. Material shall be
 50 guaranteed to be free from defects for a period of ten (10)
 51 years from date of installation. Material Thickness: 1/2".

- 52 - DuPont "Corian"
 53 - Formica "Surell"
 54 - Fountainhead
 55 - Meganite, Inc.
 56 - WilsonArt "Gibraltar"
 57 - Avonite
 58
 59

1 **2.02 WORKMANSHIP AND ASSEMBLY**
2

- 3 A. Assemble work at the mill insofar as practical and deliver to
4 the job ready for erection. Fabricate work in accord with
5 measurements taken at the job.
6
7 B. Workmanship shall be in accordance with AWI Standards for Custom
8 Grade millwork.
9
10 C. Make joints neatly and carefully with surfaces straight and
11 clean.
12 D. Do scribing, mitering and joining accurately and neatly to
13 conform to details.
14

15
16 **2.03 FABRICATION AND MANUFACTURE**
17

- 18 A. Casework - General:
19 1. Plastic laminate cabinet construction shall conform to
20 applicable Architectural Woodwork Quality Standards Sections
21 400, 400A, 400B and 400C - Architectural Cabinets.
22 2. Fabricator of all cabinets shall be experienced fabricator
23 with facilities capable of producing work of the type
24 specified.
25
26 B. Laminated Plastic Work:
27 1. Adhesives: Rigid or flexible adhesives
28 a. VOC Free, neoprene-based contact adhesive developed for
29 bonding high pressure laminate to particleboard,
30 approved by plastic laminate manufacturer.
31 b. Low-VOC FS MMM-A-125C, Type II, water and mold-
32 resistant. Use ASTM D3110, dry-use type for laminating
33 and finger jointing members, certified in accordance
34 with ASTM C57 and complying with required VOC
35 regulations.
36 2. Fabrication:
37 Laminated plastic work shall be fabricated using an adhesive
38 and laminating method acceptable to laminate manufacturer.
39 3. Finish:
40 a. Edges of case body members shall be edged with 3mm PVC
41 edge banding.
42 b. All unexposed surfaces such as cabinet backs, bases and
43 wall ends shall be balanced with .020 phenolic backing
44 sheet.
45
46 C. Solid Surfacing Material Window Stools:
47 1. Fabrication to be performed by a fabricator/installer
48 certified by the manufacturer.
49 2. Fabricate window stools from 1/2" material. Fabricate in
50 shop to greatest extent practical to sizes and shapes
51 indicated, in accordance with approved shop drawings and
52 manufacturer's requirements.
53 3. Rout and finish component edges to a smooth, uniform
54 finish. Repair or reject defective or inaccurate work.
55
56
57

* * *

Section 07 21 00 - Building Insulation**PART 1 - GENERAL****1.01 DESCRIPTION**

- A. Work Included:
Furnish and install thermal insulation and acoustical insulation.
- B. Related Work Specified Elsewhere:
1. Firestopping - Section 07 84 00
 2. Gypsum Board Assemblies - Section 09 21 16

1.02 ENVIRONMENTAL CONDITIONS

When using fibrous insulation, provide adequate ventilation during and immediately after installation to alleviate problems associated with released fibers and dust.

1.03 SUBMITTALS

- A. Submit manufacturers' names and products proposed to be used.

PART 2 - PRODUCTS**2.01 MATERIALS**

- A. General: Materials shall be products of recognized manufacturers as approved by Architect.
- B. Batt Insulation: Low density fiber glass or mineral wool batts, ASTM C 665-84 Type I, without vapor retarder.
- C. Sound control Insulation: Paperless spun mineral fiber mat or fiberglass batt meeting requirements of ASTM C 665-84.
- Thermafiber, "ThermaTech"
 - Owens-Corning "Sound Attenuation Batts"
 - CertainTeed "CertaSound"
 - Knauf, "Quiet Therm"

PART 3 - EXECUTION**3.01 INSTALLATION AND WORKMANSHIP**

- A. General:
1. Cooperate with workers whose work precedes or follows insulation work to permit orderly procedure in executing work of this section.
 2. Install insulation in a manner to avoid settlement.
 3. Insulate all corners, pockets, voids, offsets, architectural features, etc. to secure complete continuous insulation of the entire space.
 4. Place insulation around plumbing and heating pipes, etc., completely filling all voids and spaces without excessively compressing insulation.

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- B. Install Sound Attenuation Blankets in stud cavities of partitions. Friction fit securely between studs. Butt ends of blankets closely together and fill all voids.

- C. Correcting Work: Upon completion and at times when other Contractors are covering insulation, correct any loose, sagging compressed or otherwise damaged insulation and ensure that all insulation covered is in proper condition.

* * *

Section 07 53 00 - EPDM Roof Patching**PART 1 - GENERAL****1.01 DESCRIPTION**

- A. Work Included:
Patch existing EPDM roofing system including insulation, membrane, ballast, EPDM flashing and other materials required to repair roof damage resulting from rooftop equipment installation.

1.02 QUALITY ASSURANCE

- A. Use adequate numbers of skilled workers who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.
- B. If roof is under warranty, application shall be by a Roofing Contractor approved by manufacturer of roofing materials, applied in strict accordance with manufacturer's requirements for maintaining roofing warranty.

1.03 SUBMITTALS

- A. Submit the following:
1. Materials list of items proposed to be provided under this Section.
 2. Manufacturer's specifications and other data needed to prove compliance with the specified requirements.

1.04 PRODUCT STORAGE

- A. Store roofing materials in a dry place and protect from sun and weather.
- B. Store solvents and adhesives in a cool, dry area.
- C. Keep lids tightly sealed on all splice washes, adhesives and sealants.

1.05 WARRANTY

Roofing Contractor shall guarantee workmanship for roof patching for a period of two (2) years from date of final completion of Project. Any defects that might arise during period of guarantee shall be repaired immediately upon receipt of proper notice at no cost to Owner.

1 **PART 2 - PRODUCTS**

2

3 **2.01 MATERIALS**

- 4
- 5 A. Materials shall be approved high grade products of reputable
- 6 manufacturers, delivered to job in sealed, original containers
- 7 bearing manufacturers name and brand and used without
- 8 adulteration.
- 9
- 10 B. Membrane: Compounded Elastomer, (EPDM) .045" thick for loosely
- 11 laid ballasted system and .060" thick for fully adhered systems.
- 12 Membrane shall be product of same manufacturer as membrane to be
- 13 patched.
- 14
- 15 C. Bonding adhesive, splicing cement, splice tape, splice wash, lap
- 16 sealant, elastic sealer tape, water cutoff mastic, temporary
- 17 sealants, prefabricated pipe seals, etc.
- 18 - All as supplied by manufacturer of roof membrane.
- 19
- 20 D. Insulation: Where insulation needs to be replaced, use same
- 21 type, density and R-value as used for original installation.
- 22 1. Expanded polystyrene board roof insulation, formed by the
- 23 expansion of polystyrene resin beads or granules in a closed
- 24 mold, conforming to ASTM C 578, Type II, compressive
- 25 strength 15 psi, minimum, 1.35 lb./cu.ft. density, U.L.
- 26 rated. Provide tapered insulation where required.
- 27 2. Polyisocyanurate Insulation:
- 28 Closed cell, zero-ODP polyiso roof board insulation
- 29 consisting of polyisocyanurate foam core integrally
- 30 laminated to fiber-glass reinforced felt facers with
- 31 compressive strength of 20 pounds per square inch, nominal.
- 32 Zero-ODP polyiso insulation shall have a Long Term Thermal
- 33 Resistance(LTTR) Value of 6.0 per inch. Provide tapered
- 34 insulation where required.
- 35 Provide products that comply with the following:
- 36 a. ASTM 1289-01 Type II, Class 1, Grade 2.
- 37 b. Factory Mutual (FM) approvals specified.
- 38 c. Underwriters Laboratories Inc. (UL) classifications
- 39 specified.
- 40 d. International Building Code.
- 41 e. Montreal Protocol requirements to eliminate HCFC 141b
- 42 from production by January 1, 2003.
- 43
- 44 E. Ballast: (If additional ballast is required.)
- 45 Round water-worn gravel.
- 46 1. Minimum acceptable gradation (Use ASTM C 136-93 method for
- 47 sizing gravel):
- 48 a. Nominal 1-1/2" rounded water worn gravel which conforms
- 49 to the following gradation:
- 50 - 50% retained by a 3/4" screen.
- 51 - 95% retained by a 1/2" screen.
- 52 - 98% retained by a 1/4" screen.
- 53 b. #4 (1-1/2" to 3/4"), #3 (2" to 1") and #24 (2-1/2" to
- 54 3/4") stone, sized in accordance with ASTM D 448-86
- 55 method of sizing, may be used in lieu of the of water-
- 56 worn gravel specified in "a".
- 57 c. Use stone type as required by membrane manufacturer to
- 58 obtain warranty. Use #3 stone for roofs meeting
- 59 Factory Mutual (FM) requirements.
- 60

1 **PART 3 - EXECUTION**
2

3 **3.01 INSULATION**
4

- 5 A. Remove wet or otherwise damaged or missing insulation and
6 replace with new insulation prior to roof membrane application.
7 Do not apply membrane over wet insulation.
8
9 B. Cut back existing damaged insulation to a smooth straight edge.
10 Install new insulation, butting against existing insulation
11 leaving gaps no greater than 1/4" between insulation boards.
12 Fill gaps greater than 1/4" with the insulation material.
13
14

15 **3.02 ROOF PATCHING**
16

- 17 A. Position roofing membrane over areas to be patched without
18 stretching membrane. Lap edges of adjoining sheets a minimum of
19 3". Allow membrane to relax for approximately one half (1/2)
20 hour before fastening or splicing.
21
22 B. Splice using splice tape system or adhesive system following
23 manufacturer's instructions. Clean areas to be spliced prior to
24 application of tape or adhesive.
25
26 C. Mechanically fasten membrane to nailer around penetrations with
27 rubber nailing strips using nails with disks at maximum 8" o.c.
28
29 D. Replace ballast at the rate of not less than 1000 pounds per
30 square, evenly distributed at not less than 10 lbs. per square
31 foot. Provide additional ballast, if required.
32
33 E. Do all work following manufacturer's requirements for
34 maintaining roof warranty.
35
36

37 **3.03 FLASHING**
38

39 Flash between curbs and roofing using .060 cured EPDM flashing.
40 Flash pipe penetrations with prefabricated pipe seals.
41 Tie into existing roofing following EPDM manufacturer's recommended
42 details and procedures.
43
44

45 **3.04 CLEANING**
46

47 Upon completion of work, remove all rubbish, debris, dirt, equipment
48 and unused materials from site and clean all adjoining surfaces which
49 have been soiled with roofing materials.
50
51
52

* * *

Section 07 60 00 - Architectural Sheet Metal Work

PART 1 - GENERAL**1.01 DESCRIPTION**

- A. Work Included:
Labor and materials required to furnish and install architectural sheet metal work.
- B. Related Work Specified Elsewhere:
1. Section 04 20 00 - Unit Masonry
 2. Section 06 09 00 - Rough and Finish Carpentry
 3. Section 07 53 00 - Elastomeric Membrane Roof System

1.02 QUALITY ASSURANCE

- A. Installation and workmanship: Installation and workmanship shall conform to Architectural Sheet Metal Manual, latest edition, as prepared by Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA) insofar as they apply to Work.
- B. Fascia and copings shall comply with ANSI/SPRI Standard ES-1.
1. ANSI/SPRI ES-1 Test Method RE-1 Test for Roof Edge Termination of Single-Ply Roofing Membranes: Fascia systems shall be tested to secure the membrane to minimum of 100 lbs./ft. in accord with the ANSI/SPRI-ES-1 Test Method RE-1. Use the current edition of *ANSI/SPRI-ES-1 Wind Design Standard for Edge Systems Used with Low Slope Roofing Systems*.
 2. ANSI/SPRI ES-1 Test Method RE-2 Pull-Off Test for Fascia: The fascia system shall be tested in accord with the ANSI/SPRI ES-1 Test Method RE-2. Use the current edition of *ANSI/SPRI ES-1 Wind Design Standard for Edge Systems Used with Low Slope Roofing Systems*.
- C. Kynar 500 based finish coating shall conform to the following tests and standards:
- Hardness-F Minimum NCCA Technical Bulletin II-12.
 - Adhesion, Cross Hatch - 1/16" (no removal): NCCA Technical Bulletin II-5.
 - Formability, 2T Bend (no cracking or removal): 2T Bend (no cracking or removal): ASTM D522-60.
 - Reverse Impact, No removal when taped: NCCA Technical Bulletin I-6 (impact force - 70 in. lbs.).
 - Kynar shall not show a color change greater than 5 NBS color units per ASTM D2244-79 and not show chalking in excess of 8 per ASTM D659-80.

1 **1.03 SUBMITTALS**

2
3 A. Submit the following:

4 1. Shop Drawings:

5 Provide shop drawings for all architectural sheet metal work
6 in sufficient detail to show fabrication, installation,
7 anchorage and interface of the work of this Section with the
8 work of adjacent trades.

9 2. Provide color samples of prefinished sheet metal for
10 Architect approval prior to fabricating architectural sheet
11 metal items.

12
13
14 **1.04 GUARANTEE**

15
16 A. All work in this Section shall be guaranteed to be free from
17 defects in materials and workmanship for a period of one (1)
18 year from date of final completion of project.

19
20 B. Manufacturer shall warrant that coil coated material will not
21 peel, check or crack from the base metal and will not fade or
22 change in color in excess of five (5) units as tested per ASTM D
23 2244-93 for a period of twenty (20) years from date of final
24 completion of work.

25
26
27 **PART 2 - PRODUCTS**

28
29 **2.01 MATERIALS**

30
31 A. Prefinished sheet metal shall be 24 gauge galvanized steel,
32 AISI-G90 primed and finished on one (1) side with Kynar 500
33 based fluoropolymer coating 1.0 mil total dry film thickness. A
34 wash coat of .2 to .4 mil dry film thickness shall be applied to
35 reverse side. Custom color as selected by Architect.

- 36 - Ryerson, "ColorKlad"
37 - Petersen Aluminum, "Pac-Clad"
38 - Firestone Metal Products. "Una-Clad" Steel
39 - Fabral
40 - McElroy Metal

41
42 B. Nails shall be stainless steel, annular type with large heads
43 and needle points.

44
45 C. Screws, bolts and other accessories shall be aluminum or
46 non-magnetic stainless steel.

47
48 D. Expansion shields shall be lead or equal non-ferrous alloy.

49
50 E. Sealing compound: One (1) part moisture curing polyurethane
51 factory mixed and packaged in cartridges ready for use without
52 stirring, thinning or other preparation.

53 Approved Manufacturers:

- 54 - Tremco Manufacturing Company, "Dymonic"
55 - Pecora, "Dynatrol I"
56 - Sonneborn, "Sonolastic NP 1"

1 **PART 3 - EXECUTION**

2
3 **3.01 INSPECTION**

4
5 Examine all areas to be covered by sheet metal and report to General
6 Contractor any conditions which may adversely affect installation,
7 appearance or performance of sheet metal work. Do not start work
8 until such conditions have been corrected.
9

10 **3.02 INSTALLATION**

11
12 **A. General:**

- 13 1. Work shall be equal to best standards of practice in modern
14 sheet metal shops, accurately formed to sizes, shapes and
15 dimensions indicated and detailed with all angles and lines
16 in true alignment, straight, sharp, erected plumb, level and
17 in proper plane without bulges or waves. Cope or flange
18 intersections to accurately fit.
19 2. Form, fabricate and erect sheet metal work to perform
20 satisfactorily and be water and weathertight.
21 3. Exposed edges shall be turned and hemmed 1/2".
22 4. Fabricate items in maximum lengths with minimum number of
23 joints.
24 5. Provide necessary expansion joints, etc., to prevent undue
25 buckling of metal.
26

27 **B. Flashing:**

- 28 1. 24 gauge prefinished galvanized steel.
29 2. Counterflashing shall extend down minimum of 4" over base
30 flashing and shall extend minimum of 3/4" into masonry
31 joint. Turn edge up and out at 45 degrees. Wedge with lead
32 plugs and seal.
33 3. End joints of all flashing shall be interlocked.
34

35 **C. Gravel Stops and Copings:**

- 36 1. 24 gauge prefinished galvanized steel.
37 2. Gravel Stops:
38 a. Provide continuous minimum 24 gauge prefinished cleat
39 nailed to wood nailer, 12" o/c to form drip.
40 b. Gravel stop formed to hook at least 3/4" over cleat and
41 provide a ridge full height of roofing material with
42 flange extending no less than 4" onto roof. Joints
43 shall be loose lock, seam filled with mastic.
44

45 **D. Miscellaneous Sheet Metal Items:**

46 Furnish and install all sheet metal closures called for on
47 Drawings of materials as specified.
48

49 **E. Furnish and install all items of sheet metal as required even**
50 **though not shown or specifically mentioned herein.**
51

52 * * *
53

Section 07 84 00 - Firestopping**PART 1 - GENERAL****1.01 DESCRIPTION****A. Work Included:**

Furnish and install firestopping materials at the following locations.

1. Penetrations for the passage of duct, cable, cable tray, conduit, piping, electrical busways and raceways through fire-rated vertical barriers (walls and partitions), horizontal barriers (floor/ceiling assemblies) and vertical service shaft walls and partitions.
2. Openings between structurally separate sections of wall or floors.
3. Gaps between the tops of walls and ceilings or roof assemblies.
4. Expansion joints in walls and floors.
5. Openings and penetrations in fire-rated partitions or walls containing fire doors.
6. Openings around structural members which penetrate floors or walls.

B. Related Work Specified Elsewhere:

1. Unit Masonry - Section 04 20 00.
2. Gypsum Board Assemblies - Section 09 21 16

C. Definition:

Firestopping shall be defined as material or combination of materials used to retain integrity of fire-rated construction by maintaining an effective barrier against spread of flame, smoke, water and hot gases through penetrations in fire rated wall and floor assemblies.

D. Ratings:

Ratings according [ASTM E814](#), "Fire Tests of Through Penetration Fire Stops" are

1. F-rating, Flame Ratings:

The F-rating is expressed in hours and the number indicates the specific length of time that a barrier can withstand fire before being consumed or before permitting the passage of flame through the opening.

A F-rated opening shall also withstand a hose stream test.

2. T-rating, Thermal Ratings:

The T-rating is expressed in hours and the number indicates the length of time that the temperature on the non-fire side of the penetration does not exceed 325° F (163° C) above the ambient temperature. This ensures that the temperature on the side of the wall away from the flame does not reach the flash point of any materials on that side of the wall.

1.02 QUALITY ASSURANCE**A. References:**

1. Test Requirements: ASTM E-814, "Standard Method of Fire Tests of Through Penetration Fire Stops"

- 1 2. ASTM E-84, Standard Test Method for Surface Burning
- 2 Characteristics of Building Materials.
- 3
- 4 B. Firestop System installation must meet requirements of ASTM E-
- 5 814 or UL 1479 tested assemblies that provide a fire rating
- 6 equal to that of construction being penetrated.
- 7
- 8 C. Proposed firestop materials shall conform to applicable
- 9 governing codes having local jurisdiction.
- 10
- 11 D. Firestopping system shall have an F rating and a T rating of not
- 12 less than 1 hour, but not less than the required rating of the
- 13 floor penetrated. **Exception:** Floor penetrations contained and
- 14 located within the cavity of a wall do not require a T Rating.
- 15
- 16 E. For those firestop applications that exist for which no UL
- 17 tested system is available through any manufacturer, a
- 18 manufacturer's engineering judgment derived from similar UL
- 19 system designs or other tests will be submitted to local
- 20 authorities having jurisdiction for their review and approval
- 21 prior to installation.
- 22
- 23 F. Installer Qualifications:
- 24 Manufacturer trained and approved installer who has specialized
- 25 in the installation of work similar to that required for this
- 26 project.
- 27

28 **1.03 SUBMITTALS**

- 29
- 30 A. Submit the following:
- 31 1. Materials list of items proposed to be provided in this
- 32 Section.
- 33 2. Manufacturer's specifications and other data needed to
- 34 prove compliance with the specified requirements.
- 35
- 36

37 **PART 2 - PRODUCTS**

38

39 **2.01 APPROVED MANUFACTURERS**

- 40
- 41 - Hilti Construction Chemicals, Inc., Tulsa OK
- 42 - 3M Fire Protection Products, St. Paul, MN
- 43 - Nelson Firestop Products, Tulsa, OK
- 44 - Specified Technologies, Inc. (STI)
- 45 - Tremco, Inc., Cleveland, OH
- 46 - United States Gypsum Company, Chicago, IL
- 47 - Johns-Manville Fire Protection Systems, Denver, CO
- 48 - Rectorseal Corporation (Bio Fireshield, Metacaulk), Houston, TX
- 49 - W.R. Grace, "Flamesafe"
- 50

51

52 **2.02 MATERIALS**

- 53
- 54 A. Use only firestop products that have been UL 1479 or ASTM E-814
- 55 tested for specific fire rated construction conditions
- 56 conforming to construction assembly type, penetrating item type,
- 57 annular space requirements and fire rating involved for each
- 58 separate instance.
- 59
- 60

- 1 B. For penetrations by non-combustible items including steel pipe,
 2 copper pipe, rigid steel conduit and electrical metallic tubing
 3 (EMT), the following materials are acceptable.
 4 - Hilti FS-One Intumescent Firestop Sealant
 5 - 3M Fire Barrier CP25 WB+
 6 - Nelson CLK Firestop Sealant
 7 - Nelson FSP Firestop Putty
 8 - Tremco Fire-Shield, Tremstop IA, Tremstop Acrylic
 9 - USG Firecode Compound
 10 - Johns-Manville, "Firetemp CI"
 11 - Bio Fireshield Biostop 500+ sealant, BF150+ sealant
 12 - Bio Fire Rated Mortar
 13 - Metacaulk 1000 sealant, MC150+ Sealant
 14 - Metacaulk Fire Rated Mortar
 15 - STI "SpecSeal SSS100 Sealant"
 16 - STI "PEN 300 Silicone Sealant"
 17
- 18 C. For fire rated construction joints and other gaps, the following
 19 material is acceptable.
 20 - Hilti CP 601s Elastomeric Firestop Sealant
 21 - Nelson, "CLK"
 22 - STI "PEN 300"
 23 - 3M "Fire Barrier Silicone"
 24 - Tremco "Tremstop Acrylic", "Dymeric 240/240FC", THC-900,
 25 Fyre-sil
 26 - USG Firecode Compound
 27 - Johns-Manville, "Firetemp CI Caulk" or "SE Endothermic
 28 Spray Mastic"
 29 - Bio Fireshield Biostop 500+ Sealant
 30 - Biostop 700 Firestop Mastic, 750 Firestop Mastic
 31 - Metacaulk 1000 Sealant
 32 - Metacaulk 1100 Firestop Mastic, 1200 Firestop Mastic
 33
- 34 D. For penetrations by combustible items (penetrants consumed by
 35 high heat and flame) including insulated metal pipe, PVC
 36 jacketed, flexible cable or cable bundles and plastic pipe
 37 (closed piping systems), the following material is acceptable:
 38 - Hilti FS-ONE Intumescent Firestop Sealant
 39 - 3M Fire Barrier CP25 WB+
 40 - 3M Fire Barrier FS-195+ Wrap/Strip
 41 - Nelson "PCS Pipe Choke System", "FSP Firestop Putty" and
 42 "WRS Wrap Strip"
 43 - STI "SpecSeal SSS100 Sealant"
 44 - STI "SpecSeal SSWRED Wrapstrip"
 45 - Tremco, :Tremstop IA", "Tremstop Wrapstrip", "Tremstop"
 46 Devices, "Fyre-Can"
 47 - Johns-Manville, "Firetemp CI Caulk"
 48 - Biostop 500+ Sealant
 49 - Biostop Wrap Strip, Biostop Fire Rated Collar
 50 - Metacaulk 1000 Sealant
 51 - Metacaulk Wrap Strip, Metacaulk Fire Rated Collar
 52
 53

- 1 E. For large size/complex penetrations made to accommodate cable
 2 trays, multiple steel and copper pipes, electrical busways or
 3 raceways, the following material is acceptable.:
- 4 - Hilti CP 637 Firestop Mortar
 - 5 - 3M Fire Barrier CS-195+ Composite Sheet
 - 6 - Nelson "CMP Firestop Compound", "PLW Firestop Pillow" and
 7 "CPS"
 - 8 - STI "SpecSeal SSM Firestop Compound"
 - 9 - STI "SpecSeal SSB Firestop Pillows"
 - 10 - USG, "Firecode Compound"
 - 11 - Tremco, "Tremstop IA", "Tremstop Fire Putty", "Tremstop
 12 Pillows", "Fyre Shield", "Fyre-Sil"
 - 13 - Johns-Manville, "Firetemp CI Caulk", "SI Intumescent Spray
 14 Mastic", "SE Endothermic Spray Mastic"
 - 15 - Bio Fire Rated Mortar
 - 16 - Bio Firestop Pillows
 - 17 - Metacaulk Fire Rated Mortar
 - 18 - Metacaulk Firestop Pillows
- 19
- 20 F. For Openings between structurally separate sections of walls and
 21 floors and top of walls:
- 22 - STI "PEN 300 Silicone Joint Sealant"
- 23
- 24 G. Provide a firestop system with an "F" rating as determined by UL
 25 1479 or ASTM E814 which is equal to the time rating of
 26 construction being penetrated.
 27

28 **PART 3 - EXECUTION**

29 **3.01 PREPARATION**

- 30
- 31 A. Examine areas and conditions under which work is to be performed
 32 and identify conditions detrimental to proper and timely
 33 completion of firestopping work.
- 34 1. Verify penetrations are properly sized and in suitable
 35 condition for application of materials.
 - 36 2. Surfaces to which firestop materials will be applied shall
 37 be free of dirt, grease, oil, rust, laitance, release
 38 agents, water repellents and other substances which may
 39 affect proper adhesion.
 - 40 3. Provide masking and temporary covering to prevent soiling
 41 of adjacent surfaces by firestopping materials.
 - 42 4. Comply with manufacturer's recommendations for temperature
 43 and humidity conditions, before, during and after
 44 installation of firestopping.
 - 45 5. Do not proceed until unsatisfactory conditions have been
 46 corrected.
 47
 48
 49

50 **3.02 INSTALLATION**

- 51 A. Regulatory Requirements: Install firestop materials in
 52 accordance with published "Through-Penetration Firestop Systems"
 53 in UL Fire Resistance Directory.
 54
 55
 56
 57

- B. Manufacturer's Instructions: Comply with manufacturer's instructions for installation of through-penetration materials.
 - 1. Seal all holes or voids made by penetrations to ensure an air and water resistant seal.
 - 2. Consult with mechanical engineer, project manager prior to installation of UL firestop systems that might hamper the performance of fire dampers as it pertains to duct work.
 - 3. Protect materials from damage on surfaces subjected to traffic.

3.03 FIELD QUALITY CONTROL

- A. Examine sealed penetration areas to ensure proper installation before concealing or enclosing areas.
- B. Keep areas of work accessible until inspection by applicable code authorities.
- C. Perform under this Section patching and repairing of firestopping caused by cutting or penetrating of existing firestop systems already installed by other trades.

3.04 ADJUSTMENT AND CLEANING

- A. Remove equipment, materials and debris, leaving area in undamaged, clean condition.
- B. Clean all surfaces adjacent to sealed holes and joints to be free of excess firestop materials and soiling as work progresses.

* * *

Section 07 90 00 - Caulking and Sealants**PART 1 - GENERAL****1.01 DESCRIPTION**

- A. Section covers all sealant and caulking materials and their application, wherever required for complete installation of building materials or systems.
1. All locations where sealing is required by material or product manufacturers.
- B. Related Work Specified Elsewhere:
1. Acoustical and Smoke Sealant at Gypsum Board Partitions - Section 09 21 16.

1.02 QUALITY ASSURANCE

Installer Qualifications: An experienced installer who has specialized in installing joint sealants similar in material, design, and extent to those indicated for this Project and whose work has resulted in joint-sealant installations with a record of successful in-service performance.

1.03 SUBMITTALS

- A. Submit the following:
1. Materials list of items proposed to be furnished under this Section.
 2. Manufacturer's specifications and other data needed to prove compliance with the specified requirements.
 3. Cured samples of exposed sealants for each color where required to match adjacent material.

1.04 PRODUCT DELIVERY, HANDLING AND STORAGE

- A. Deliver materials in sealed containers with manufacturer's name, type, grade and date of manufacture clearly shown on each package.
- B. Store materials in a cool, dry, covered or shaded area assigned exclusively to this contractor so as to protect them from damage, contamination and premature aging.

1.05 JOB CONDITIONS

- A. Environmental Requirements: Do not apply sealants when surfaces are frosty, damp or wet or when temperatures are below 40 degrees F.
- B. Joint-Substrate Conditions:
Do not proceed with installation of joint sealants until contaminants capable of interfering with adhesion are removed from joint substrates.

1 **1.06 DEFINITIONS:**

- 2
3 A. Definitions of terms in accordance with ASTM C717 and as
4 specified.
5
6 B. Back-up Rod: A type of sealant backing.
7
8 C. Bond Breakers: A type of sealant backing.
9
10 D. Filler: A sealant backing used behind a back-up rod.
11
12

13 **1.07 GUARANTEE**

- 14
15 A. All work in this Section shall be guaranteed to be free from
16 defects in materials and workmanship for a period of five (5)
17 years from date of final completion of project.
18
19 B. Repair or replace all such defective work and all other work
20 damaged as a result of defective caulking and sealing work,
21 which becomes defective during term of this guarantee.
22
23 C. Following will be considered defective work:
24 1. Discoloration of sealant or materials to which sealant is
25 applied.
26 2. Improper bonding to surfaces to which sealant is applied.
27 3. Cracking, checking and discoloration of sealant.
28
29

30 **PART 2 - PRODUCTS**

31
32 **2.01 MATERIALS**

- 33
34 A. Sealing compound for general exterior and interior caulking; for
35 caulking around new exterior windows:
36 One (1) part moisture curing polyurethane or silicone sealant
37 factory mixed and packaged in cartridges ready for use without
38 stirring, thinning or other preparation conforming to Federal
39 Specification TT-S-00230C, Type II, Class A.
40 Approved Manufacturers:
41 1. Tremco Manufacturing Company, "Dymonic"
42 2. Tremco, "Spectrem 3"
43 3. Pecora, "Dynatrol I"
44 4. Sonneborn, "Sonolastic NP 1"
45 5. General Electric Company, "Silpruf"
46 6. Dow-Corning Corporation, "No. 790"
47
48 B. Sealing compound for horizontal surfaces, including construction
49 and expansion joints in concrete slabs:
50 Single or multi-component polyurethane based compound conforming
51 to requirements of FS TT-S-00227E , Type 1, Class A and ASTM
52 C920-87, Type M, Grade P, Class 25.
53 Approved Manufacturers:
54 1. Mameco, "Vulkem 45"
55 2. Sika, "Sikaflex-1a"
56 3. Tremco, "THC-901"
57 4. Sonneborn, "Sonolastic SL 2"
58
59

- 1 C. Paintable Sealant: Sealants for use at interior metal frames
 2 and other interior surfaces scheduled to be painted: Siliconized
 3 latex sealant or 100% silicone sealant, permitting surface to be
 4 painted after curing, meeting performance requirements of TT-S-
 5 00230C and TT-S-001543A.
 6 1. Tremco, "Tremflex 834"
 7 2. Pecora, "AC-20 + Silicone"
 8 3. BASF Sonneborn, "Sonolac"
 9 4. Approved equal
- 10
 11 D. Sealing compound for sealing joints between plumbing fixtures
 12 and adjacent surfaces: Mildew resistant, silicone sanitary
 13 sealant. Products shall meet requirements of Federal
 14 Specification TT-S-001543, Class A.
 15 - GE "Silicone Sanitary 1702 Sealant"
 16 - Dow Corning "786 Mildew-Resistant Silicone Sealant"
 17 - Sonneborn, "Sonolastic Omniplus"
 18 - Pecora, "898 Silicone"
 19 - Tremco, "Tremsil 200"
 20
- 21 E. Colors:
 22 Colors for each sealant installation will be selected by the
 23 Contractor from standard colors normally available from the
 24 specified manufacturers subject to Architect approval.
 25
- 26 F. Primer: Made by manufacturer of sealant applied in accordance
 27 with manufacturer's instructions.
 28
- 29 G. Solvent Cleaner: as recommended by sealant manufacturer.
 30
- 31 H. Provide other materials, not specifically described, but
 32 required for a complete and proper installation, as selected by
 33 the Contractor, subject to approval of Architect.
 34

35 2.02 JOINT SEALANT BACKING:

- 36
 37 A. General: Provide sealant backings of material and type that are
 38 non-staining; are compatible with joint substrates, sealants,
 39 primers, and other joint fillers; and are approved for
 40 applications indicated by sealant manufacturer based on field
 41 experience and laboratory testing.
 42
- 43 B. Cylindrical Sealant Back-up Rod: ASTM C1330, of size and density
 44 to control sealant depth and otherwise contribute to producing
 45 optimum sealant performance:
 46
- 47 C. Bond-Breaker Tape: Polyethylene tape or other plastic tape
 48 recommended by sealant manufacturer for preventing sealant from
 49 adhering to rigid, inflexible joint-filler materials or joint
 50 surfaces at back of joint where such adhesion would result in
 51 sealant failure.
 52

53 2.03 FILLER:

- 54
 55 A. Definition: Sealant backing used behind a back-up rod.
 56
 57 B. Material: Mineral fiber board: ASTM C612, Class 1.
 58
 59 C. Thickness same as joint width.
 60

1 D. Depth to fill void completely behind back-up rod.
2

3 **PART 3 - EXECUTION**
4

5 **3.01 SURFACE CONDITIONS**
6

7 Examine the areas and conditions under which work of this Section
8 will be performed. Report to General Contractor any conditions which
9 may adversely affect installation or performance of caulking and
10 sealants. Do not start application of sealants until such conditions
11 have been corrected.
12

13 **3.02 PREPARATORY WORK**
14

- 15 A. Prepare joints in accordance with sealant manufacturer's
16 instructions
17
- 18 B. Clean surfaces of joint to receive caulking or sealants leaving
19 joint dry to the touch, free from frost, moisture, grease, oil,
20 wax, lacquer, paint, or other foreign matter that would tend to
21 destroy or impair adhesion.
- 22 1. Clean porous joint substrate surfaces to produce a clean,
23 sound substrate capable of developing optimum bond with
24 joint sealants.
- 25 2. Remove loose particles remaining from above cleaning. Porous
26 joint surfaces include the following:
27 a. Concrete.
28 b. Masonry.
29 c. Unglazed surfaces of ceramic tile.
- 30 4. Clean non-porous surfaces with cleaners that do not stain,
31 harm substrates, or leave residues capable of interfering
32 with adhesion of joint sealants.
33 a. Metal.
34 b. Glass.
35 c. Porcelain enamel.
36 d. Glazed surfaces of ceramic tile
37

38 **3.03 BACKING INSTALLATION:**
39

- 40 A. Where joint backing is required, insert backer material into the
41 joint cavity so that joint depth does not exceed one half (1/2)
42 joint width. Do not apply sealant directly against mortar in a
43 joint.
44
- 45 B. Where deep joints occur, install filler to fill space behind the
46 back-up rod and position the rod at proper depth.
47
- 48 C. Cut fillers installed by others to proper depth for installation
49 of back-up rod and sealants.
50
- 51 D. Install back-up rod, without puncturing the material, to a
52 uniform depth, within plus or minus 1/8 inch for sealant depths
53 specified.
54
- 55 E. Where space for back-up rod does not exist, install bond breaker
56 tape strip at bottom (or back) of joint so sealant bonds only to
57 two opposing surfaces.
58
- 59 F. Take all necessary steps to prevent three sided adhesion of
60 sealants.

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3.04 APPLICATION

- A. Prior to start of installation, verify that the required proportion of joint width to depth has been secured.
- B. Prime all surfaces. Apply primer to all joints to be sealed. Follow manufacturer's instructions regarding application and number of coats.
- C. Application of Sealant:
 - 1. For application of sealants, follow requirements of ASTM C1193 unless specified otherwise.
 - 2. Apply sealant by means of a pressure gun with nozzle diameter equal to width of joint.
 - 3. Firmly press sealant into joint to ensure complete wetting of bonding surface and obtain good adhesion.
 - 4. Apply sealant in accordance with manufacturer's instructions and tool to a concave surface.
 - 5. Where practical, mask joints and do not remove tape until joint has been tooled and initial cure has taken place.

3.05 CLEANING

Clean adjacent materials which have been soiled and leave work in a neat, clean condition.

* * *

Section 08 11 00 - Hollow Metal Doors and Frames**PART 1 - GENERAL****1.01 DESCRIPTION**

- A. Work Included:
1. Furnish and install hollow metal doors and frames.
 2. Modify existing frames as required to convert door frames to borrowed light frames and other configurations.
- B. Related Work Specified Elsewhere:
1. Wood Doors - Section 08 14 00
 2. Finish Hardware - Section 08 70 00
 3. Glass and Glazing - Section 08 80 00
 4. Finish Painting - Section 09 90 00

1.02 QUALITY ASSURANCE

- A. Use adequate numbers of skilled workers who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.
- B. Fire Rated Doors and Frames: Ratings as indicated on Door Schedule, when tested in accordance with NFPA 252, UL 10B or UL 10C. Labeled by UL, WH, or other agency acceptable to the authorities having jurisdiction.
- C. Side-hinged or pivoted swinging fire rated doors shall be tested in accordance with NFPA 252 or UL 10C. After 5 minutes into the NFPA 252 test, the neutral pressure level in the furnace shall be established at 40 inches or less above the sill. Rated hollow metal doors shall have factory installed silicone perimeter seal and a bottom seal to prevent the positive air pressure from blowing smoke through the cracks.

1.03 REFERENCES

- A. ASTM A 366 - Specification for Steel, Sheet, Carbon, Cold-Rolled, Commercial Quality.
- B. ASTM A 526 - Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Commercial Quality.
- C. ASTM A 569 - Specification for Steel, Carbon, (0.15 Maximum, Percent), Hot-Rolled Sheet and Strip, Commercial Quality.
- D. ANSI/SDI A250.3 - Test Procedure and Acceptance Criteria for Factory Applied Finish Painted Steel Surfaces for Steel Doors and Frames.
- E. ANSI/SDI A250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames, Frame Anchors and Hardware Reinforcings.
- F. ANSI/SDI A250.6 Recommended Practice for Hardware Reinforcing

- 1 on Standard Steel Doors and Frames.
- 2
- 3 G. ANSI/SDI A250.8 - SDI-100 Recommended Specifications for
- 4 Standard Steel Doors and Frames; 1998.
- 5
- 6 H. SDI 111 - Recommended Standard Details for Steel Doors & Frames.
- 7
- 8 I. ANSI/NFPA 252 - Fire Tests of Door Assemblies.
- 9
- 10 J. ANSI/UL 10B - Fire Tests of Door Assemblies.
- 11
- 12 K. ANSI/UL 10C - Positive Pressure Fire Tests of Door Assemblies.
- 13
- 14 L. ANSI/UL 1784 - Air Leakage Tests of Door Assemblies
- 15 UL - Building Materials Directory; Underwriters Laboratories
- 16 Inc.
- 17
- 18 M. WH - Certification Listings; Warnock Hersey International Inc.
- 19
- 20 N. NFPA 80 - Fire Doors and Fire Windows.
- 21

22 **1.04 SUBMITTALS**

- 23
- 24 A. Submit the following:
- 25 1. Materials list of items proposed to be provided under
- 26 this Section.
- 27 2. Manufacturer's specifications and other data needed to
- 28 prove compliance with the specified requirements.
- 29
- 30 B. Shop Drawings:
- 31 1. Shop drawings in accordance with General Conditions and
- 32 General Project Requirements.
- 33 2. Show all openings in the door schedule and/or the
- 34 Drawings.
- 35 3. Provide details of door design, door construction details
- 36 and methods of assembling sections, hardware locations,
- 37 anchorage and fastening methods, door frame types and
- 38 details, anchor types and spacing, and finish
- 39 requirements.
- 40 4. Provide door, frame, and hardware schedule in accordance
- 41 with SDI 111.
- 42
- 43 C. Furnish to wood door manufacturer copy of approved shop
- 44 drawings and templates giving accurate location of butt slots,
- 45 locks and door bolts.
- 46

47 **1.05 PRODUCT DELIVERY, STORAGE AND HANDLING**

- 48
- 49 A. Products shall be marked with Architect's opening number on all
- 50 doors, frames, misc. parts and cartons.
- 51
- 52 B. Upon delivery, inspect all materials for damage; notify shipper
- 53 and supplier if damage is found.
- 54
- 55 C. Protect products from moisture, construction traffic, and
- 56 damage.
- 57 1. Store vertically under cover in a manner that will
- 58 prevent rust or damage.
- 59 2. Do not use non-vented plastic or canvas shelters.
- 60 3. Should wrappers become wet, remove immediately.

- 1 4. Provide 1/4 inch space between doors to promote air
2 circulation.
3

4 **PART 2 - PRODUCTS**

5 6 **2.01 MANUFACTURERS**

7
8 Acceptable Manufacturers:

9 Products shall be manufactured by a member of the Steel Door
10 Institute, 30200 Detroit Road, Cleveland, Ohio 44145.

11 Tel: (440) 899-0010, Fax: (440) 892-1404.

12 Steel Door Institute Members are as follows:

- 13 - Amweld Building Products, LLC.
- 14 - Benchmark Commercial Doors.
- 15 - Ceco Door Products.
- 16 - Curries Company.
- 17 - Deansteel Manufacturing Co.
- 18 - The Kewanee Corporation.
- 19 - Mesker Door, Inc.
- 20 - Pioneer Industries, Inc.
- 21 - Republic.
- 22 - Security Metal Products Corp.
- 23 - Steelcraft.

24 25 26 **2.02 MATERIALS**

27
28 Doors, frames, frame anchors, and hardware reinforcing for each of
29 the levels and models specified shall be provided to meet the
30 requirements of the performance levels specified. The material used
31 in manufacturing these products and components shall comply with
32 ANSI/SDI A250.8. Hardware reinforcing on doors and frames shall
33 comply with ANSI/SDI A250.6. The physical performance levels shall be
34 in accordance with ANSI/SDI A250.4.
35

36 37 **2.03 HOLLOW METAL DOORS**

38
39 A. Materials:

- 40 1. Commercial quality, level, cold rolled steel conforming
41 to ASTM A366 or hot rolled, pickled and oiled steel
42 conforming to ASTM A 569 and free of scale, pitting or
43 surface defects.
- 44 2. Interior Doors: Face sheets not less than 18 gauge.

45
46 B. Design and Construction:

- 47 1. Fully welded seamless construction with no visible seams
48 or joints on door faces or vertical edges. Minimum door
49 thickness 1-3/4".
- 50 2. Doors to be strong, rigid and neat in appearance, free
51 from warpage or buckle, with corner bends true and
52 straight and of minimum radius for the gauge of metal
53 used.
- 54 3. Stiffen face sheets by continuous vertical formed 22
55 gauge steel sections spanning the full thickness of the
56 interior space between door faces, spaced not more than
57 6" apart and securely attached to face sheets by spot
58 welds not more than 5" high on center. Sound deaden and
59 insulate spaces between stiffeners the full height of the
60 door with an inorganic non-combustible batt type

1
2

material.

- 1 4. Join door faces at their vertical edges by a continuous
 2 weld extending the full height of the door. Grind all
 3 welds, fill and dress smooth to make them invisible and
 4 provide a smooth flush surface.
- 5 5. Close top and bottom edges of doors with a continuous
 6 recessed steel channel not less than 16 gauge, extending
 7 the full width of the door and spot welded to both faces.
- 8 6. Provide edge profiles on both vertical edges of doors as
 9 follows:
 10 Single Acting Swing Doors - Beveled 1/8" in 2".
- 11 7. All hardware furnished by the hardware contractor for
 12 single acting doors shall be designed for beveled edges
 13 as specified herein.
- 14 8. Hardware reinforcements:
 15 a. Mortise, reinforce, drill and tap doors at the
 16 factory for fully templated hardware, only, in
 17 accord with approved hardware schedule and
 18 templates provided by the hardware contractor.
 19 Where surface-mounted hardware is to be applied,
 20 provide doors with reinforcing plates only; all
 21 drilling and tapping will be by others.
- 22 b. Minimum gauges for hardware reinforcing plates to
 23 be as follows:
 24 - Hinge and Pivot reinforcements: 7 gauge or
 25 equivalent number of threads.
 26 - Reinforcements for lock face, flush bolts,
 27 concealed holders, concealed or surface-mounted
 28 closers: 12 gauge or equivalent number of
 29 threads.
 30 - Reinforcements for all other surface mounted
 31 hardware: 16 gauge.
- 32 9. Glass Moldings and Stops:
 33 a. Where required, provide doors with hollow metal
 34 moldings to secure glazing in accordance with glass
 35 opening sizes shown on approved shop drawings.
- 36 b. Securely weld fixed moldings to the door on the
 37 security side.
- 38 c. Loose stops shall be not less than 20 gauge steel,
 39 with mitered corner joints, secured to the frame
 40 opening by corrosion resistant countersunk screws.
 41 Snap-on attachments are not permitted.

42 43 44 **2.04 HOLLOW METAL FRAMES**

- 45 A. Materials:
 46 Interior Openings: Commercial grade cold-rolled steel
 47 conforming to ASTM A 366 or commercial grade hot-rolled and
 48 pickled steel conforming to ASTM A569. Metal thickness to be
 49 not less than 16 gauge for frames in openings 4'-0" or less in
 50 width and not less than 14 gauge for frames in openings over
 51 4'-0" in width.
- 52
53
- 54 B. Design and Construction:
 55 1. All frames shall be face welded units with integral trim
 56 of the sizes and shapes shown on shop drawings. Knocked-
 57 down frames are not permitted.
- 58 2. All finished work shall be strong and rigid, neat in
 59 appearance, square, true and free of defects, warp or
 60 buckle. Molded Members shall be clean cut, straight and

- 1 of uniform profile throughout their lengths.
- 2 3. Jamb depths, trim, profile and backbends as scheduled by
- 3 the Architect and shown on approved shop drawings.
- 4 4. Close tight all contact edges at corner joints, with trim
- 5 faces mitered and continuously welded and stops mitered.
- 6 The use of gussets is not permitted.
- 7 5. Minimum depth of stops: 5/8".
- 8 6. When shipping limitations so dictate, fabricate frames
- 9 for large openings in sections designated for splicing in
- 10 the field.
- 11 7. Frames for multiple or special openings shall have
- 12 mullion and/or rail members which are closed tubular
- 13 shapes having no visible seams or joints. Securely weld
- 14 all joints. Finish smooth.
- 15 8. Hardware reinforcements:
- 16 a. Mortise, reinforce, drill and tap frames at the
- 17 factory for fully templated mortised hardware in
- 18 accord with approved hardware schedule and
- 19 templates provided by hardware contractor. Where
- 20 surface-mounted hardware is to be applied, provide
- 21 reinforcing plates only. Drilling and tapping will
- 22 be done by others.
- 23 b. Minimum thickness of hardware reinforcing plates
- 24 shall be as follows:
- 25 - Hinge and pivot reinforcements - 7 gauge.
- 26 - Strike reinforcements - 12 gauge.
- 27 - Flush bolt reinforcements - 12 gauge.
- 28 - Closer reinforcements - 12 gauge.
- 29 - Reinforcements for:
- 30 - surface-mounted hardware - 12 gauge.
- 31 - hold-open arms - 12 gauge.
- 32 - surface panic devices - 12 gauge.
- 33 9. Floor Anchors:
- 34 a. Securely weld floor anchors inside each jamb with
- 35 two holes provided at each jamb for floor
- 36 anchorage.
- 37 b. Minimum thickness of floor anchors: 14 gauge.
- 38 10. Jamb Anchors:
- 39 a. Provide frames for installation in masonry walls
- 40 with adjustable jamb anchors of the T-strap type
- 41 fabricated of not less than 16 gauge steel or 0.156
- 42 diameter steel wire. The number of anchors
- 43 provided on each jamb shall be as follows:
- 44 - Frames up to 7'-6" height - 3 anchors.
- 45 - Frames 7'-6" to 8'-0" height - 4 anchors.
- 46 - Frames over 8'-0" height - 1 anchor for each 2'
- 47 or fraction thereof in height.
- 48 b. Provide frames for installation in stud
- 49 partitions with steel anchors of suitable design,
- 50 not less than 18 gauge thickness, securely welded
- 51 inside each jamb as follows:
- 52 - Frames up to 7'-6" height - 4 anchors
- 53 - Frames 7'-6" to 8'-0" height - 5 anchors.
- 54 - Frames over 8'-0" height - 5 anchors plus one
- 55 additional for each 2' or fraction thereof over
- 56 8'-0".
- 57 11. Frames for installation in masonry wall openings more
- 58 than 4'-0" in width shall have an angle or channel
- 59 stiffener of not less than 12 gauge steel factory weld
- 60 into frame head. Do not use as lintels as load bearing
- 61 members.
- 62

12. Provide dust cover boxes (or mortar guards) of not thinner than 26 gauge steel at all hardware mortises on frames to be set in masonry partitions.
13. Provide all frames with a steel spreader temporarily attached to the feet of both jambs to serve as a brace during shipping and handling. The steel spreader is not to be used for installation purposes.
14. Provide three (3) Glynn-Johnson, "No. 64" pneumatic rubber silencers installed in strike jamb of single doors.
15. Loose glazing beads: Cold rolled steel, minimum 20 gauge, butted at the corners and secured to the frame with self-tapping corrosion resistant sheet metal screws.
16. Provide 2" paper pass in borrowed light frames where indicate.
17. Reconfigure existing frames to new configurations indicated.
18. Provide electrical conduit in frames for all electric and magnetic locks, keeper switches and door position indicator switches.
 - a. Raceways: Rigid metal conduit and intermediate metal conduit (IMC) shall be steel, galvanized inside and outside. Minimum 3/4" trade size conduit shall be used. Minimum 1/2" trade size conduit may be used incorporating wiring for one device.
 - b. Raceway Fittings: Fittings for steel conduit shall be galvanized or other corrosion resistant material. Fittings for rigid conduit and IMC shall be galvanized steel threaded couplings. Locknuts and bushings shall be steel or malleable iron.

2.05 FABRICATION

- A. Design clearances: Fabricate doors and frames to maintain the following clearances:
 1. The clearance between the door and frame shall be 1/8 inch in the case of both single swing and pairs of doors.
 2. The clearance between the meeting edges of pairs of doors shall be 3/16 inch plus or minus 1/16 inch. For fire rated applications, the clearances between the meeting edges of pairs of doors shall be 1/8 inch plus or minus 1/16 inch.
 3. The clearance measured from the bottom of the door to the bottom of the frame (undercut) shall be a maximum of 3/4 inch unless otherwise specified. Fire door undercuts shall comply with ANSI/NFPA 80, "Fire Doors and Fire Windows."
 4. The clearance between the face of the door and the stop shall be 1/16 inch to 3/32 inch.
 5. All clearances shall be, unless otherwise specified in this document, subject to a tolerance of plus or minus 1/32 inch.
 6. The clearance between the face of the door and doorstep shall be 1/16 inch to 1/8 inch.
 7. All clearances shall be, unless otherwise specified, subject to a tolerance of plus or minus 1/32 inch.

- B. Prime finish: Doors and frames shall be thoroughly cleaned, and chemically treated to ensure maximum paint adhesion. All surfaces of the door and frame exposed to view shall receive a factory applied coat of rust inhibiting primer, either air-dried or baked-on. The finish shall meet the requirements for acceptance stated in ANSI/SDI A250.10 "Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames." Allow primer to fully cure before shipment

2.06 RATED DOORS AND FRAMES

- A. Provide labeled doors and frames for those openings requiring fire protection ratings. Construct such doors and frames as tested and approved by Underwriter's Laboratories or other nationally recognized testing agency having a factory inspection service.
- B. Provide doors with minimal clearances as per the Life Safety Code.
- C. Rated hollow metal doors shall have factory installed silicone perimeter seal and a bottom seal to prevent the positive air pressure from blowing smoke through the cracks.
- D. Fire doors (3 Hr.) require a metal threshold below doors having carpet adjacent.
- E. Doors that are not code compliant will be rejected by Architect.
- F. If any door or frame specified by the Architect to be fire-rated cannot qualify for appropriate labeling because of its design, size, hardware or any other reason, advise Architect prior to submitting bid.

PART 3 - EXECUTION

3.01 INSPECTION

- A. Verify that project conditions are suitable before beginning installation of frames. Do not begin installation until conditions have been properly prepared.
 - 1. Verify that completed masonry openings to receive butt type frames are of correct size.
 - 2. Verify that drywall construction walls are the correct thickness.
- B. If opening preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 INSTALLATION

- A. Install frames plumb, level, rigid, and in true alignment in accordance with ANSI A250.11 and DHI A115.1G.
- B. Install fire rated doors and frames in accordance with NFPA 80.

- 1 C. Frames shall be fastened to the adjacent structure so as to
2 retain their position and stability.
- 3
- 4 D. Install frames as masonry is laid-up. Fill welded wrap-around
5 frames solid with grout in masonry construction and other areas
6 where noted. Brace or fasten frame in such a way to prevent
7 pressure of the grout from deforming frame.
- 8
- 9 E. Grout shall be mixed to provide a 4 inch maximum slump
10 consistency, hand troweled into place. Grout mixed to a thin
11 "pumpable" consistency shall not be used.
- 12
- 13 F. Doors shall be installed and fastened to maintain alignment
14 with frames to achieve maximum operational effectiveness and
15 appearance. Adjust doors to maintain perimeter clearances
16 specified. Shimming shall be performed by the installer as
17 needed to assure the proper clearances are achieved.
- 18
- 19

20 **3.03 ADJUSTMENTS AND CLEANING**

- 21
- 22 A. Adjust doors for proper operation, free from binding or other
23 defects.
- 24
- 25 B. Clean and restore soiled surfaces. Remove scraps and debris and
26 leave site in a clean condition.
- 27

28 * * *

29

Section 08 14 00 - Wood Doors

PART 1 - GENERAL**1.01 DESCRIPTION**

- A. Work Included:
1. Labor and materials required to furnish wood doors.
- B. Related Work Specified Elsewhere:
1. Rough and Finish Carpentry - Section 06 09 00
 2. Hollow Metal Doors and Frames - Section 08 11 00
 3. Finish Hardware - Section 08 70 00
 4. Glass and Glazing - Section 08 80 00

1.02 QUALITY ASSURANCE

- A. Use adequate numbers of skilled workers who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and methods needed for proper performance of the work of this Section.
- B. ASTM D 1037 - Standard Methods of Evaluating the Properties of Wood Base Fiber and Particle Panel Materials.
- C. ASTM E 90 - Standard Method for Laboratory Measurement of Airborne - Sound Transmission Loss of Building Partitions.
- D. Comply with the following standards:
1. WDMA Quality Standard: I.S.1-A "Architectural Wood Flush Doors", of Window and Door Manufacturers Association (WDMA).
 2. AWI Quality Standards: "Architectural Woodwork Quality Standards Illustrated"; of Architectural Woodwork Institute (AWI) for grade of door, core construction, finish and other requirements exceeding those of WDMA quality standard.
- E. Doors shall conform to Architectural Woodwork Institute, Architectural Woodwork Quality Standards, latest edition, Section 1300 - Architectural Flush Doors, Specification PC-5 for solid core doors.
- Approved Manufacturers:
- Algoma
 - Eggers
 - Graham Doors
 - Lambton Doors
 - Marshfield DoorSystems, Inc.
 - Oshkosh Architectural Door Company
 - VT Industries

1.03 SUBMITTALS

- A. Product Data: Submit door manufacturer's product construction data, hardware attachment performance data, specifications and installation instructions for each type of wood door, including details of core and edge construction, trim for lite openings and similar components.

- 1 B. Shop Drawings: Provide the following information:
 - 2 1. Door type.
 - 3 2. Door size.
 - 4 3. Hardware types and locations.
 - 5 4. Hardware blocking requirements and location.
 - 6 5. Vision panel or louver cutout size and location.
 - 7 6. Prefinish system type and approved color.

- 8
- 9 C. Samples:
 - 10 1. Color samples for factory prefinishing. Manufacturer shall
 - 11 submit samples of not less than 4" x 6" size of
 - 12 representative veneer or with sample date indicated.
 - 13 2. Construction samples. Corner sections with door faces,
 - 14 edges, and core representative of the specified door
 - 15 type(s). Corner samples to be not less than 6" x 6".

16

17

18 **1.04 PRODUCT DELIVERY, STORAGE AND HANDLING**

19

- 20 A. Protect wood doors during transit, storage and handling to
- 21 prevent damage, staining, soiling and deterioration. Comply
- 22 with requirements of ANSI/NWMA I.S.1. standard and
- 23 recommendations of NWMA pamphlet "How to Store, Handle, Finish,
- 24 Install, and Maintain Wood Doors", as well as with
- 25 manufacturer's instructions. Package doors at factory prior to
- 26 shipping using manufacturer's standard method.
 - 27 1. Store doors flat and off the floor on a level surface in a
 - 28 dry, well-ventilated building. Do not store on edge. Protect
 - 29 doors from dirt, water and abuse.
 - 30 2. Do not subject interior doors to extremes in either heat or
 - 31 humidity. HVAC systems should be operational and balanced,
 - 32 providing a temperature range of 50 to 90 degrees Fahrenheit
 - 33 and 30% to 50% relative humidity.
 - 34 3. When handling doors, always lift and carry. Do not drag
 - 35 across other doors or surfaces. Handle with clean hands or
 - 36 gloves.
 - 37 4. Each door shall be marked on top rail with opening number.
- 38
- 39 B. Identify each door with individual opening numbers which
- 40 correlate with designation system used on shop drawings for
- 41 door, frames, and hardware, using temporary, removable or
- 42 concealed markings
- 43
- 44

45 **1.05 GUARANTEE**

46

- 47 A. Furnish to architect a written guarantee that wood doors will
- 48 not contain any defects that make them unsuitable for their
- 49 intended use, subject to provisions of Standard Door Guarantee
- 50 of Window and Door Manufacturer's Association (WDMA). Duration
- 51 of guarantee shall be for life of original installation.
- 52
- 53 B. If any door is found to be defective within meaning of this
- 54 guarantee, manufacturer shall replace defective door as
- 55 originally purchased and sustain reasonable costs of hanging and
- 56 finishing door.
- 57
- 58
- 59

1 **PART 2 - PRODUCTS**

2
3 **2.01 MATERIALS**

- 4
5 A. Interior Solid Core Doors:
6 Conform to AWI requirements for PC-5 doors. Solid core flush
7 construction with hardwood edges to match face veneer.
8 1. Wood used shall be thoroughly seasoned, kiln dried with a
9 moisture content of not less than 5% and not greater than
10 8%.
11 2. Face Veneers: Standard thickness, thoroughly dried,
12 tapeless spliced, per AWI Section 200, latest edition, belt
13 and polish sanded. Grades shall be as per AWI Section 200-S-
14 7. Wood veneers shall be Grade A Plain Sliced Red Oak to
15 match existing doors.
16 3. Core: Medium density particle board panel, mat-formed,
17 consisting of wood particles bonded together with synthetic
18 resins or other added binder. Core shall meet or exceed the
19 requirements ANSI A208.1, Type 1, Grade 1-LD-2. Linear
20 expansion, under ASTM D 1037, Section 76-79, shall not
21 exceed .20 percent in either direction.
22 4. Face, edge, bead and matching standards shall conform with
23 AWI Section 1300-S requirements for Custom Grade.
24 5. Stiles and Rails:
25 Stile edge bands shall be two-ply laminated to the core.
26 Outer stile shall be of same species as face veneers. Two-
27 ply rails of mill option hardwoods shall be used. Stiles and
28 rails shall measure a minimum of 1-3/8" and be glued
29 securely to the core parts with no voids allowed. All doors
30 shall be 1-3/4" thick unless otherwise noted.
31 6. Crossbands shall be 1/16", minimum, hardwood or engineered
32 wood product extending full width of door and laid with
33 grain at right angles to face veneers. Cross bands and faces
34 shall be laminated to the Core with urea formaldehyde free
35 glue by the hot press process. Entire core unit to be sanded
36 before veneering to ensure minimal telegraphing of core
37 through the veneer.
38

39 **2.02 FABRICATION AND MANUFACTURE**

- 40
41 A. Fabricate doors in accordance with Door Schedule as to size and
42 materials and conform to details where shown or noted.
43
44 B. Factory-prefit and bevel doors (3°) to suit frame sizes
45 indicated, with 3/16" prefit in width, + 0"/- 1/32", tolerances.
46 Prefit top of door 1/8" +1/16"/-0", and undercut as designated
47 by floor condition.
48
49 C. Factory pre-machine doors for hardware that is not surface
50 applied. Locations and hole patterns to comply with specified
51 hardware requirements as per NFPA 80 standards for doors
52 specified; and to maintain door manufacturer's warranty.
53 1. Specific locations for hardware will be coordinated between
54 frame and door manufacturers.
55 2. Specific hardware preps will be per hardware schedule(s)
56 provided. Hardware preps to be neatly and cleanly squared as
57 required per hardware templates.
58 3. Metal astragals and channels to be supplied where fire-
59 ratings will not allow metal-free edge(s).
60
61

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- D. Solid Core Flush Doors:
 - 1. Direction of veneer grain shall be parallel to door stiles.
 - 4. Entire face shall be from one flitch and shall be "running match" and matched for color and grain at veneer joints.
 - 5. Laminate face and crossbanding together and to core with urea free adhesive by hot plate process
 - 6. Provide glazed doors with molded wood stops.

2.03 FINISHING

- A. Interior doors shall receive a factory finish equal to AWI Section 1500-T-14, Conversion Varnish, Premium Grade.
- B. Custom color tone to be selected by Architect. Submit 12" x 12" sample of proposed finish and receive Architect approval of sample prior to finishing doors.

* * *

1 Section 08 56 53 - Bullet Resistant Aluminum Windows

2
3 **PART 1 - GENERAL**

4
5 **1.01 DESCRIPTION**

- 6
7 A. Work Included:
8 Furnish and install thermally broken bullet resistant aluminum
9 windows with bullet resistant insulating glass.

10
11 **1.02 QUALITY ASSURANCE**

- 12
13 A. Bullet resistant windows shall meet the following requirements:
14 1. UL752 Level 2 ballistic requirements.
15 2. ASTM F1233 - Standard Test Method for Security Glazing
16 Materials and Systems.
17 3. ASTM F588 - Standard Test Methods for Measuring the
18 Forced Entry Resistance of Window Assemblies, Excluding
19 Glazing Impact.
20
21 B. Units shall be manufactured in strict accordance with the
22 specifications, design and details. No field alterations to
23 the construction of the units fabricated under the acceptable
24 standards shall be allowed unless approved by the manufacturer
25 and the architect.
26
27 C. Performance Requirements:
28 1. Air filtration shall not exceed .06 cfm per square foot
29 with a pressure differential of 6.24 psf, equal to 50 mph
30 wind (ASTM E283).
31 2. No uncontrolled water penetration shall occur when
32 subjected to both a static and dynamic water penetration
33 test with a pressure differential of 8 psf, equal to 56
34 mph wind (ASTM E331 and AAMA 501.1).

35
36 **1.03 SUBMITTALS**

37
38 Submit for approval prior to fabrication:
39 VERIFICATION OF UL LISTING OF BULLET RESISTANT COMPOSITE, catalog
40 cuts, shop drawings, specifications, frame profiles, size, type and
41 spacing of frame anchors, reinforcement size and locations, details
42 of joints and connections and printed data in sufficient detail to
43 indicate compliance with the contract documents.
44

45
46 **PART 2 - PRODUCTS**

47
48 **2.01 MANUFACTURERS**

- 49
50 A. Approved Manufactures: In order to establish a standard of
51 quality, this specification is based on bullet resistant,
52 thermally broken aluminum windows as manufactured by:
53 - United States Bullet Proofing, Inc., Upper Marlboro, MD
54 Telephone: 800-363-8328,
55 Model "USAW 400 - Bullet/Blast Resistant Fixed Aluminum
56 Window System"
57

1 Equal products by the following manufacturers which meet the
2 requirements of this specification are also approved:

- 3 - Action Bullet Resistant, Inc., West Islip, NY 11795:
4 Tel. 800-962-8088, "Model BL 350-4 Fixed Window"
5 - North American Bulletproof, Cibolo, TX, 888-746-8427,
6 "EXVW-A" Aluminum Storefront System
7

8 Equal products may be submitted for approval no less than ten
9 days prior to bid date. Submittal shall include the name and
10 model number of the specific item being submitted for approval
11 and shall include all technical literature, samples, drawings
12 and performance data specific to that model required to prove
13 compliance with the specified requirements.

14 Test reports by an independent test laboratory shall be made
15 available upon request.
16

17 **2.02 BULLET RESISTANT ALUMINUM WINDOWS**

- 18
19 A. Window System Description:
20 Construction shall consist of heavy-duty aluminum extrusion
21 with 1/8" minimum wall thickness requiring no steel inserts for
22 Ballistic Levels 1 thru 3.
23
- 24 B. Materials All aluminum extrusion shall be 6063-T5 alloy and
25 temper or equal or with a minimum tensile strength (minimum
26 22.0 ksi; ultimate, 16.0 ksi yield).
27
- 28 C. Aluminum Finish: Finish shall be equal to AAM12C22A31 clear
29 anodized to match existing windows frames.
30
- 31 D. All fasteners shall be zinc coated. There shall be no exposed
32 fasteners.
33
- 34 E. The interior glazing gaskets shall be a composition of
35 Thermoplastic Elastomer (TPE 65AB) and Polyolefin Foam
36 Concentrate (resulting in a 55 to 65 Shore "A" durometer) or
37 wet glazed as needed.
38
- 39 F. Setting blocks shall be solid neoprene (80-90 shore "a"
40 durometer).
41
- 42 G. All neoprene shall be in strict compliance with ASTM C-509-00
43 Type II Option 1 and C-864-99.
44
- 45 H. Frame Size - 2-1/2" W x 4 1/2" D
46
- 47 I. Thermally Broken Frame System
48
- 49 J. Glazing Thickness: Windows shall accommodate glass thickness
50 from 1/4" to 2-3/8".
51
52

1 **2.03 FABRICATION**
2

- 3 A. All joints and connections shall be tight providing hairline
4 joints and true alignment of adjacent members.
5
6 B. Ballistic Certification: All aluminum members shall be
7 ballistically improved so as to provide complete protection
8 against penetration of a projectile as required by the
9 specified UL 752 bullet resistant Level. A recognized
10 independent testing laboratory shall conduct ballistic testing.
11 Proof of certification shall be made available upon request.
12

13 **2.04 GLAZING**
14

- 15
16 A. Ballistic Attack Retention Requirement:
17 1. Mounting: Glass unit 18 inches by 96 inches shall be
18 mounted in a security frame of approved design. Frame then
19 shall be securely anchored, so as to not absorb any of the
20 testing shock.
21 2. Ballistic attack: UL 752 listed, Level 2.
22 3. Results: Glazing collapse at any time so as to allow edge
23 disengagement will constitute failure. Penetration of any
24 bullet will constitute failure.
25
26 B. Bullet Resistant Glass: UL 752 Listed Level 2.
27 - Global Security Glazing, "SP293"
28 - North American Specialty Glass
29 - Oldcastle Glass
30
31 C. High Performance Glass:
32 1/4" clear float glass with Low E coating.
33
34 d. Insulated Glass: (Dual Seal Construction, Class A Label,
35 Insulating Glass Certification Council Silicone Secondary Seal)
36 shall consist of two (2) sheets of glass with a high
37 performance (Low E) coating on the #3 surface and hermetically
38 sealed argon gas filled air space. Heat strengthen insulated
39 glazing units as required by glass fabricator to obtain ten
40 (10) year warranty. Insulated glazing units shall meet
41 requirements of ASTM E 2190 - Standard Specification for
42 Insulating Glass Unit Performance and Evaluation.
43 IGU thickness: 2-1/8".
44 a. 15/16" Bullet Resistant Glass (exterior)
45 1/2" air space
46 1/4" high performance glass (interior)
47
48
49

1 **PART 3 - EXECUTION**

2
3 **3.01 INSPECTION**

4
5 Inspect opening where bullet resistant windows are to be installed
6 and report to General Contractor any conditions which may adversely
7 affect installation, performance or appearance of windows. Do not
8 start installation until such conditions have been corrected.

- 9 1. Examine opening to verify locations of connections before
10 installation.
11 2. Prepare a written report, endorsed by the installer, listing
12 conditions detrimental to the functionality and performance of
13 security window system.
14 3. Install anchors that comply with window manufacturer's
15 requirements in accordance with manufacturer's shop drawings.
16 4. Clean surfaces thoroughly prior to installation.
17

18
19 **3.02 INSTALLATION**

- 20
21 A. Install bullet resistant window in their correct locations, set
22 level, square and plumb in alignment with other work and
23 substrates, in accordance with manufactures instructions,
24 approved shop drawings and accepted industry standards. All
25 joints between windows and rough opening shall be sealed using
26 sealant to ensure a weather tight installation.
27
28 B. Installer shall take special care to ensure that impact side of
29 glass faces the exterior.
30

31 * * *
32

Section 08 70 00 - Finish Hardware

PART 1 - GENERAL**1.01 DESCRIPTION OF WORK**

- A. Work and Hardware Included:
1. All finish hardware to required to completely equip building.
 2. All finish screws, washers, nuts, bolts and other accessories required for proper installation of hardware.
 3. Special details, templates and instructions to other contractors as may be required.
 4. Samples; complete schedule and marking.
 5. Installation by Section 06090.
 6. Note: Refer to other Sections for hardware by others.
- B. Work Not Included:
Rough hardware and hardware for following items:
- Shelf standards and supports
 - Millwork Hardware
 - Toilet partition hardware
 - Detention Hardware
- C. Related Work Specified Elsewhere:
1. Hollow Metal Doors and Frames - Section 08 11 00
 2. Wood Doors - Section 08 14 00
 3. Electrical Work - Division 26
 4. Card Readers - Division 26

1.02 CONTRACTOR PERFORMANCE

- A. Furnish and deliver all hardware, including accessories, required for doors as scheduled. If not scheduled, furnish hardware equal to that specified for similar location as far as practical.
- B. Hardware Contractor shall familiarize himself with other branches of specification to determine what hardware is excluded from this section.
- C. Provide template or non-template hardware as required by door and jamb construction. Furnish wood or machine screws or thru-bolts as required by those furnishing items to which hardware is to be applied.
- D. Cooperate with contractors and others with regard to application of hardware. Make occasional inspections to verify that items are properly used, in correct location, and master key system is maintained. Report improper application of hardware to Architect.
- E. Deliver hardware only after detailed schedule, keying diagram and samples have been approved by Architect.
- F. Equip two or more doors in an opening with similar hardware unless otherwise specified. Furnish flush bolts GJ-FB6-12 on pairs of locked doors.

- 1 G. Furnish UL doors with all hardware necessary to meet UL or local
2 fire and safety requirements.
- 3
- 4 H. Include in schedule a chart detailing for the installer,
5 installation dimensions for the various items of hardware herein
6 specified. These dimensions shall be arrived at after
7 consultation with the Architect.
- 8
- 9 I. Finish hardware will be installed as specified under
10 Section 06 09 00 - Rough and Finish Carpentry.
- 11
- 12 J. Hardware in metal jambs: Reinforcing and cover boxes will be
13 provided with metal jambs.
- 14
- 15 K. Locks having bolts or latches engaging with mullions or jambs of
16 hollow metal construction shall have box type strikes.
- 17
- 18 L. Coordinate low voltage wiring requirements with related trades.
- 19

20 **1.03 QUALITY ASSURANCE**

- 21
- 22 A. Hardware shall be as specified. No substitutions will be
23 considered.
- 24

25

26 **1.04 SUBMITTALS**

- 27
- 28 A. Samples:
 - 29 1. Samples requested shall be submitted to Architect for
30 approval. Approved samples, of proper finish, will be
31 delivered to job for ultimate use. Otherwise, samples will
32 be returned to contractor upon completion.
33 Provide the following samples for approval:
 - 34 a. Lever Set - one (1) each
 - 35 2. Installed materials shall be equal in all respects to
36 approved samples.
- 37
- 38 B. Schedule:
 - 39 1. Before ordering hardware, submit three (3) copies of
40 complete Hardware Schedule to Architect for approval. After
41 approval, submit five (5) copies.
 - 42 2. Successful bidder shall check specified schedule against
43 latest revised plans when making up schedule for approval.
 - 44 3. Schedule each door separately and, where practical, item
45 numbers will be same as door numbers and in consecutive
46 sequence.
- 47

48 **1.05 PRODUCT DELIVERY, STORAGE AND HANDLING**

- 49
- 50 A. Deliver hardware to carpenter, or hollow metal contractors, or
51 to respective shops of other contractors as directed.
- 52
- 53 B. Consult with carpenter, hollow metal and other contractors and
54 follow their directions regarding manner, sequence and time of
55 delivery and obtain receipt.
- 56
- 57 C. Responsibility for safekeeping after delivery rests with trade
58 to whom hardware was delivered.
- 59
- 60

1 **1.06 KEYING**

- 2
- 3 A. Key locks in sets or subsets and master key to Dane County
- 4 Communications Center Best masterkey system. After award of
- 5 contract, hardware supplier shall confer with Owner and
- 6 Architect to determine keying system. Furnish three (3) master
- 7 keys and three (3) grand master keys. Contractor to provide to
- 8 Dane County all blank cores and blank keys for setup, keying and
- 9 installation of cores by Dane County Staff.
- 10
- 11 B. Tag each key mark with item or plan door number.
- 12
- 13 C. Keys: Furnish three (3) change keys with each lock. Keys to be
- 14 stamped per owners requirements. Two change keys shall be
- 15 shipped to key cabinet manufacturer for installation in cabinet.
- 16 Keys shall be properly marked in key gathering envelopes.
- 17
- 18 D. Direct representative of manufacturer shall see that personnel
- 19 assigned to make equipment ready for operation are fully
- 20 instructed in the system. Representative shall contact Architect
- 21 for name of personnel to be instructed.
- 22
- 23

24 **1.07 GUARANTEE**

25

26 All work in this Section shall be guaranteed to be free from defects

27 in materials and workmanship for a period of one (1) year from date

28 of final completion of project.

29

30

31 **PART 2 - PRODUCTS**

32

33 **2.01 FINISHES AND MATERIALS**

- 34
- 35 A. Hardware finishes shall be US26D and US32D.
- 36
- 37 B. Materials shall be the following. Provide with the finish
- 38 designated in parenthesis ().
- 39 1. Knobs locks and latches - bronze with (US26D) finish.
- 40 2. Kickplates -(US32D).
- 41 3. Door closers: Interior Powdercoat aluminum.
- 42 4. Door butts - nonferrous for exterior and wet areas with
- 43 (US32D) finish. Ferrous for other doors with (US26D)
- 44 finish.
- 45 5. Door stops and holders - stainless steel with (US32D)
- 46 finish or bronze with (US26D) finish.
- 47 6. Miscellaneous items - bronze with (US26D) finish.
- 48 7. All stainless steel shall be Type 302 - 18-8.
- 49
- 50
- 51

1 **2.02 LOCKS, LATCHES AND DEAD LOCKS**

- 2
- 3 A. Shall be Best 9K with 15D design.
- 4
- 5 B. Backset shall be 2-3/4" for all locks, latches and dead locks.
6 Strikes shall be box type with wide enough lip projection to
7 protect door frame but not to exceed 3/16" beyond face of frame.
- 8
- 9 C. All locks and cylinders shall be of one manufacturer and shall
10 have not less than six (6) pins.
- 11
- 12 D. Furnish Best rim or mortise cylinders as required for coiling
13 doors, keyswitches for light fixtures, and access panels..
- 14
- 15 E. All cylinders shall by Best keyed to existing Dane County
16 Communications Center system. Contractor shall provide to Dane
17 County all blank cores and keys for setup, keying and
18 installation by Dane County Staff.
- 19
- 20 F. Provide two (2) spare locksets in the following:
21 - 1 Storeroom
22 - 1 Classroom
- 23
- 24 G. Lock Function Legend (As indicated by code in remarks column):
25 1. N Passage
26 2. L Privacy
27 3. AB Office
28 4. C Vestibule
29 5. R Classroom
30 6. D Storeroom

31

32

33

34 **2.03 EXIT DEVICES**

- 35
- 36 A. None required
- 37

38

39 **2.04 BUTT HINGES**

- 40
- 41 A. Shall be Hager, McKinney or PBB ball bearing, non-rising loose
42 pin, flat button tip, unless otherwise specified.
- 43
- 44 B. Provide three butts per door, unless otherwise noted in
45 Schedule.
- 46
- 47 C. Butt size requirements:
48 1. Interior doors up to 37" wide 4-1/2 x 4-1/2.
- 49
- 50 D. Door butt legend: (unless otherwise noted in Schedule)
51 1. Interior doors BB81 4-1/2 x 4-1/2
- 52
- 53 E. Furnish UL approved butts on labeled doors.
- 54
- 55 F. All butts on doors with card access shall be NRP.
- 56
- 57 G. Continuous gear hinges to be Select Hinge.
- 58
- 59
- 60

1 **2.05 DOOR CLOSERS**
 2

- 3 A. Shall be LCN, Norton, or Dorma of proper size as described in
 4 manufacturer's schedule of sizes. Provide cush-n-stop option at
 5 90 degrees swing doors where wall stop is not applicable.
 6
- 7 B. Furnish all drop plates and brackets necessary to mount closers
 8 with other types of hardware including overhead stops,
 9 weatherstripping, etc.
 10
- 11 C. All closers, unless otherwise specified, to have metal covers.
 12
- 13 D. Closers shall have key adjusting device. Furnish six adjusting
 14 keys.
 15
- 16 E. Mount to provide maximum opening permitted by building
 17 construction or equipment, and note on this schedule the maximum
 18 swing per location for other trades involved in reinforcement or
 19 installation.
 20
- 21 F. Closers shall be of cast iron or cast aluminum, of full rack and
 22 pinion construction, including two speed closing adjustment,
 23 adjustable hydraulic back-check and fully adjustable spring
 24 power plus reversible shoe feature, of type listed in schedule.
 25 Closer fluid shall be "all weather" type not subject to normal
 26 temperature changes.
 27
- 28 G. All doors closers shall be similar in design and appearance to
 29 those listed in the schedule, so far as possible, and shall be
 30 of one manufacturer. Furnish special arms and applications as
 31 indicated in hardware schedule or as dictated by structural
 32 conditions or local code requirements.
 33
- 34 H. Door closers at labeled fire doors shall bear UL approval.
 35
- 36 I. Where more than one door occurs in an opening, equip each
 37 door with closer, unless otherwise noted.
 38
 39

40 **2.06 PUSH AND PULL HARDWARE, KICKPLATES**
 41

- 42 A. Shall be as manufactured by Hiawatha Industries, Inc. Rockwood
 43 Mfg., or CHMI.
 44
- 45 B. Stainless steel plates shall be .050 thick and security screw
 46 fastened. Size of kick plates and armor plates:
 47 1. Single door, pull side: 1/2" less than door width.
 48 2. Single door, push side: 1-1/2" less than door width.
 49 3. Pair of Doors, pull side: 1/2" less than door width.
 50 4. Pair of Doors, push side: 1" less than door width.
 51 5. Height, as indicated in Hardware Schedule and the
 52 following:
 53 - "Kickplate 12" high", "Armorplate 40" high"
 54
- 55 C. Legend:
 56 1. Push plates as noted in schedule.
 57 2. Pull plates as noted in schedule.
 58 3. Push bars as noted in schedule.
 59 4. Kick plate push side of door only.
 60 5. Flush pulls as noted in Hardware Schedule.

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2.07 STOPS AND BUMPERS

- A. Shall be Ives 406/407 cast brass or overhead type, indicated in the Hardware Schedule. Provide 406/407 bumper wherever possible. If construction prohibits the use of 406/407, furnish FS436 type. Equal products as manufactured by Trimco and Rockwood are also approved.
- B. Install bumper behind each door.
- C. Where two doors interfere with each other in swinging, provide roller bumper "RB4", "RB5" as required.
- D. Apply with expansion shield and machine screws only.
- E. Overhead stops shall be ABH, Inc. or Glynn-Johnson as specified in hardware groups.

2.08 MISCELLANEOUS HARDWARE

- A. Door Position Switch (DPIS): Provide Sentrol 1070 series or Dorma MC4 at all locations as noted in door schedule.
- B. Electric Strike: Folger Adam 310, Von Duprin 6200 or Dorma ES100 series.
- C. Desktop Console: Dorma DTW series as specified in hardware groups
- D. Card Access system, Request to Exit Detectors: By owner vendor.

2.09 LOCK FUNCTIONS

See Remarks section.

2.10 HARDWARE GROUPS

HG1
BUTTS
LOCK
STOP

HG2
LOCK
ADAPTER PLATE
STRIKE

NOTE:

- 1. PROVIDE ALL CUSTOM STRIKES AND ADAPTER PLATES REQUIRED FOR RETROFITTING EXISTING DOORS AND FRAMES WITH NEW LOCK

1 HG3
 2 BUTTS
 3 LOCK
 4 CLOSER 8916/8916SPA
 5 STOP
 6 KICKPLATE 8
 7 ELECTRIC STRIKE ES111
 8 DOOR POSITION SWITCH MC-4
 9 DESKTOP CONSOLE CC401DTM
 10 CUSTOM WIRING DIAGRAM
 11 CARD READER AND REQUEST TO EXIT DETECTOR BY OWNER VENDOR
 12 CONNECTION BY DIVISION 26.
 13 OPERATIONAL DESCRIPTION: DOOR NORMALLY CLOSED AND LOCKED. FREE
 14 EGRESS ALLOWED AT ALL TIMES. OUTSIDE ACCESS BY CARD READER OR
 15 DESKTOP CONSOLE, WHICH WILL SHUNT THE ALARM AND UNLOCK ELECTRIC
 16 STRIKE.

17
 18 HG4
 19 BUTTS
 20 LOCK
 21 CLOSER 8916/8916SPA
 22 STOP
 23 KICKPLATE 8

24
 25 HG5
 26 BUTTS
 27 LOCK
 28 CLOSER 8916DS
 29 KICKPLATE 8

30
 31
 32
 33 **GENERAL NOTES:**

- 34
 35 A. One each per set unless noted otherwise.
 36
 37 B. Hinges indicated throughout.
 38
 39 C. Stops as listed within hardware sets to be floor stop,
 40 wallbumper or door stop, as required.
 41
 42

43 **2.11 FINAL ADJUSTMENTS AND CHECKING**

- 44
 45 A. All locks and latches:
 46 1. Properly lubricate with lock lubricant.
 47 2. Check, test and adjust all moving parts to insure free,
 48 smooth operation.
 49
 50 B. Door closers and holders:
 51 1. Lubricate as specified above.
 52 2. Check, test and adjust.
 53 3. Final adjustments by factory representative to meet
 54 building conditions after building is in use.
 55
 56
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* * *

Section 08 80 00 - Glass and Glazing**PART 1 - GENERAL****1.01 DESCRIPTION**

- A. Work Included:
Labor and materials required to complete glass and glazing work
- 1 Borrowed lights and door view windows glazed with 1/4" clear tempered float glass
- B. Related Work Specified Elsewhere:
1. Hollow Metal Doors and Frames - Section 08 11 00.
 2. Wood Doors - Section 08 14 00

1.02 QUALITY ASSURANCE

- A. Glass shall conform to Federal Specification DD-G-451a
- B. Use adequate numbers of skilled workers who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the Work of this Section.

1.03 SUBMITTALS

- A. Submit the following:
1. Materials list of items proposed to be furnished under this Section.
 2. Manufacturer's specifications and other data needed to prove compliance with the specified requirements.

1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Deliver materials when and as required and store in a safe location as directed. Do not unpack materials until they are to be used.
- B. During storage and handling of glass, provide protection to prevent impact damage.

PART 2 - PRODUCTS**2.01 MATERIALS**

- A. Float Glass:
1. Glazing quality, clear, float glass, not less than 1/4" thick, conforming to ASTM C-1036-85 for annealed glass thickness, cutting and quality tolerances.
 2. Tempered Float Glass:
1/4" thick, clear, float glass, heat treated and cooled to provide high resistance to breakage conforming to ASTM C-1048-92.
 3. Float glass as manufactured by:
 - Guardian Industries Corp.
 - PPG
 - Pilkington
 - ACH Glass Operations

- 1 - approved equal
2
- 3 B. Fire Rated Glass/Impact Resistant Glass:
4 1. Thickness: 1/4 inch.
5 2. Weight: 3.0 lbs./sq. ft.
6 3. Approximate Visible Transmission: 89 percent.
7 4. Approximate Visible Reflection: 8 percent.
8 5. Fire-rating: 20 minutes (WITHOUT HOSE STREAM TEST).
9 6. Impact Safety Resistance: ANSI Z97.1 and CPSC 16CFR1201
10 (Cat. I and II).
11 7. Labeling: Permanently label each piece of Fireglass 20™
12 with the fireglass 20™ logo, UL logo and fire rating in
13 sizes up to 6,396 sq. in.
14 8. Fire Rating: Fire rating listed and labeled by UL for fire
15 rating scheduled at opening locations on drawings, when
16 tested in accordance with ASTM E2074-00, NPFA 252, UL 9,
17 UL 10B and UL10C.
18 9. Approved Manufacturer:
19 "Fireglass20®" as manufactured by J.R. Four Ltd., and
20 distributed by Technical Glass Products, Snoqualmie, WA
21 1-800-426-0279.
22
- 23 C. Fire Rated Glass/Impact Resistant Glass:
24 1. Fire-rated glass ceramic laminated clear and wireless
25 glazing material for use in impact safety-rated locations
26 such as doors, transoms and borrowed lites with fire rating
27 of 45 minutes and 90 minutes with hose stream test. See
28 Door Schedule on Drawings for required ratings.
29 2. Approved Manufacturer:
30 - FireLite Plus as manufactured by Nippon Electric
31 Glass Company, Ltd., and distributed by Technical
32 Glass Products, 8107 Bracken Place SE, Snoqualmie, WA
33 98065, voice 1-800-426-0279, fax 1-800-451-9857,
34 - SaftiFirst, 888-653-3333 "SuperLite C/SP"
35 3. Thickness: 5/16 inch overall.
36 4. Weight: 4 lbs./sq. ft.
37 5. Approximate Visible Transmission: 85 percent.
38 6. Approximate Visible Reflection: 9 percent.
39 7. Fire-rating: 45 minute and 90 minute, as scheduled.
40 8. Impact Safety Resistance: ANSI Z97.1 and CPSC 16CFR1201
41 (Cat. I and II).
42 9. STC Rating: Approximately 35 dB.
43 10. Surface Finish: Premium (polished).
44 11. Positive Pressure Test: UL 10C, UBC 7-2 and 7-4; passes
45 12. Labeling: Permanently label each piece of FireLite Plus
46 with the FireLite logo, UL logo and fire rating in sizes up
47 to 3,325 sq. in., and with the FireLite label only for
48 sizes that exceed the listing (as approved by the local
49 authority having jurisdiction).
50 13. Fire Rating: Fire rating listed and labeled by UL for fire
51 rating scheduled at opening locations on drawings, when
52 tested in accordance with ASTM E2074-00 and ASTM E2010- and
53 UL 9, UL 10B and UL 10C.
54
55

1 D. Glazing Materials:

- 2 1. Sealants: For cap beads and other glazing not in contact
3 with insulated glass seal or PVB interlayer of laminated
4 glass.
5 - Tremco, "Proglaze"
6 - GE, "Silglaze N"
7 - Dow Corning, "999-A"
8 2. Sealants in contact with insulating glass seal and PVB
9 interlayer of laminated glass shall be one part neutral
10 cure silicone.
11 - Tremco, "Spectrem 2"
12 - GE, "SilGlaze II"
13 - Dow Corning, "799"
14 3. Extruded compound shall be Tremco, "No. 440", 100 percent
15 solid polyisobutylene butyl reinforced tape.
16 4. Setting block and spacer shims shall be of neoprene rubber
17 or other suitable material with Shore "A" hardness of 70
18 to 80 for setting blocks and 40 to 60 for spacer shims.
19

20 E. Glazing Materials for Fire Rated Glass:

- 21 1. Glazing Tape: Closed cell polyvinyl chloride (PVC) foam,
22 coiled on release paper over adhesive on two sides, maximum
23 water absorption by volume of 2 percent.
24 2. Setting Blocks: Neoprene, EPDM or hardwood; tested for
25 compatibility with glazing compound; of 70 to 90 Shore A
26 hardness.
27 3. Cleaners, Primers, and Sealers: Type recommended by
28 manufacturer of glass and gaskets.
29

- 30 F. Provide other materials not specifically described, but required
31 for a complete and proper installation, subject to approval of
32 Architect.
33

34 **2.02 FABRICATION**

35
36 Glass Sizes: Obtain glass sizes from work at building or from
37 manufacturer of frames in which glass is to be set. Sizes shown are
38 for estimating purposes only and must be verified.
39
40

41 **PART 3 - EXECUTION**

42
43 **3.01 INSPECTION AND PREPARATION**

- 44
45 A. Examine the areas and conditions under which work of this
46 Section will be performed. Report to General Contractor
47 conditions detrimental to timely and proper completion of the
48 Work. Do not proceed until unsatisfactory conditions have been
49 corrected.
50
51 B. Clean glazing channels, stops and rabbets to receive the glazing
52 materials, making free from obstructions and deleterious
53 substances which might impair the work.
54 1. Remove protective coatings which might fail in adhesion or
55 interfere with bond of sealants.
56 2. Comply with manufacturer's instructions for final wiping of
57 surfaces immediately prior to application of primer and
58 glazing compounds or tapes.
59 3. Prime surfaces to receive glazing compounds in accordance
60 with manufacturers' recommendations.

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3.02 INSTALLATION

- A. General: Glazing shall be in accord with Glazing Manual of Glazing Association of North America (GANA). Each pane shall bear the factory label.
- B. Inspect each piece of glass immediately prior to start of installation.
 - 1. Do not install items which are improperly sized, have damaged edges or are scratched, abraded or damaged in any other manner.
 - 2. Do not remove labels from glass until so directed by the Architect.
- C. Locate setting blocks at sills at quarter points, unless otherwise recommended by the glass manufacturer.
 - 1. Use blocks of proper size to support the glass in accordance with the manufacturer's recommendations.
 - 2. Provide spacers for glass sizes larger than 50 united inches, to separate glass from stops, except where continuous glazing gaskets or felts are provided.
 - a. Locate spacers no more than 24" apart and no closer than 12" to a corner.
 - b. Place spacers opposite one another.
 - c. Make bite of spacer on glass 1/4" or more.
- D. Set glass in a manner which produces the greatest possible degree of uniformity of appearance.
- E. Miter cut and seal the joints of glazing gaskets in accordance with the manufacturer's recommendations to provide watertight and airtight seal at corners and other locations where joints are required.
- F. Install fire rated glass so that appropriate fireglass 20™ markings remain permanently visible.

3.03 ADJUSTMENT AND CLEANING

- A. At completion, remove dirt, stains, excess glazing compounds, etc., clean and polish all exposed work, including glass and leave work in acceptable condition.
- B. Final cleaning of glass shall be in accordance with General Conditions as amended.

3.04 PROTECTION

Protect glass from breakage after installation. Do not apply warning markings, streamers, ribbons or other items directly to the glass

3.05 BREAKAGE

- A. This Contractor shall be responsible for all glass broken because of faulty setting and shall replace same at Contractor's own expense.
- B. Replace glass broken by others. Cost will be adjusted in accordance with General Conditions.

Section 09 21 16 - Gypsum Board Assemblies**PART 1 - GENERAL****1.01 DESCRIPTION**

- A. Work Included: Labor and materials required to complete drywall construction including metal stud partition system, furring channels, gypsum board and all fasteners and accessories required for a complete and proper installation.
- B. Related Work Specified Elsewhere:
1. Building Insulation - Section 07 21 00
 2. Firestopping - Section 07 84 00
 3. Caulking and Sealants - Section 07 90 00
 4. Hollow Metal Doors and Frames - Section 08 11 00
 5. Painting and Finishing - Section 09 90 00

1.02 QUALITY ASSURANCE

- A. Standards:
1. ASTM C754 - Installation of Steel Framing Members to Receive Screw-Attached Gypsum Board.
 2. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board.
 3. ASTM C1047 - Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base
 4. ASTM C1063 - Standard Specification for Installation of Lathing and Furring to Receive Interior and Exterior Portland Cement Based Plaster. (Plaster and Stucco Accessories).
 5. ASTM C 1396 - Standard Specification for Gypsum Board.
 6. Gypsum Association GA-201 - "Using Gypsum Board For Walls and Ceilings".
 7. Gypsum Association GA-214 - "Recommended Levels of Gypsum Board Finish".
 1. Unexposed Surfaces: Level 1
 2. All Exposed Surfaces: Level 4
 8. Gypsum Association GA-216 - "Recommended Specifications for the Application and Finishing of Gypsum Board".

1.03 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Storage and Handling:
1. Deliver all materials in original packages, containers or bundles bearing the brand names of manufacturer.
 2. Store materials inside, level, under cover. Keep dry. Protect from weather, other elements and damage from construction operations and other causes.
 3. Handle gypsum board to prevent damage to edges, ends or surfaces. Protect metal accessories and trim from being bent or damaged.
 4. Steel framing and related accessories shall be stored and handled in accordance with A.I.S.I. "Code of Standard Practice".

1 **1.04 PROJECT CONDITIONS**

- 2
3 A. Environmental Requirements General: Comply with requirements of
4 gypsum board application standards and recommendations of gypsum
5 board manufacturer for environmental conditions before, during
6 and after application of gypsum board.
7
8 B. Ventilation: Ventilate building spaces as required to remove
9 excess moisture that would prevent drying of joint treatment
10 material immediately after its application.
11

12 **1.05 GUARANTEE**

13
14 All work under this section shall be guaranteed to be free from
15 fastener popping, ridging and other faulty workmanship for a period
16 of one (1) year from date of final completion of project. Evidence of
17 same shall be remedied at no cost to Owner.
18

19
20 **PART 2 - PRODUCTS**

21
22 **2.01 MATERIALS**

- 23
24 A. Metal studs: Cold-formed galvanized steel C-studs, in
25 conformance with AISI Specifications for Design of Cold-formed
26 Steel Structural Members, 20 gauge, unless otherwise indicated,
27 in widths as called for on drawings, complete with floor and
28 ceiling runners. Provide studs of heavier gauge, as required,
29 by wall heights. Stud depth, gauge and spacing shall be as
30 required for 5 PSF interior wind load for all partitions based
31 on L/240 deflection criteria using the stud properties alone.
32 Approved Manufacturers:
33 - Marino\Ware
34 - Dietrich Metal Framing.
35 - Clark Western Building Systems
36 - approved equal
37
38 B. Runner Track: Same gauge as studs, unless otherwise noted.
39
40 C. Channels:
41 Furring channels:
42 Cold-formed galvanized steel in conformance with AISI
43 Specifications for Design of Cold-formed Steel Structural
44 Members. Designed for screw attachment.
45 Face width 1-3/8".
46 Depth as indicated on Drawings.
47 - Provide necessary galvanized wire attachment clips.
48
49 D. Deflection Clips:
50 Slotted angle clips for installation in interior head-of-wall
51 partitions to provide positive attachment to web of stud.
52 - Dietrich, "Sliptrack System"
53 - The Steel Network, Inc., Raleigh, NC, (888) 474-4876
54 "VertiClip SLD" or "VertiTrack VTD".
55 - Dietrich Metal Framing, "Fast Strut", "Fast Top" Clips,
56 "FastClip" Slide Clips, "QuickClip", "The Slide Clip" (SD)
57 (866) 638-1908
58 - approved equal
59
60 E. Hanger wire shall be No. 8 gauge galvanized, soft annealed.

- 1
2 F. Flat Strap and Backing Plate: Sheet for blocking and bracing in
3 length and width indicated. Subject to compliance with
4 requirements, provide Dietrich Metal Framing, "Danback" Fire
5 Treated Wood Backing Plate.
6
- 7 G. Gypsum wallboard shall have eased radial edges and conform to
8 F.S. SS-L-30C and ASTM C1396.
9 1. Mold Resistant Gypsum Board: For general use in project
10 unless otherwise noted.
11 Gypsum Panels with a non-combustible, moisture and mold-
12 resistant gypsum core that is encased in moisture resistant,
13 100 percent recycled face and back papers, or, coated
14 inorganic glass matt-faced water-resistant treated gypsum
15 core wallboard conforming to the physical properties of ASTM
16 C1396 and ASTM C 1177. The panels shall have tapered long
17 edges for finishing. 5/8" panels UL Classified for fire
18 resistance (Type X).
19 - USG "SheetRock Mold Tough"
20 - G-P Gypsum, "DensArmor Plus"
21 - Gold Bond, "XP"
22 - CertainTeed, "ProRoc" Moisture and Mold Resistant With
23 M2TECH™
24 - approved equal
25
- 26 H. Screws:
27 Fasteners: Self-drilling, self-tapping screws; steel, complying
28 with ASTM C 1513; galvanized coating, plated or oil-phosphate
29 coated complying with ASTM B 633 as needed for required
30 corrosion resistance
31 1. 1" drywall screw, Type S, bugle head for steel studs and
32 furring. Use screws with corrosion resistant coating in wet
33 areas.
34
- 35 I. Adhesive: For laminating gypsum board to gypsum board shall be
36 an adhesive approved by manufacturer of gypsum drywall products.
37 - USG "Sheetrock 90" or "Sheetrock 210" Setting Type Joint
38 Compound or equal products manufactured by Gold Bond.
39
- 40 J. Control Joints: Dietrich Metal Framing "093 Control Joint".
41
- 42 K. Accessories shall be galvanized steel; PVC, as manufactured by
43 Plastic Components, Inc.; or tape-on profiles as manufactured by
44 Beadex Manufacturing Co., Inc., Auburn, WA.
45 1. Corner Bead:
46 a. Dietrich "103 Deluxe Bead"
47 b. tape-on paper faced corner trim
48 - Beadex, "B1 Series"
49 - Dietrich "Goldline" Paper-faced Metal Products
50 2. Edge Trim: Dietrich Metal Trims "M20A" and "M20B"
51 3. Use zinc alloy in lieu of galvanized steel in exterior
52 installations.
53
- 54 L. Provide joint reinforcing tape and cement as approved by gypsum
55 board manufacturer.
56
57

M. Sealants:

1. Acoustical sealant: Flexible synthetic rubber sealant.
 - Tremco, "Acoustical Sealant"
 - Pecora, "BA-98" Acoustical Sealant
 - USG, "Sheetrock Brand Acoustical Sealant"
2. General Purpose Sealant: Single component polyurethane sealant.
 - Tremco "Dymonic"
 - Pecora, "Dynatrol I"
 - Sonneborn, "Sonolastic NP 1"

PART 3- EXECUTION

3.01 INSPECTION

A. Drywall Installation:

1. Examine and inspect materials to which gypsum wallboard is to be applied.
2. Report to General Contractor any conditions which will adversely affect installation, appearance or performance of drywall construction. Do not start drywall construction until such conditions have been corrected.
3. Defects due to installation on misaligned framing or other defective substrate will be responsibility of work under this section of specifications and shall be corrected without cost to Owner.

3.02 SITE ENVIRONMENTAL PROCEDURES

A. Indoor Air Quality:

Temporary ventilation: Provide temporary ventilation for work of this Section.

3.03 METAL STUD INSTALLATION

A. Metal Studs: Install steel studs in strict accordance with AISI "Standard for Cold-Formed Steel Framing - General Provisions". Comply with manufacturer's recommendation and procedures described in ASTM C754 to secure a sound and plumb installation. Cut all framing components squarely for attachment to perpendicular members, or as required for an angular fit against abutting members. Hold members positively in place until properly fastened.

B. Erection:

1. Align runner tracks accurately according to partition layout and secure to floor with power driven anchors, spaced not over 24" o/c and to structure above with suitable fasteners spaced not to exceed 16" o/c. Install concrete anchors only after full compressive strength has been achieved. Butt all track joints. Securely anchor abutting pieces of track to a common structural element, or splice them together.
2. Before placing floor and ceiling runners for partitions containing sound attenuation insulation, apply two (2) 3/8" diameter beads of acoustical sealant to floor and ceiling runners and end studs, including those used at partition intersections with dissimilar wall construction, to provide air-tight seal.

- 1 3. Place studs vertically in runner track spaced 16" o/c
2 unless otherwise indicated on Drawings. Align and plumb
3 studs, and securely attach to the flanges or webs of both
4 upper and lower tracks.
- 5 4. Where partition is fire or smoke rated, extend to structure
6 above with fire and smoke resistant joint treatment.
- 7 5. Partitions separating individual departments from common
8 corridors, individual departments from each other and all
9 toilet room partitions shall extend full height from floor
10 to bottom of deck above.
- 11 6. Where studs extend to roof structure, provide slip joint to
12 permit roof deflection. Follow manufacturer's installation
13 instructions for system used.
- 14 7. Partitions which end above ceiling line and do not continue
15 to roof or floor structure above shall be braced to
16 structure as required to provide a rigid and stable
17 installation.
- 18 8. Provide double studs at exterior corners and at door and
19 borrowed light openings. Studs located adjacent to door and
20 window frames, partition intersections and corners shall be
21 anchored to runner flanges with metal lock fastener tool.
22 Provide studs 2" from inside corners.
- 23 9. Provide studs at both sides of control joints.
- 24 10. Provide solid backing at 45 degree outside corners to avoid
25 "floating end joints" in gypsum board.
- 26 11. Provide horizontal blocking between studs at the ceiling
27 line when full-height partitions are incorporated.
- 28 12. Nest lapped studs a minimum of 8" and secure with at least
29 one (1) fastening per stud flange.
- 30 13. Securely anchor metal studs to jamb and head anchor clips of
31 door or borrowed light frame with bolt or screw attachment.
- 32 14. Over door and top and bottom of borrowed light frames,
33 install runner track cut and fit between studs with web
34 flange bent at each end securely fastened with one (1)
35 fastener per flange.
- 36 15. Align stud openings to facilitate running of wires and
37 conduit.
- 38 16. Reinforce stud partitions and provide additional metal studs
39 as required for installation of wall cabinets, wall mounted
40 equipment, wall mounted mechanical and electrical fixtures,
41 accessories, shelves and shelf standards. Provide 16 gauge
42 steel plate to span minimum of 3 studs for installation of
43 mirrors, toilet accessories and grab bars.

44 3.04 FURRING

- 45 A. Suspended Ceilings:
 - 46 1. Suspend 1-1/2" runner channels spaced 4'-0" o/c from
47 structure with hanger wires spaced 4'-0" o/c. Do not
48 suspend channels or any other ceiling framing from metal
49 deck. Provide additional steel attached to structural steel
50 as required for installation of ceiling suspension system.
 - 51 2. Attach furring channels to runner channels with wire clips,
52 and space 24" o/c.
- 53 B. Wall Furring Channels: Apply vertically to wall, spaced 24"
54 o/c, and attach with hammer set or power-activated stud
55 fasteners or concrete stub nails, spaced 24" o/c and staggered
56 on alternate wing flanges. Place asphalt felt protection strip
57 between each furring channel and wall.
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3.05 DRYWALL INSTALLATION

- A. General:
 - 1. Erect all drywall work in strict accordance with "Recommended Specifications for the Application and Finishing of Gypsum Board", GA-216, as published by Gypsum Association, 1603 Orrington Avenue, Evanston, Illinois 60201.
 - 2. Lay out panels to minimize waste. Reuse cutoffs whenever feasible.

- B. Levels of Gypsum Board Finish: Conform to requirements of Gypsum Association Publication GA-214.
 - 1. Level 1 Finish: Plenum areas above ceilings, attics and other concealed areas.
 - 2. Level 4 Finish: All exposed gypsum board surfaces.

- C. Cutting: Cut gypsum board using industry standard methods as recommended by gypsum board manufacturer. Where board meets projecting surfaces, it shall be neatly scribed.

- D. Placing:
 - 1. Ceilings: Install ceiling boards in the direction that will minimize the number of end-butt joints. Stagger end joints at least one foot.
 - 2. Walls: Apply gypsum board vertically or horizontally, at Contractor's option, providing sheet lengths that will minimize end joints.
 - 3. Bring boards in contact with each other but do not force into place.
 - 4. Make end joints on framing members or between framing members with backblocking. Metal backed tape may be used in place of backblocking.
 - 5. Use tile backer board in all locations where ceramic tile wall surfacing is scheduled.
 - 6. Terminate gypsum board 1/2" above floor.

- E. Drive screws not less than 3/8" from ends or edges to provide uniform dimple not over 1/32" deep.
 - 1. Apply gypsum board to metal studs with screws spaced 12" o/c in field and along vertical edges.

- F. Laminating to Gypsum Board Base:
 - 1. On Walls: Apply base layer and face layers vertically with joints of base layer over supports and face layer joints offset at least 10" with base layer joints.
 - 2. Screw attach first layer of gypsum board to metal studs.
 - 3. Apply laminating compound to back of face panels with a notched metal spreader having four 1/4" x 1/4" minimum notches spaced maximum of 2" o/c, in accordance with manufacturer's instructions.
 - 4. Laminate face panels to base layer panels using moderate pressure and temporary nailing. Stagger joints with base layer.

1 G. Sealing:

2 Where gypsum board partitions are of sound rated, fire rated, or
3 smoke barrier construction, follow requirements of ASTM C919 to
4 seal all cut-outs and intersections with the adjoining
5 construction.

- 6 1. Use acoustical sealant for walls containing sound
7 attenuation insulation. Use general purpose sealant for
8 sealing smoke partitions and smoke barriers.
- 9 2. Partition intersections: Seal edges of face layer of gypsum
10 board abutting intersecting partitions, before taping and
11 finishing or application of joint reinforcing.
- 12 3. Openings: Apply a 1/4 inch bead of sealant around all cut-
13 outs to seal openings of electrical boxes, ducts, pipes and
14 similar penetrations. To seal electrical boxes, seal sides
15 and backs.
- 16 4. Control Joints: Before control joints are installed, apply
17 sealant in back of control joint to reduce flanking path for
18 sound through control joint.

19 H. Accessories:

- 20 1. General: Use the same fasteners to anchor trim accessory
21 flanges as required to fasten gypsum board to the supports.
- 22 2. Install corner beads on all exterior corners, attached with
23 suitable fasteners spaced 9" o/c on both sides in one (1)
24 length up to stock length. Follow manufacturer's
25 installation instruction for tape-on corner beads.
- 26 3. Install metal trim over face layer of wallboard. Attach with
27 suitable fasteners spaced 9" o/c in one (1) length up to
28 stock length.
- 29 4. Install control joints every 30'.

30 I. Gypsum Board Finish:

- 31 1. General: Apply treatment at gypsum board joints, flanges of
32 trim accessories, penetrations, fastener heads and surface
33 defects. Prefill open joints and rounded or beveled edges
34 using type of compound recommended by gypsum board
35 manufacturer.
- 36 2. Mix compounds in accordance with manufacturer's
37 instructions.
- 38 3. Pre-Filling: All "V" grooves formed by eased edges of
39 wallboard shall be filled flush with taper and all excess
40 compound wiped clean, leaving flat joint ready for taping.
- 41 4. Apply compound to joints and corners in strict accordance
42 with directions of wallboard manufacturer.
- 43 5. Level 1 Finish: Plenum areas above ceilings, attics and
44 other concealed areas.
 - 45 a. Joints: Tape set in joint compound.
 - 46 b. Interior Angles: Tape set in joint compound.
 - 47 c. Surface: Tool marks and ridges acceptable. Surface
48 free of excess joint compound.
- 49 6. Level 4 Finish: All exposed gypsum board surfaces.
 - 50 a. Joints: Tape embedded in joint compound and wiped with
51 a joint knife, leaving a thin coat of compound over
52 tape, then cover with two (2) separate coats of joint
53 compound.
 - 54 b. Interior Angles: Tape embedded in joint compound and
55 wiped with a joint knife, leaving a thin coat of
56 compound over tape, then cover with one (1) separate
57 coat of joint compound.
 - 58 c. Accessories: Cover by three (3) separate coats of
59 joint compound.

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- d. Fasteners: Cover by three (3) separate coats of joint compound.
- e. Surface: Joint compound shall be smooth and free of tool marks and ridges.

3.06 CLEANING

Remove all excess materials, debris, cartons, containers, etc. from premises as work progresses and immediately after completion of work.

* * *

Section 09 24 00 - Portland Cement Plaster**PART 1 - GENERAL****1.01 DESCRIPTION**

Work Included: Patch existing cement plaster damaged as a result of the work of this Project. Include metal lath, trim pieces and all accessories required for a complete and proper installation.

1.02 QUALITY ASSURANCE**A. Standards:**

ASTM C 206 - Standard Specification for Special Finishing Hydrated Lime.

ASTM C 150 - Standard Specification for Portland Cement

B. Use adequate numbers of skilled workers who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and methods needed for proper performance of the work of this Section.**1.03 SUBMITTALS****A. Submit the following:**

1. Materials list of items proposed to be furnished under this Section.
2. Manufacturer's specifications and other data needed to prove compliance with the specified requirements.
3. Samples of proposed accessories.

1.04 PRODUCT DELIVERY, HANDLING AND STORAGE**A. Deliver materials in original packages, containers or bundles bearing name of manufacturer and brand.****B. Keep cementitious materials dry until ready for use.****PART 2 - PRODUCTS****2.01 FURRING AND LATHING MATERIALS****A. Metal lath shall be galvanized diamond mesh type lath expanded from steel weighing 3.4 lbs. per square yard.****D. Accessories shall be as manufactured by:**

1. USG
2. Gold Bond

E. Metal grounds and plaster stops shall be USG #66 or Gold Bond "No. 66", square nose, No. 26 gauge, galvanized expanded flange plain edge casing beads.**F. Control joints shall be made from roll-formed zinc with open slot 1/4" wide x 1/2" deep.**

- USG #50, 75 or 100 as required by plaster thickness

1 - Gold Bond, "No. 40"

2
3 G. Expansion Joints:

4 Double V expansion joints to minimize cracking in large plaster
5 areas with flanges fabricated from expanded metal, zinc for
6 exterior use.

7 - USG, "Double V Expansion Joint"

8 - Gold Bond, "No. 15" Double V Expansion Joint

9
10 **2.02 PLASTER MATERIALS**

11
12 A. Water for mortar shall be clean and free from oil, acid and
13 alkaline, salts or vegetable matter.

14
15 B. Hydrated lime shall be types conforming to ASTM C206 hydrated
16 lime, containing not more than eight (8) percent unhydrated
17 oxides.

18
19 C. Portland Cement: ASTM C 150

20
21 D. Sand shall be free of saline, alkaline, organic or other
22 deleterious materials. ASTM C 35.

23
24
25 **PART 3 - EXECUTION**

26
27 **3.01 INSPECTION**

28
29 A. Inspect areas where cement plaster system is to be installed and
30 report to General Contractor any conditions which may adversely
31 affect installation of suspension system, lath or application of
32 cement plaster. Do not start work until such conditions have
33 been corrected.

34
35 B. Proceeding with work shall indicate acceptance of surfaces.

36
37
38 **3.02 INSTALLATION - FURRING AND LATHING**

39
40 A. Applicable Specifications: Erect furring and lathing work in
41 strict accordance with following specifications, insofar as they
42 apply to this section to same extent as if written out in full.

43 1. Specifications for Metal Lathing and Furring, as published
44 by Metal Lath Association, latest edition.

45
46 B. Install metal lath with long dimensions of sheets across
47 supports secured every 6" along each support with No. 18 gauge
48 galvanized annealed wire.

49 - Lap lath at sides and ends not less than 1". Make end laps
50 of at least 1" over supports. If between, securely lace
51 ends of sheets together. Wire-tie side laps between
52 supports at intervals of not more than 9".

53
54 C. Install plaster stops at all plaster edges and where plaster
55 joins other materials.

56
57 D. Control Joints: Distance between control joints shall not exceed
58 18 feet in either direction or a length-to-width ratio of 2 1/2
59 to 1.
60
61

1 **3.03 MIXING AND APPLICATION - PLASTERING MATERIALS**
2

3 A. Mortar:

4 Portland Cement Plaster (all coats):

5 One (1) part Portland Cement to not less than three (3) or more
6 than five (5) parts sand. Hydrated lime may be added as a
7 plasticizing agent, but the amount used shall not exceed 10
8 percent by weight or 25 percent by volume of the amount of
9 portland cement. If lime putty is added, the amount shall not
10 exceed 25 percent by volume of the portland cement.
11

12 B. Plaster Thickness: To match areas being patched.
13

14 C. Plastering:

15 1. Scratch Coat:

16 Apply scratch coat to metal lath with sufficient material
17 and pressure so that it is shoved through the lath to embed
18 the lath completely. Before scratch coat hardens, evenly
19 scratch to provide good mechanical key for the second
20 (brown) coat.
21

22 2. Brown Coat:

23 Apply no sooner than 48 hours after application of scratch
24 coat. Dampen scratch coat evenly to obtain uniform
25 suction. Apply brown coat to thickness of 3/8" and bring
26 to a true, even surface by floating or rodding and leave
27 rough, ready to receive finish coat. Use grounds to obtain
28 uniform thickness. Moist cure for 48 hours after
29 application and allow to dry.

30 3. Finish Coat:

31 Lay out work to complete an entire wall surface in one
32 operation. Apply finish coat no sooner than 7 days after
33 application of the brown coat. Before applying the finish
34 coat, dampen the brown coat evenly to obtain uniform
35 suction. The thickness of the finish coat shall be
36 sufficient to secure the texture required, but in no case
37 less than 1/8". If a smooth troweled finish is specified,
38 use a float for preliminary finishing and use a steel
39 trowel only to force the sand particles down into the
40 plaster for final compaction. Avoid excessive troweling.
41 Delay troweling as long as possible to avoid drawing excess
42 fines to the surface.

43 4. Curing:

44 Each coat of portland cement plaster shall be kept damp for
45 at least 48 hours after application. Moistening of each
46 coat shall begin as soon as the plaster has hardened
47 sufficiently so as not to be injured.
48

49 **3.04 PROTECTION**

50 Protect work of other trades against damage and soiling. Repair or
51 replace any work so damaged or soiled at no additional cost to Owner.
52

53 **3.05 CLEANING AND PATCHING**
54

55 A. Wipe accessories clean after application of each coat.
56

57 B. Upon completion of work in a space, remove rubbish, debris,
58 scaffold and tools and leave space broom clean.
59

60 C. Plaster containing cracks, blisters, pits, checks, or

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discoloration will not be acceptable.

D. Patching of defective work will be permitted only when approved.

E. In addition to any other requirements for cleaning, immediately upon completion of this portion of the Work, visually inspect adjacent surfaces and remove all traces of spilled and splashed plaster.

* * *

Section 09 30 00 - Tiling**PART 1 - GENERAL****1.01 DESCRIPTION**

- A. Work Included:
Labor and materials required to furnish and install tile work.
- B. Related Work Specified Elsewhere:
1. Drywall Construction - Section 09 21 16

1.02 QUALITY ASSURANCE

- A. U.S. Department of Commerce SPR-R61-61 - Simplified Practice Recommendations
- B. ANSI 137.1 - Recommended Standard Specifications for Ceramic Tile
- C. ANSI 118.1 - Specifications for Dry Set Portland Cement Mortar
- D. The following specifications published by the Tile Council of North America, Inc. are hereby made a part of this specification and have the same force as though written herein in full, except where they may be herein modified.
1. American National Standard Specifications for Installation of Ceramic Tile with Water-Resistant Organic Adhesives A108.4.
 2. American National Standard Specifications for Installation of Ceramic Tile with Dry-Set Portland Cement Mortar or Latex Portland Cement Mortar 108.5.
 3. Handbook for Ceramic Tile Installation.
- E. Single Source Responsibility: Provide setting material and grout systems from a single manufacturer with a warranty beyond contractor's warranty.

1.03 SUBMITTALS

- A. Submit the following:
1. Materials list of items proposed to be provided under this Section.
 2. Manufacturer's specifications and other data needed to prove compliance with the specified requirements.
 3. Samples of each type, class and color of tile required.
- B. Furnish master grade certificate stating grade, kind of tile, identification marks on tile packages, name and location of Project signed by manufacturer and Tile Contractor. Deliver containers to site with seals unbroken.

1.04 EXTRA STOCK

Deliver to the Owner for use in future modification, an extra stock of approximately five percent (5%) of each color and pattern for each material installed under this Section, packaging each type of material separately, distinctly marked, and adequately protected

1 against deterioration.
2

3 **1.05 MANUFACTURER WARRANTY:**
4

5 Manufacturer shall warrant complete tile installation system to be
6 free from defects in materials and workmanship for a period of ten
7 (10) years from date of final completion of Project.
8

9 **PART 2 - PRODUCTS**
10

11 **2.01 MATERIALS**
12

- 13 A. Tile quality shall be in accordance with American National
14 Standard Specifications for Ceramic Tile (ANSI 137.1).
15
16 B. Color and Pattern:
17 Size, color and pattern of tile shall be as called for in the
18 Color and Material Schedule.
19
20 C. Factory Blending: For tile exhibiting color variations, blend
21 tile in the factory and package so tile taken from one package
22 shows the same range of colors as those taken from other
23 packages.
24
25 D. Ceramic Tile:
26 Dust-pressed, impervious, unglazed, cushion edged, porcelain
27 type.
28
29 E. Architectural Paver Tile Base:
30 Porcelain Paver Tile Base consisting of inorganic stains blended
31 into a precise mix of porcelain raw materials that are pressed
32 and fired at 2200 degrees F to achieve an impervious product
33 with water absorption of less than 1/2% per ASTM C373. Product
34 shall be evenly colored throughout the tile. See Color and
35 Material Schedule for manufacturer and colors.
36
37 F. Provide all corners, angles, etc., required for a complete and
38 proper installation
39
40 G. Thin-Setting Mortar: For interior application not affected by
41 freeze and thaw, provide Dry-set Portland Cement Mortar,
42 conforming to ANSI 118.1.
43 - Tec Specialty Construction, "Full Set"
44 - Mapei, "KeraBond"
45 - Custom, "Thin-Set"
46 - Mapei, "Kerabond"
47
48 H. Polymer modified dry set mortar system for installation of large
49 format tiles on walls and floors, use a non slip non slump
50 medium set mortar Exceeding ANSI 118.4 and ANSI 118.11.
51 - Tec Specialty Construction, "3N1 Performance Mortar"
52 - Mapei, "Keralastic" admixture and "Kerabond"
53 - Custom Building Products, "Megaflex"
54 - Laticrete "255 MultiMax"
55
56 I. Adhesive: Water resistant organic adhesive Exceeding ANSI 136.1,
57 Type I and II. (Water based, low VOC (Maximum 44 grams/liter).
58 - Tec Specialty Construction, "Double Duty"
59 - Mapei Ultra Mastic ECO
60 - Custom OmniGrip

1 - Laticrete laticrete15
 2 Primers and solvents as recommended by manufacturer of adhesive.

3
 4 J. Grout:

- 5 1. Portland Cement Grout:
 6 For general use with floor tile set with Portland Cement
 7 Mortar.
 8 Stain resistant, Exceeding ANSI 118.7.
 9 - Tec Specialty Construction, "AccuColor XT "
 10 - Laticrete, "500 Series"
 11 - Mapei, "Keracolor Floor"
 12 - Custom "Polyblend"
 13 2. Wall Tile: Use self-curing, Portland Cement grout,
 14 non-shrinking, stain resistant, odorless, and non-toxic,
 15 fungus and bacterial growth inhibiting. Stain Resistant,
 16 exceeding ANSI 118.3.
 17 - Tec Specialty Construction, "AccuColor XT"
 18 - Mapei, "Keracolor Floor"
 19 - Laticrete, "500 Series"
 20 - Custom "Polyblend"
 21 3. All Grout colors as selected by Architect. See Color and
 22 Material Schedule.
 23
 24

25 **PART 3 - EXECUTION**

26
 27 **3.01 INSPECTION**

28
 29 Examine areas and conditions under which work of this Section will be
 30 performed. Report to General Contractor any conditions which may
 31 adversely affect tile installation or performance. Do not start
 32 installation until such conditions have been corrected. Installation
 33 of tile work shall indicate acceptance of substrate and acceptance of
 34 responsibility for finished results.
 35
 36

37 **3.02 PREPARATION**

38
 39 Surfaces that are to receive thin-setting beds must be dry, clean,
 40 true, firm and proper for bond.
 41
 42

43 **3.03 INSTALLATION**

- 44
 45 A. Comply with ANSI A108.1, ANSI 108.2 and the "Handbook for
 46 Ceramic Tile Installation" of the Tile Council of North America,
 47 latest edition, except as otherwise directed by Architect or
 48 specified herein.
 49
 50 B. Maintain minimum temperature limits and installation practices
 51 recommended by materials manufacturers.
 52
 53 C. Type of Setting Bed:
 54 1. Use setting bed recommended for substrate by Tile Council
 55 of North America Handbook, latest edition. Set tile in
 56 strict accordance with applicable TCNA Specifications.
 57 2. Ceramic Tile Base Set Directly on new Concrete Block: TCNA
 58 W202.
 59 3. Wall Tile Base on Coated Glass Mat Backer Board: Set with
 60 dry-set mortar or organic adhesive at Contractor's option

- 1 in accordance with TCNA W245.
- 2 4. Porcelain Paver Tile: Set with polymer modified dry-set
- 3 mortar in accordance with TCNA F113.
- 4
- 5 D. Layout: Take measurements as necessary to obtain full
- 6 information as to building conditions.
- 7 1. No tiles less than one-half (1/2) full size will be
- 8 permitted.
- 9
- 10 E. Fitting: Fit neatly to walls.
- 11 1. Grind edges of tiles against trim, built-in fixtures,
- 12 partitions, walls, permanent fittings and similar work.
- 13 2. Cut, drill, grind and fit tiles as required by other
- 14 Contractors for installing their work.
- 15
- 16 F. Damaged Tile: Cracked, broken or chipped tiles will not be
- 17 acceptable.
- 18 - Replace damaged tile.
- 19
- 20

21 **3.04 PROTECTION AND CLEANING**

- 22
- 23 A. After grout has sufficiently set or hardened, thoroughly clean
- 24 tile in an approved manner. Remove all traces of cement and dust
- 25 accumulations. Do not use acid solutions for cleaning glazed
- 26 tile.
- 27
- 28 B. Give tile work one (1) thorough final cleaning when so
- 29 instructed by General Contractor.
- 30
- 31 C. Cleaning: Upon completion of various work, remove all unused
- 32 materials, rubbish, etc. that have accumulated as a result of
- 33 tile work.
- 34

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36

Section 09 51 00 - Acoustical Ceilings**PART 1 - GENERAL****1.01 DESCRIPTION**

- A. Work Included:
Furnish and install acoustical ceilings including grid, lay-in panels and all components required for a complete and proper installation.
- B. Related Work Specified Elsewhere:
1. Section 05 20 00 - Steel Joists
 2. Section 09 21 16 - Gypsum Board Assemblies
 3. Section 09 84 00 - Acoustical Wall Panels

1.02 QUALITY ASSURANCE

- A. Use adequate numbers of skilled workers who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.
- B. Specifications
1. ASTM C 635 - Standard Specification for the Manufacture, Performance and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings.
 2. ASTM C 636 - Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels.
 3. ASTM E 1264 - Standard Classification for Acoustical Ceiling Products.
- C. Comply with the following standards:
1. CISCA "Acoustical Ceilings: Use and Practice."
 2. CISCA "Ceiling Systems Handbook."

1.03 SUBMITTALS

- A. Submit the following:
1. Materials list of items proposed to be provided under this Section.
 2. Manufacturer's specifications and other data needed to prove compliance with the specified requirements.
 3. Shop Drawings in sufficient detail to show suspension, layout, lateral restraint, installation, anchorage and interface of the work of this Section with the work of adjacent trades.
 4. Submit samples of each type of ceiling panel specified for Architect approval.

1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Receive and store materials in a protected, dry shelter until used.
- B. Deliver materials to job in manufacturer's original packages with seals unbroken and with manufacturer's name and contents

legibly marked thereon.

1.05 ENVIRONMENTAL CONDITIONS

A. Environmental Conditions:

Install acoustical ceiling systems only when temperature and humidity conditions closely approximate interior conditions to exist when building is occupied. Maintain this condition prior to, during, and after installation.

B. Prior to installation, the following conditions must exist:

1. Work of all wet trades completed and thoroughly dried.
2. Mechanical and Electrical trades shall have completed their work above ceiling line prior to acoustical ceiling systems installation. Coordinate with Mechanical and Electrical trades prior to start of installation.

1.06 EXTRA STOCK

Deliver to Owner for use in future modifications, an extra stock of approximately five percent (5%) of each type of acoustical material installed, packaging each type of material separately, distinctly marked and adequately protected against deterioration.

1.07 WARRANTY

Acoustical ceiling panels shall be warranted by manufacturer to be free from defects in materials and workmanship for a period of ten (10) years from date of final completion of Project.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Suspension System:

1. Design, fabrication and installation of acoustical suspension systems shall conform to Specifications for Acoustical Tile and Lay-In Panel Ceiling Suspension Systems, latest edition, as published by Acoustical Materials Association, National Acoustical Contractor's Association and Suspended Ceiling Manufacturers' Association.
2. Carrying Channels: Minimum 1-1/2" .442 lb. cold-rolled steel, as required around duct or pipe work.
3. Hanger Wires: Galvanized, soft annealed, no less than 12 gauge for suspension systems and no less than No. 8 gauge for carrying channels. Use Monel metal for hanger wires in high humidity areas.
4. Suspension System: Intermediate or heavy-duty type as required by ceiling loads due to light fixtures and air diffusers.

- 1 5. Attachment Devices: Size anchors and intermediate support
2 members for 5 times design load indicated in ASTM C 635,
3 Table I. Wire for hangers of size and type to suit intended
4 application, complying with ASTM C 641, Class 1 zinc
5 coating, not less than 12 gauge.
6
7 a. Angle Hangers: ASTM A 446 steel with G90 coating.
8 b. Flat Hangers: Zinc-coated steel.
9 c. Hanger Rods: Zinc-coated steel.
10 d. Concrete Anchors: Corrosion-resistant design; tested
11 pursuant to ASTM E 488.

- 12
13 B. Exposed Grid System:
14 1-1/2" deep x 15/16" face main tees suspended from structure and
15 1" x 15/16" cross tees locked into main tees. Tees of 26 gauge,
16 electrogalvanized, sheet steel, enamel finish, color as selected
17 by Architect. See Color and Material Schedule. Provide matching
18 steel angles at perimeter.
19 - Armstrong
20 - Chicago Metallic
21 - USG Donn
22 - approved equal
23

- 24 C. Lay-in panels:
25 1. Mineral fiber panels and fiberglass panels with
26 acoustically transparent membrane..
27 2. See Color and Material Schedule for manufacturer, panel
28 size, pattern, edge treatment and color.
29 3. Approved Manufacturers:
30 Manufacturer listed in Color and Material Schedule is
31 intended to establish a standard of quality, color and
32 pattern. Products by the following manufacturers which meet
33 the standards of quality, color and pattern and other
34 characteristics of the product specified are also approved
35 subject to Architect review.
36 - Armstrong
37 - CertainTeed
38 - USG
39

- 40 D. Provide other materials, not specifically described, but
41 required for a complete and proper installation.
42
43

44 **PART 3 - EXECUTION**

45 **3.01 INSPECTION**

46 Determine acceptability of substrates and conditions under which
47 acoustical ceiling systems are to be installed. Report unacceptable
48 substrates to General Contractor. Do not proceed until unacceptable
49 conditions have been corrected. Commencement of installation
50 constitutes Installer's acceptance of substrates and conditions and
51 acceptance of responsibility for finished acoustical ceiling
52 installation.
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3.02 INSTALLATION

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- 4 A. General:
 - 5 1. Consult and cooperate with trades whose work precedes and
 - 6 follows to permit orderly and expeditious procedure in
 - 7 executing work in this section.
 - 8 2. Install work according to manufacturer's recommendations
 - 9 and specifications.
- 10 B. Provide scaffolding and staging required for erection of work
- 11 under this section.
- 12
- 13 C. Work in cooperation with Electrical Contractor where fixtures
- 14 are recessed in ceiling.
- 15
- 16 D. Install acoustical ceiling systems in accordance with
- 17 manufacturer's recommendations and ASTM C636 to produce finished
- 18 ceiling true to lines and levels and free from warped, soiled or
- 19 damaged grid or acoustical ceiling units.
- 20
- 21 E. Lay out work from various openings as well as from center of
- 22 panels.
 - 23 1. Scribe units to vertical walls, columns, etc.
 - 24 2. All lines shall be true and straight, and completed
 - 25 ceilings shall be on a level plane.
- 26
- 27 F. Main runners directly suspended by minimum 12 gage galvanized
- 28 steel wire; hanger wire wrapped tightly a minimum three full
- 29 turns.
- 30
- 31 G. Main runners interconnected by cross-tees to form modules as
- 32 shown on reflected ceiling plans. Suitable cross-tee lengths
- 33 adjacent to recessed light fixtures on each side not supported
- 34 by a main runner.
- 35
- 36 H. Install ceiling systems in a manner capable of supporting
- 37 superimposed loads, with maximum permissible deflection of 1/360
- 38 of span and maximum surface deviation of 1/8" in 10 feet.
- 39
- 40 I. Hang independently of walls, columns, ducts, pipes and conduit.
- 41 Where carrying members are spliced, avoid visible displacement
- 42 of longitudinal axis or face plane of adjacent members.
- 43
- 44 J. Install edge moldings at intersection of ceiling and vertical
- 45 surfaces, using maximum lengths, straight, true to line and
- 46 level. Miter corners. Provide edge moldings at junctions with
- 47 other ceiling finishes. Provide trim molding around recessed
- 48 light fixture openings.
- 49
- 50 K. Fit acoustic lay-in panels in place, free from damaged edges or
- 51 other defects detrimental to appearance and function. Fit
- 52 border units neatly against abutting surfaces and support on
- 53 wall molding. Scribe and cut panels to fit accurately at
- 54 ceiling edges and penetrations. Field recess units with tegular
- 55 or reveal edge at border or ceiling edge.
- 56
- 57 L. Where exposed to view, smooth the cut edges of ceiling panels
- 58 and paint to match panel face. Raw, cut edge of mineral fiber
- 59 board exposed to view is not permitted.
- 60
- 61

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M. Install hold-down clips on lay-in panels to hold such panels tight to grid system where within 20 feet of exterior door and as recommended by suspension system manufacturer.

3.03 CLEANING

- A. As work progresses, and as directed, remove all rubbish, dirt, debris, unused materials, empty cartons, etc. from building and site.
- B. Leave completed rooms broom-clean.
- C. Upon completion, clean acoustical work in a manner and with materials as directed by manufacturer of product.

* * *

Section 09 65 00 - Resilient Base**PART 1 - GENERAL****1.01 DESCRIPTION**

- A. Work Included: Furnish and install resilient base.
- B. Related Work Specified Elsewhere:
1. Section 04 20 00 - Unit Masonry
 2. Section 09 21 16 - Gypsum Board Assemblies

1.02 QUALITY ASSURANCE

- A. Standards: Products shall meet the following requirements:
1. Vinyl Base: ASTM F-1861, Type TV, Group 1 (solid).

1.03 SUBMITTALS

- A. Submit the following:
1. Materials list of items proposed to be provided under this Section.
 2. Manufacturer's specifications and other data needed to prove compliance with the specified requirements.
 3. Samples of each scheduled item, color and pattern for Architect approval.

1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

Deliver materials to job in manufacturer's original, unopened containers with manufacturer's name and brand indicated.

1.05 JOB CONDITIONS

- A. Maintain 70 degrees F. or over at least 48 hours prior to installation, during installation and 48 hours after installation. Maintain a minimum temperature of 55 degrees F. thereafter.
- B. Provide adequate light levels to install materials and as required to inspect work.

1.06 EXTRA STOCK

Deliver to the Owner for use in future modification, an extra stock of approximately five percent (5%) of each color and pattern for each material installed under this Section, packaging each type of material separately, distinctly marked, and adequately protected against deterioration.

1 **PART 2 - PRODUCTS**

2
3 **2.01 MATERIALS**

- 4
5 A. General: Only first quality products of make and type specified
6 shall be furnished.
7 1. Products other than those listed below may be bid only if
8 approved in writing by Architect prior to bid date.
9 2. Color selections are indicated in Color and Material
10 Schedule. Colors must be equal to those scheduled.
11
12 B. Vinyl Base:
13 6" high by 1/8" thick molded vinyl base, conforming to ASTM F-
14 1861, Type TV, Group 1 (solid) Color as scheduled.
15 As manufactured by:
16 - Roppe
17 - VPI
18 - Johnsonite
19 - Flexco
20
21 C. Adhesive: VOC compliant adhesive as recommended by flooring
22 manufacturer.
23
24

25 **PART 3 - EXECUTION**

26
27 **3.01 INSPECTION**

- 28
29 A. Inspect substrate prior to installation and notify General
30 Contractor of any conditions in substrate which may adversely
31 affect installation, performance or appearance of resilient
32 base. Do not start installation until such conditions have been
33 corrected. Start of installation shall indicate acceptance of
34 substrate and acceptance of responsibility for finished
35 resilient base installation.
36
37 B. In renovation or remodel work, inspect substrate and confirm
38 that existing adhesive residue has been removed so that 100% of
39 the overall area of the original substrate is exposed.
40

41 **3.02 PREPARATION**

- 42
43 A. Substrates must be dry, clean, smooth and free from paint,
44 varnish, wax, oils, solvents and other foreign matter.
45
46 B. Allow all resilient base and adhesives to condition to the room
47 temperature a minimum of 48 hours before starting the
48 installation.
49
50 C. The area to receive resilient base shall be maintained at a
51 minimum of 65°F and a maximum of 100°F for 48 hours before,
52 during and for 48 hours after completion.
53
54 D. Surfaces shall be clean, free from moisture, oil and grease.
55
56
57

1 **3.03 INSTALLATION**

2
3 A. Base:

- 4 1. Apply resilient wall base to walls, columns, pilasters,
5 casework and cabinets in toe spaces, and other permanent
6 fixtures in rooms and areas where base is required.
7 2. Install wall base in lengths as long as practicable without
8 gaps at seams and with tops of adjacent pieces aligned.
9 3. Tightly adhere wall base to substrate throughout length of
10 each piece, with base in continuous contact with horizontal
11 and vertical substrates.
12 4. Do not stretch base during installation.
13 5. On masonry surfaces or other similar irregular substrates,
14 fill voids along top edge of resilient wall base with
15 manufacturer's recommended adhesive filler material.
16

17
18 **3.04 ADJUSTMENT AND CLEANING**

19
20 A. Adjustments: Inspect resilient base work and make necessary
21 adjustments.
22

- 23 B. Clean resilient base in accordance with manufacturer's
24 instructions prior to owner's acceptance.
25 1. Remove visible adhesive and other surface blemishes using
26 cleaning methods recommended by manufacturer.
27 2. Remove marks and soil.
28

29
30 * * *
31

Section 09 68 13 - Carpet Tile**PART 1 - GENERAL****1.01 DESCRIPTION**

- A. Work Included: Furnish and install carpet tile including all accessories and components required for a complete and proper installation.
- B. Related Work Specified Elsewhere:
- Section 09 69 00 - Access Floor System

1.02 SUBMITTALS

- A. Furnish to Owner for approval, samples of all materials specified before proceeding with all work.
- B. Furnish eight (8) copies of approved testing laboratories report stating that carpet passes Flooring Radiant Panel Test (ASTM E-648) with a Critical Radiant Flux of .22 watts/cm² or greater.

1.03 GUARANTEE

All work in this section shall be guaranteed to be free from defects in materials and workmanship for a period of one (1) year from date of final completion of project.

1.04 MAINTENANCE INSTRUCTIONS

Prepare and present Owner with suitable maintenance manual.

1.05 ADDITIONAL MATERIALS

Provide and deliver to owner five (5) percent overrun of each carpet pattern and color for future repairs.

PART 2 - PRODUCTS**2.01 MATERIALS**

- A. Carpet: See Color and Material Schedule for manufacturer, pattern and color.
- B. Additional Materials: Provide and deliver to Owner five (5) percent overrun of each carpet pattern for future repairs.
- C. Adhesive: VOC compliant release adhesive as approved by carpet tile manufacturer.
- D. Edge Moldings and Transition Strips:
100% homopolymer vinyl moldings, transition strips and reducers of types and sizes as required. Colors as selected by Architect from manufacturer's standard colors.
- Johnsonite
- Mercer Products Company, Inc.

- Roppe Corporation

PART 3 - EXECUTION

3.01 INSPECTION

- A. Contractor shall carefully check all physical dimensions and other conditions in the field and shall be responsible for proper fitting of carpet in all areas.
- B. Installation shall be delayed until all surrounding work has been completed.

3.02 PREPARATION

- A. Sub-floor must be firm, smooth, clean and free from floor adhesives and other foreign materials.
- B. Coordinate installation requirements with access floor manufacturer when installed on access flooring.

3.03 INSTALLATION

- A. The following are general installation procedures. Carpet. Follow carpet tile and access floor manufacturers' recommendations for installation on access flooring.
 - 1. Fully spread pressure sensitive adhesive following adhesive and carpet tile manufacturer's recommendations for installation on access floor. Proceed with tile placement.
 - 2. Install carpet, butting edges together evenly, being careful not to compress modules (this can cause peaked edges). Tiles shall be offset so as not to coincide with the joints in the floor panels. Arrows are embossed or printed on the module backing to show pile direction. Unless instructions are stated for quarter turn installation, lay tile with the arrows in the same direction. To ensure proper alignment, check spacing every ten modules. Measure ten 18-inch modules for a total of 180 inches; proper spacing should be within 1/4 inch. Continue to check spacing every ten modules throughout the entire installation.
 - 3. Install edge molding at door openings.

3.04 ADJUSTMENTS AND CLEANING

- A. On completion of work, remove from site all cuttings, clippings, wrappings, cartons, etc. and leave premises clean and in a neat manner.
- B. Vacuum and clean entire carpeted area as recommended by manufacturer before final acceptance.

* * *

Section 09 69 00 - Access Floor System**PART 1 - GENERAL****1.01 DESCRIPTION****A. Work Included:**

1. Work of this section includes, but is not limited to:
 - a. Removal and reinstallation of existing access flooring on pedestals at 8" height
 - b. Provide new access flooring system installed to align with existing access floor system.

B. Related Work Specified Elsewhere

1. Section 09 68 13 - Carpet Tile
2. Division 26 - Electrical.

1.02 QUALITY ASSURANCE

A. Use adequate numbers of skilled workers who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of this Section.

B. Approved Manufacturers:

In order to establish a standard of quality, this specification is based on concrete filled steel access floor system as manufactured by:

- Tate Access Floors, Inc. "ConCore 1250" with "PosiLock Understructure".

Equal products by the following manufacturers which meet the requirements of this specification are also approved.

- ASM Modular Systems,
- Camino Modular Systems, Inc.
- approved equal

1.03 PERFORMANCE REQUIREMENTS

A. Design Load: Panel supported on actual understructure (the system) shall be capable of supporting a safe working load or design load of 1250 lbs. This rating signifies that the system will withstand not only a concentrated load placed on a one square inch area at any location on the panel without yielding, but also demonstrate the ability to withstand an overload capacity of two times its rating (i.e. a safety factor of 2).

B. Safety Factor: Panel supported on actual understructure (the system) shall be capable of withstanding a minimum of (2) two times the design load anywhere on the panel without failure. Failure is defined as the point at which the system will no longer accept the load.

C. Uniform Load: Panel supported on actual understructure (the system) shall be capable of supporting a uniform load of 400 lbs./ft² placed on the entire area of the panel without yielding and generating a permanent set of no more than 0.100" once the load is removed.

- 1
2 D. Rolling Load: Panel supported on actual understructure (the
3 system) shall be able to withstand the following rolling loads
4 at any location on the panel without developing a local and
5 overall surface deformation greater than 0.040 inches. Note:
6 wheel 1 and wheel 2 tests shall be performed on two separate
7 panels.
8
- | | | |
|----|---------------------------------------|-----------------|
| 9 | Wheel 1: Size: 3" dia x 1 13/16" wide | Load: 1000 lbs. |
| 10 | Passes: 10 | |
| 11 | Wheel 2: Size: 6" dia x 2" wide | Load: 800 lbs. |
| 12 | Passes: 10,000 | |
- 13
14 E. Impact Load: Panel supported on actual understructure (the
15 system) shall be capable of supporting an impact load of 150
16 lbs. dropped from a height of 36 inches onto a one square inch
17 area (using a round or square indenter) at any location on the
18 panel.
19
- 20 F. Panel Drop Test: Panel shall be capable of being dropped face
21 up onto to a concrete slab from a height of 36", after which it
22 shall continue to meet all load performance requirements as
23 previously defined.
24
- 25 G. Panel Cutout: Panel with an 8" diameter interior cutout
26 supported on actual understructure shall be capable of
27 maintaining its design load strength anywhere on the panel
28 without the use of additional supports.
29
- 30 H. Flammability: System shall meet Class A Flame spread requirements
31 for flame spread and smoke development. Tests shall be performed in
32 accordance with ASTM-E84-1998, Standard Test Method for Surface
33 Burning Characteristics for Building Materials.
34
- 35 I. Combustibility: All components of the access floor system shall
36 qualify as noncombustible by demonstrating compliance with
37 requirements of ASTM E 136, Standard Test Method for Behavior of
38 Materials in a Vertical Tube Furnace at 750 deg C.
39
- 40 J. Axial Load: Pedestal support assembly shall provide a minimum
41 5000 lb. axial load without permanent deformation.
42
- 43 K. Overturning Moment: Pedestal support assembly shall provide an
44 average overturning moment of 1000 in-lbs. when glued to a
45 clean, sound, uncoated concrete surface. ICBO number for the
46 specific system or structural calculations shall be required
47 attesting to the lateral stability of the system under seismic
48 conditions.
49

50 1.04 DESIGN REQUIREMENTS:

- 51
52 A. Access floor system shall consist of modular and removable fully
53 encased cementitious filled welded steel panels fastened onto,
54 and supported by, adjustable height pedestal assemblies.
55 Pedestal head and panel corner design must provide a positive
56 location and lateral engagement of the panel to the
57 understructure support system without the use of fasteners.
58
- 59 B. Panel shall be easily removed by one person with a suction cup
60 lifting device and shall be interchangeable except where cut for

1 special conditions.

- 2
3 C. Quantities, finished floor heights (FFH) and location of
4 accessories shall be as specified on the contract drawings.

5
6
7 **1.05 SUBMITTALS**

8 A. Submit the following:

- 9
10 1. Detail sheets, for each proposed product type, which
11 provide the necessary information to describe the product
12 and its performance.
13 2. Test reports, certified by an independent testing
14 laboratory with a minimum of five years experience testing
15 access floor components in accordance CISCA Recommended
16 Test Procedures, certifying that component parts perform as
17 specified.
18

19
20 **PART 2 - PRODUCTS**

21
22 **2.01 SUPPORT COMPONENTS**

23
24 A. Pedestals:

- 25 1. Pedestal assemblies shall be corrosive resistant, all steel
26 welded construction, and shall provide an adjustment range
27 of +/- 1" for finished floor heights 6" or greater.
28 2. Pedestal assemblies shall provide a means of leveling and
29 locking the assembly at a selected height, which requires
30 deliberate action to change height setting and prevents
31 vibration displacement.
32 3. Pedestal head shall be designed with locating tabs and
33 integral shape to interface with the panel for positive
34 lateral retention and positioning without fasteners.
35 4. Hot dip galvanized steel pedestal head shall be welded to a
36 threaded rod which includes a specially designed adjusting
37 nut. The nut shall provide location lugs to engage the
38 pedestal base assembly, such that deliberate action is
39 required to change the height setting.
40 5. Threaded rod shall provide a specially designed anti-
41 rotation device, such that when the head assembly is
42 engaged in the base assembly, the head cannot freely
43 rotate.
44 6. Hot dip galvanized pedestal base assembly shall consist of
45 a formed steel plate with no less than 16 inches of bearing
46 area, welded to a 7/8" square steel tube and shall be
47 designed to engage the head assembly.
48

49 **2.02 PANEL COMPONENTS**

50
51 A. Floor Panels:

- 52 1. Panels shall consist of a top steel sheet welded to a
53 formed steel bottom pan filled internally with a
54 lightweight cementitious material.
55 2. Cementitious fill material shall be totally encased within
56 the steel welded shell except where cut for special
57 conditions.
58 3. Panel shall have an electrically conductive epoxy paint
59 finish.
60

- 1 4. Corner of panel shall have a locating tab and integral
- 2 shape design to interface with the pedestal head for
- 3 positive lateral retention and positioning with or without
- 4 fasteners.
- 5 5. Fastening of panels to pedestal heads shall be accomplished
- 6 by the use of a machine screw which is specially designed
- 7 to be self capturing within the body of the panel.
- 8 6. Top surface of the panel shall have four positioning
- 9 location holes to engage positioning buttons on the
- 10 manufacturer's carpet tile for precise matching of the
- 11 carpet tile to the panel.
- 12 7. Fit between the pedestal head, panel, and screw shall
- 13 enable an installation with an average panel to panel gap
- 14 of 0.015".

15
16 **2.03 ACCESSORIES**

- 17
- 18 A. Provide UL listed Power, Voice & Data service centers.
- 19 Coordinate locations with Architect if boxes are not shown on
- 20 drawings. Standard capacity 7-5/16 by 6-15/16 inch PVD service
- 21 centers shall be capable of accommodating two duplex receptacles
- 22 and two voice/data interface plates or grommets interface
- 23 plates. The service outlet box shall be a drop-in design having
- 24 a hinged polycarbonate lid with carpet insert and polycarbonate
- 25 frame with tapered edge. Service outlet box lid shall be capable
- 26 of withstanding without failure a load of 800 lb.
- 27
- 28 B. Provide manufacturer's standard steps, ramps, fascia plate,
- 29 perimeter support, and grommets where indicated on the contract
- 30 drawings.
- 31
- 32 C. Provide two spare floor panels for maintenance stock. Deliver
- 33 to project in manufacturer's standard packaging clearly marked
- 34 with the contents.
- 35
- 36 D. Provide two (2) panel lifting devices.
- 37

38 **2.04 FINISHES**

39

40 Carpet tile: Access floor system shall be designed to accommodate

41 modular carpet tile.

42

43

44 **PART 3 - EXECUTION**

45

46 **3.01 PREPARATION**

- 47
- 48 A. Examine structural subfloor for unevenness, irregularities and
- 49 dampness that would affect the quality and execution of the
- 50 work. Do not proceed with installation until structural floor
- 51 surfaces are level, clean, and dry as completed by others.
- 52
- 53 B. Concrete sealers and adhesive residues shall be identified and
- 54 proven to be compatible with pedestal adhesive. Verify that
- 55 adhesive achieves bond to slab before commencing work.
- 56
- 57 C. Verify dimensions on contract drawings, including level of
- 58 interfaces including abutting floor, ledges and doorsills.
- 59
- 60

3.02 INSTALLATION

- 1
2
3 A. Pedestal locations shall be established from approved shop
4 drawings so that mechanical and electrical work can be installed
5 without interfering with pedestal installation.
6
7 B. Installation of access floor shall be coordinated with other
8 trades to maintain the integrity of the installed system. All
9 traffic on access floor shall be controlled by access floor
10 installer. No traffic but that of access floor installers shall
11 be permitted on any floor area for 24 hours to allow the
12 pedestal adhesive to set. Access floor panels shall not be
13 removed by other trades for 72 hours after their installation.
14
15 C. Floor system and accessories shall be installed under the
16 supervision of the manufacturer's authorized representative and
17 according to manufacturer's recommendations.
18
19 D. No dust or debris producing operations by other trades shall be
20 allowed in areas where access floor is being installed to ensure
21 proper bonding of pedestals to subfloor.
22
23 E. Access floor installer shall keep the subfloor broom clean as
24 installation progresses.
25
26 F. Partially complete floors shall be braced against shifting to
27 maintain the integrity of the installed system where required.
28
29 G. Additional pedestals as needed shall support panels where floor
30 is disrupted by columns, walls, and perimeter cutouts.
31
32 H. Understructure shall be aligned such that all uncut panels are
33 interchangeable and fit snugly but do not bind when placed in
34 alternate positions.
35
36 I. Finished floor shall be level, not varying more than 0.062" in
37 10 feet or 0.125" overall.
38
39 J. Installed panels shall be straight and square and spaced so that
40 the distance from one end to the other of any line of 12 panels
41 is not less than 24 feet and does not exceed 24'-1/8".
42
43 K. Where new or relocated access flooring abuts existing access
44 flooring, Contractor shall do all cutting, fitting and
45 modification of support pedestal system as required to make a
46 satisfactory joined and aligned finished condition acceptable to
47 Owner and Architect.
48

3.03 ADJUSTMENT, CLEANING AND PROTECTION

- 49
50
51 A. Remove access floor installation debris as work progresses,
52 maintaining area under finished floor in a clean condition.
53
54 B. Vacuum clean the entire system floor area (plenum) beneath
55 system.
56
57 C. Before any equipment is moved across the access floor, protect
58 access floor with 1/2" plywood.
59
60

* * *

Section 09 84 00 - Acoustical Wall Panels**PART 1 - GENERAL****1.01 DESCRIPTION**

Work Included:

Furnish and install fabric wrapped sound absorbing acoustical wall panels.

1.02 QUALITY ASSURANCE

A. Panel components shall meet requirements of ASTM E84, Class 1 (0-25) rating.

B. Use adequate numbers of skilled workers who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and methods needed for proper performance of the work of this Section.

1.03 SUBMITTALS

A. Submit the following:

1. Materials list of items proposed to be provided in this Section.
2. Manufacturer's specifications and other data needed to prove compliance with the specified requirements.
3. 12" x 12" sample panel showing core material, edge and corner details, finish and mounting hardware for Architect approval.

1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver materials in manufacturer's original unopened containers and packaging with labels clearly indicating manufacturer and material.

B. Store materials in dry area, indoors, protected from damage.

1.05 ENVIRONMENTAL CONDITIONS

A. Do not install wall panels until all wet work is completely dry.

B. Install wall panels at air temperature between 60 and 85 degrees F. at maximum relative humidity of 80 percent, in an enclosed building.

1 **PART 2 - PRODUCTS**

2
3 **2.01 ACOUSTICAL WALL PANELS**

- 4
5 A. Approved Manufacturers:
6 - Conwed Designscape, Ladysmith, WI 800.932.2383
7 "Respond ACT"
8 - Armstrong, "Soundsoak", 1-877-276-7876
9 - ESSI Acoustical Products, Cleveland, OH, 216 251-7888
10 - PSI Panel Solutions, Inc. ,Hazleton, PA, 570-459-3490
11
12 B. One piece, 7 pcf, noncombustible and dimensionally stable glass
13 fiber core, 2 inches thick.
14
15 C. Edges: Square, chemically hardened.
16
17 D. Corners: Square
18
19 E. Finish: Custom fabric. See Color and Material Schedule for
20 fabric selection.
21
22 F. Mounting: Mechanical Clips.
23
24 G. NRC: 1.10
25
26

27 **PART 3 - EXECUTION**

28
29 **3.01 INSPECTION**

30
31 Inspect areas on which acoustical wall panels are to be installed and
32 notify General Contractor of any conditions which will adversely
33 affect installation or performance of acoustical wall panels. Do not
34 start installation until such conditions have been corrected.
35
36

37 **3.02 INSTALLATION**

38
39 Install panels in locations noted using mechanical clip fasteners in
40 accordance with manufacturer's installation instructions. Install
41 plumb, level, square and in alignment with adjacent work.
42
43

44 **3.03 CLEANING**

45
46 Clean acoustical wall panel surfaces in accordance with
47 manufacturer's instructions. Repair minor damaged surfaces.
48
49

50 * * *

Section 09 90 00 - Painting**PART 1 - GENERAL****1.01 DESCRIPTION****A. Work Included:**

1. Labor and materials required to complete painting work.
2. Complete painting of all areas of existing building where alterations occur. (See Room Finish Schedule).
4. Furnish tools, ladders, scaffolding and other equipment necessary for completion of work.
5. Examine specifications for various other trades. Become familiar with their provisions regarding their painting. Paint or finish surfaces that are left unfinished by requirements of other sections.

B. Related Work Specified Elsewhere:

1. Unit Masonry - Section 04 20 00
2. Miscellaneous Metals - Section 05 50 00
3. Hollow Metal Doors and Frames - Section 08 11 00
4. Wood Doors - Section 08 14 00
5. Drywall Construction - Section 09 21 16

1.02 QUALITY ASSURANCE

A. Use adequate numbers of skilled workers who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and methods needed for proper performance of the work of this Section.

B. Volatile Organic Compound content of materials shall be compliant with requirements of the governmental agency having jurisdiction.

C. Painting materials shall have identifying labels.

D. Paint Coordination:

1. Provide finish coats which are compatible with the prime coats used.
2. Provide barrier coats over incompatible primers or remove the primer and reprime as required.
3. Notify General Contractor, in writing, of anticipated problems in using the specified coating systems over prime coatings supplied under other sections.

1.03 SUBMITTALS

A. Prior to beginning work, submit to Architect for approval four (4) 8" x 10" color finish samples clearly identified with paint and code from Color and Material Schedule.

1. Revise and resubmit each sample, as requested, until the required gloss, color and texture is achieved. Such samples, when approved, will become standards of color and finish for accepting or rejecting the work of this Section.
2. Architect's stamp of approval will be needed before work proceeds.

B. Immediately after award of Contract, submit brand names and manufacturer's name of each product intended to be used.

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1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Deliver only specified or "approved equal" materials to building, in original containers with seals unbroken. Use materials as they come from container. Do not reduce or intermix unless specifically called for in manufacturer's instructions.
- B. Storage: A space will be designated for storage of paint materials and tools. Protect storage space floor from damage. Keep paints covered at all times.

1.05 JOB CONDITIONS

- A. Temperatures:
 - 1. Exterior: Do not apply paint in damp, rainy weather or when temperature is below 35 degrees F.
 - 2. Interior: Do not apply paint or varnish when temperature is below 60 degrees F. or when satisfactory results cannot be obtained due to high humidity or excessive temperatures.

1.06 EXTRA STOCK

Upon completion of the work of this Section, deliver to the Owner an extra stock equaling 5% of each color, type and gloss of paint used in the Work, tightly sealing each container and clearly labeling with contents and location where used.
Minimum quantity: 1 quart.

1.07 DEFINITIONS

- A. Standard coating terms, as defined in ASTM D16 - Standard Terminology Relating to Paint, Varnish, Lacquer and Related Products, apply to this Section.
- B. Gloss Levels:
 - 1. Flat refers to a lusterless or matte finish with a gloss range below 15 when measured at an 85⁰ meter.
 - 2. Eggshell refers to low-sheen finish with a gloss range between 5 and 20 when measured at a 60⁰ meter.
 - 3. Satin refers to low-sheen finish with a gloss range between 15 and 35 when measured at a 60⁰ meter.
 - 4. Semi-gloss refers to medium-sheen finish with a gloss range between 30 and 65 when measured at a 60⁰ meter.
 - 5. Full gloss refers to high-sheen finish with a gloss range more than 65 when measured at a 60⁰ meter.

1.08 MOCK-UP

Prepare and paint a designated room to the requirements specified herein, using a specified paint or coating in the specified colors, gloss / sheen, textures and workmanship for Architect review and approval. When approved, finished surfaces within room shall become the standard of finish quality and workmanship for similar on-site work.

1 **1.09 GUARANTEE**

- 2
- 3 A. Work and materials in this section shall be guaranteed to be
- 4 free from defects for a period of one (1) year from date of
- 5 final completion of project.
- 6
- 7 B. Any defects, not due to or caused by faulty construction or
- 8 materials furnished or performed by other crafts, but due to
- 9 defective materials and workmanship in painting and finishing,
- 10 shall be repaired and corrected by Painting Contractor without
- 11 cost to Owner.
- 12
- 13

14 **PART 2 - PRODUCTS**

15

16 **2.01 FINISH PRODUCTS**

- 17
- 18 A. Architect Approved Materials: Following manufacturer's materials
- 19 have been approved. Each container shall bear specific brand
- 20 name or number as listed.
- 21
- 22 B. Exterior Enamel (waterborne):
- 23 1. Pratt and Lambert, "Enducryl Acrylic Maintenance Enamel,
- 24 Z/F2900 Series".
- 25 2. ICI, "Devflex 4208 Waterborne Acrylic Gloss Enamel"
- 26 3. PPG, "Pitt Tech Interior/Exterior High Gloss DTM Industrial
- 27 Enamel 90-374"
- 28 4. Sherwin Williams, "Shercryl B66 Series"
- 29 5. Benjamin Moore "Impervex #309 Series"
- 30 6. Hallman/Lindsay, "Duratech" Series 317 Waterbased Acrylic
- 31 7. Diamond Vogel, "Nu-Cling Interior/Exterior Gloss Latex, MH-
- 32 Series"
- 33
- 34 C. Exterior Metal Primer:
- 35 1. Pratt and Lambert, "Tech-Gard Acrylic Metal Primer".
- 36 2. ICI, "Devflex 4020 DTM Flat Waterborne Primer & Finish"
- 37 3. PPG, "#90-712 Pitt Tech Interior/Exterior Direct To Metal
- 38 Primer "
- 39 4. Sherwin Williams, B66W1 DTM Acrylic Primer & Finish"
- 40 5. Benjamin Moore, "Retard-X #162 R.I. Inhibitive Latex
- 41 Primer"
- 42 6. Hallman/Lindsay, "Metal Guard Acrylic Primer", #338
- 43 7. Diamond Vogel, "V-Cote 200 Maintenance Primer/Finish, MC-
- 44 Series"
- 45
- 46 D. Galvanized Metal Primer:
- 47 1. Hentzen, "No. 2110GVP Wash Primer" and "No. 4080
- 48 Zinc-Tite".
- 49 2. Sherwin Williams "Galvite" B50W3
- 50 3. Pittsburgh, "Speed Hide Interior/Exterior Galvanized Steel
- 51 Primer 6-209"
- 52 4. Valspar Bonding Elastomer 13-B-6
- 53 5. Carboline "Carbocrylic 120"
- 54 6. Approved equal
- 55
- 56

- 1 E. Varnish: Waterborne varnish in satin and gloss finish.
 - 2 1. Pratt and Lambert, "Acrylic Latex Varnish"
 - 3 2. ICI, "Woodpride Aquacrylic 1802(Satin)/1808(Gloss) Varnish"
 - 4 3. Benjamin Moore, "Moore's Interior Latex Urethane Acrylic"
 - 5 4. Pittsburgh, "REZ Acrylic Polyurethane 77-49 Satin, 77-45"
 - 6 5. Minwax "Polycrylic" Gloss and Satin"
 - 7 6. Hallman/Lindsay, #V364, "Clearguard Acrylic Urethane Satin"
 - 8 7. Diamond Vogel, Old Masters H2O Acrylic Interior Varnish, Wood Finish and #V466 Gloss."
 - 9 8. Sherwin Williams, "Wood Classics" A68 Series"
- 10 F. Interior Wood Stain: Waterborne
 - 11 1. Pratt and Lambert, "Acrylic Latex Stain"
 - 12 2. ICI, "Woodpride Aquacrylic 1600 Waterborne Wood Stain".
 - 13 3. Benjamin Moore, "Penetrating Stain 241"
 - 14 4. Hallman/Lindsay, "Wood Tone 346 Aqua Tone Waterborne Wood"
 - 15 5. Sherwin-Williams, "Sherwood Water Reducible Wiping Stain"
 - 16 6. S64N500 Series"
- 17 G. Interior Wood Stain: solvent base
 - 18 1. Pratt and Lambert, "Tonetic Wood Stain".
 - 19 2. Pittsburgh, "Rez 77-560 Interior Wood Stain".
 - 20 3. ICI, "Woodpride 1700 Interior Oil Finishing Stain"
 - 21 4. Benjamin Moore, "Benwood Architectural Penetrating Stain".
 - 22 5. Sherwin-Williams, "A-48 Series" Oil Stain.
 - 23 6. Hallman/Lindsay, #345, Colortones Interior Wood Stain"
 - 24 7. Diamond Vogel, "MP Series Old Masters Wiping Stain"
- 25 H. Block Filler:
 - 26 1. Pratt and Lambert, "Primafile 200".
 - 27 2. ICI, "Ultra-Hide 3010 Vinyl Acrylic Block Filler"
 - 28 3. PPG, "Speedhide, #6-7 Latex Block Filler"
 - 29 4. Sherwin Williams, "PrepRite B25W25 Block Filler"
 - 30 5. Benjamin Moore, "#285 Latex Block Filler"
 - 31 6. Hallman/Lindsay, #184 "Block Kote Latex Interior Block"
 - 32 7. Diamond Vogel, #BF-1515, "Dia Pro Block Filler"
- 33 I. Drywall Primer/Sealer:
 - 34 1. U.S. Gypsum "Sheetrock First Coat"
 - 35 2. Gold Bond, "Drywall Primer"
 - 36 3. ICI, "Ultra-Hide 1030 PVA Interior Primer/Sealer"
 - 37 4. PPG, "6-2 Speedhide Primer/Sealer"
 - 38 5. Hallman/Lindsay, #227 "Wall Prep Pro Latex Wall Primer".
 - 39 6. Diamond Vogel, "DU1520 Interior PVA Primer/Surfacer".
 - 40 7. Sherwin-Williams "PrepRite 200"
 - 41 8. Benjamin Moore, "#216 FirstCoat"

52
53

- 1 J. Latex Flat Paint:
- 2 1. Pratt and Lambert, "Vapex".
- 3 2. ICI, "Dulux Ultra-Flat" #1201
- 4 3. Pittsburgh, "9-110 Series Pure Performance 0 VOC Interior
- 5 Flat"
- 6 4. Sherwin Williams, "Superpaint A86 Series Interior Latex
- 7 Flat Finish"
- 8 5. Benjamin Moore, "#215 Regal Wall Satin"
- 9 6. Hallman/Lindsay, "Signature Series Wonder Kote" #260
- 10 Interior Latex Flat Wall Paint
- 11 7. Diamond Vogel, #DF-1530, "DF Series Permacryl Interior Flat
- 12 Enamel".
- 13
- 14 K. Latex Satin Enamel Paint:
- 15 1. Pratt and Lambert, "Accolade Interior Satin Enamel Z/F4700
- 16 Series.
- 17 2. ICI, "Ultra-Hide Latex Low Lustre Interior Wall & Trim
- 18 Enamel 14114-XXXX".
- 19 3. Pittsburgh, "Speed Hide" 6-3511 series Interior Satin
- 20 Acrylic Latex"
- 21 4. Sherwin Williams, "SuperPaint Latex Satin A86 Series"
- 22 6. Diamond Vogel, "Permacryl Interior Satin Latex Enamel DS
- 23 Series"
- 24 7. Hallman/Lindsay, #285, "Lustre Kote Satin" 100% Acrylic
- 25 Interior Wall Paint.
- 26 8. Diamond Vogel, #DS-1530, "DS Series Permacryl Interior
- 27 Satin Latex Enamel"
- 28
- 29 L. Interior Gloss Enamel:
- 30 1. Pratt and Lambert, "Enducryl Acrylic Z/F2900 Series".
- 31 2. ICI, "Devflex 4208 Waterborne Acrylic Gloss Enamel".
- 32 3. Pittsburgh, " Pitt Tech Interior/Exterior High Gloss DTM
- 33 Industrial Enamel 90-374".
- 34 4. Sherwin Williams, "DTM Acrylic Gloss Coating B66 Series"
- 35 5. Benjamin Moore, "Impervex #309 Waterbased Enamel".
- 36 6. Hallman/Lindsay, #317, "Duratech 100% Acrylic Gloss DTM
- 37 Enamel".
- 38 7. Diamond Vogel, MH Series, "Nu-Cling 100% Acrylic Gloss
- 39 Enamel Finish".
- 40
- 41

42 **PART 3 - EXECUTION**

43 **3.01 INSPECTION OF SURFACES**

- 44
- 45
- 46 A. Before starting work, inspect surfaces to be painted or
- 47 decorated and report to General Contractor any conditions which
- 48 will affect application or performance of paint and finish
- 49 systems. Do not start work until such conditions have been
- 50 corrected.
- 51
- 52 B. Commencing of work by Contractor indicates acceptance of
- 53 surfaces.
- 54
- 55
- 56

3.02 PREPARATION OF SURFACES

- 1
2
3 A. All spaces shall be broom clean prior to starting and surfaces
4 to be painted shall be dry.
5
6 B. Before painting, remove dust, dirt, plaster, grease and other
7 extraneous matter which would affect finish work. Foreign matter
8 on surfaces, left by other trades, will be removed by others.
9
10 C. Clean dirty or greasy metal surfaces before applying materials.
11 Remove rust and scale and clean surfaces before painting.
12
13 D. Where shop coats of paint have been marred, clean and touch up
14 with metal primer.
15
16 E. Galvanized Metal:
17 1. Remove oils and wash surfaces.
18 2. Galvanized metal, copper or aluminum specified to be
19 painted: Paint with one of the following prior to
20 application of finish coats:
21 a. one (1) coat Hentzen, "No. 2110GVP Wash Primer"
22 followed by one (1) coat, "No. 4080 Zinc-Tite", as
23 manufactured by Hentzen Coatings, Inc.
24 b. One (1) coat Sherwin Williams "Galvite" B50W3
25 c. One (1) coat Valspar Bonding Elastomer 13-B-6
26 d. One (1) coat Carbolite "Carbocrylic 120"
27 e. Pittsburgh, "Speed Hide Interior/Exterior Galvanized
28 Steel Primer 6-209"
29 f. Approved equal
30
31 F. Wood Surfaces(site finished): Do not consider as ready for
32 finishing as received. Before applying any finish, thoroughly
33 block-sand or belt-sand exposed faces with 100 to 150 grit
34 sandpaper in order to remove scuffs, scratches, burnishes,
35 raised grain, handling marks and effects of exposure to
36 moisture.
37
38 G. Sand woodwork and metal doors, frames and trim between coats.
39 Remove all residue prior to application of next coat.
40

3.03 PREPARATION OF EXISTING SURFACES

- 41
42
43 A. Wherever existing finish is badly checked, cracked, alligatored,
44 peeling or in generally poor condition, remove old finish
45 entirely.
46
47 B. Plaster and Gypsum Board: Wash surfaces and rinse. Remove soil
48 and grease. Remove loose, blistered or otherwise defective
49 paint. Smooth and feather edges. Cut out and properly patch
50 cracks. Glaze unevenness so that surface will be smooth.
51

3.04 MATERIALS PREPARATION

- 52
53
54 A. General:
55 1. Mix and prepare paint materials in strict accordance with
56 the manufacturer's recommendations.
57 2. When materials are not in use, store in tightly covered
58 containers.
59 3. Maintain containers used in storage, mixing and application
60 of paint in a clean condition, free from foreign materials

1 and residue.
2

3 **3.05 PROTECTION**
4

- 5 A. Protect work of other trades against damage or injury of
6 materials, tools or utensils used.
7
8 B. Mask, cover and protect adjacent surfaces against spatter and
9 overspray.
10

11
12 **3.06 APPLICATION**
13

- 14 A. Work shall be done by skilled mechanics in a manner applied so
15 as to be free from sags, runs, crawls or other defects.
16
17 B. When materials are brush applied, apply evenly with clean
18 brushes, best suited for the type of material being applied.
19 When using a roller, use type of cover best suited for materials
20 used and surface texture.
21
22 C. Thoroughly mix paints, especially heavily pigmented paints,
23 before application and at regular intervals during application
24 to insure uniform distribution of pigment throughout application
25 and consistent appearance and performance of finished surfaces.
26
27 D. Before applying succeeding coats, make sure primers and
28 undercoats are dry and performing the function for which they
29 are intended.
30
31 E. Varnish Coats:
32 Between all coats, sand lightly when preceding coat is
33 thoroughly dry. Remove sanding residue prior to application of
34 next coat.
35
36 F. Hardware:
37 1. Coordinate painting and finishing with carpenter's work so
38 that final finish is applied before final placement of
39 finish hardware.
40 2. Hardware already in place which needs to be removed to
41 allow finishing will be responsibility of Contractor who
42 installed hardware.
43
44 G. Fixtures, Covers, Grilles
45 1. Coordinate painting and finishing work with that of other
46 trades in order to complete painting of areas affected
47 before final placement of fixtures, grilles and other
48 finish covers.
49 2. Removal or replacement of such items already installed to
50 allow for proper finishing will be responsibility of
51 Contractor who installed them.
52
53

54 **3.07 SURFACES TO BE PAINTED AND TYPES OF FINISHES**
55

- 56 A. Verify with Architect all stopping and starting points for
57 colors and finishes before work proceeds and paints are ordered.
58
59 B. Field finish all metals, including grilles, louvers and vents to
60 match wall color or ceiling color on which they occur, unless

- 1 otherwise noted in Finish Schedule.
2
3 C. "Exposed surfaces" means areas visible when all permanent
4 fixtures are in place in rooms or areas scheduled to be painted.
5
6 D. Exterior:
7 1. Unfinished galvanized sheet metal work, exterior ductwork,
8 ventilators, louvers, bollards and other exterior,
9 galvanized miscellaneous metal work.
10 a. One (1) coat galvanized metal primer
11 b. Two (2) coats exterior enamel.
12 2. Exposed structural steel and all other miscellaneous
13 ferrous metal items:
14 a. One (1) coat exterior metal primer for items not
15 already primed.
16 b. Two (2) coats exterior enamel
17
18 E. Interior Surfaces:
19 1. Interior Woodwork: Wood surfaces not scheduled to be
20 factory finished. For wood doors specified to be field
21 finished, finish tops, bottoms and edges.
22 a. One (1) coat Pre-Stain Wood Conditioner (to control
23 absorption of stain).
24 b. One (1) coat stain
25 c. Two (2) coats gloss varnish
26 d. One (1) coat satin varnish
27 2. Existing Woodwork:
28 a. One (1) coat satin varnish, except where finish is
29 badly worn, remove old finish and finish same as
30 specified for new work.
31 3. Interior Concrete Block:
32 a. One (1) coat primer/filler
33 b. Two (2) coats latex satin enamel paint as scheduled.
34 4. Drywall:
35 a. One (1) coat primer.
36 b. Two (2) coats latex flat or satin enamel paint as
37 scheduled.
38 5. Existing Walls and Ceilings:
39 a. Prime all patched areas and apply same finish coats as
40 specified for new work.
41 6. Metal Work: Including, but not limited to, exposed
42 convectors, access panels, metal doors and frames, fire
43 extinguisher cabinets:
44 a. One (1) coat gloss enamel
45 b. One (1) coat satin enamel
46 7. Exposed insulated and bare metal ductwork in rooms and
47 areas scheduled to be painted:
48 a. Two (2) coats of paint corresponding to adjacent wall
49 surfaces.
50 b. Insulated ductwork to receive one (1) additional coat
51 of sealer prior to application of finish coats.
52 8. Piping: Exposed insulated and bare heating, plumbing and
53 other mechanical piping of all types, including copper in
54 finished and unfinished areas of building.
55 a. Two (2) coats of paint corresponding to adjacent wall
56 surfaces, or as directed.
57 b. Insulated piping to receive one (1) additional coat of
58 sealer prior to application of finish coats.
59 9. Deep and Bright Tones:
60 - Surfaces to be painted with deep and bright tone colors
61 shall have three (3) finish coats or more, as necessary to

provide even coverage.

3.08 CLEANING

- A. At close of each working day, collect all wiping rags and waste materials and remove from building.
- B. Upon completion of work, remove all staging scaffolding and containers from site.
- C. Remove all paint where spilled, splashed or spattered.

* * *

1 **Section 10 44 00 - Fire Extinguishers and Cabinets**

2
3 **PART 1 - GENERAL**

4
5 **1.01 DESCRIPTION**

- 6
7 A. Work Included:
8 Furnish fire extinguishers and cabinets.
9
10 B. Related Work Specified Elsewhere:
11 1. Unit Masonry - Section 04 20 00
12 2. Gypsum Board Assemblies - Section 09 21 16
13 3. Painting - Section 09 90 00
14

15 **1.02 REFERENCES**

- 16
17 A. NFPA 10-Portable Fire Extinguishers
18
19 B. Americans with Disabilities Act 1990- Maximum 4" cabinet
20 projection for corridors.
21
22

23 **1.03 QUALITY ASSURANCE**

- 24
25 A. Conform to NFPA 10 requirements for portable fire extinguishers.
26
27 B. Provide fire extinguishers, cabinets and accessories by a single
28 manufacturer.
29
30 C. Conform to UBC 43-6 (ASTM E814-83) for fire resistive wall
31 performance where necessary.
32
33

34 **1.04 SUBMITTALS**

- 35 Submit the following:
36
37 1. Materials list of items proposed to be provided in this Section.
38 2. Manufacturer's specifications and other data needed to prove
39 compliance with the specified requirements.
40 3. Shop Drawings in sufficient detail to show fabrication,
41 installation, anchorage and interface of the work of this
42 Section with the work of adjacent trades.
43
44

45 **PART 2 - PRODUCTS**

46
47 **2.01 FIRE EXTINGUISHER CABINETS AND MOUNTING BRACKETS**

- 48
49 A. Cold-Rolled Steel Sheet: Carbon steel, complying with ASTM
50 A1008/A1008M, commercial quality, stretcher leveled, temper
51 rolled.
52
53 B. Recessed or semi-recessed type, as required by wall condition,
54 fabricated of 18 gauge steel with 20 gauge vertical duo-panel
55 glazed door.
56 1. Glazing: Clear Float Glass, ASTM C1036, Type 1, Class 1.
57 2. Door Hardware: Provide manufacturer's standard door-
58 operating hardware of proper type for cabinet type, trim
59 style, and door material and style indicated. Provide

- 1 recessed door pull and friction latch. Provide continuous-
- 2 type hinge permitting door to open 180 degrees.
- 3 3. Cabinet and Door Finish: Prime coat inside and out.
- 4 4. Size to fit specified extinguisher.
- 5 5. Recessed units shall have flat trim.
- 6 6. Semi-recessed units shall have rolled edge trim.
- 7 7. Approved manufacturers:
- 8 - JL Industries, "Ambassador Series"
- 9 - Larsen's, "Architectural Series"
- 10 - Modern Metal Products, "100 Series"
- 11 - Potter-Roemer, "1700 Series"
- 12
- 13 C. Fire-Rated Cabinets: Listed and labeled to meet requirements of
- 14 ASTM E814 for fire-resistance rating of wall where it is
- 15 installed. Construct fire-rated cabinets with double walls
- 16 fabricated from 0.0478-inch thick, cold-rolled steel sheet lined
- 17 with minimum 5/8-inch thick, fire-barrier material. Provide
- 18 factory drilled mounting holes
- 19
- 20

21 **2.02 FIRE EXTINGUISHERS**

- 22
- 23 A. Multi purpose dry chemical - 10 lb. dry chemical, air
- 24 pressurized with squeeze grip activator. UL and FM Labels for
- 25 Class "A", "B" and "C" fires. Provide visual pressure gauge.
- 26 U.L. Rating 4A-60BC.
- 27 - JL Industries, "Cosmic 10E"
- 28 - Larsen's, "MP10"
- 29 - Modern Metal Products, "Wing 10 HB"
- 30 - Potter-Roemer, "3000 Series"
- 31
- 32

33 **PART 3 - EXECUTION**

34

35 **3.01 INSPECTION**

36

37 Examine walls and partitions for suitable framing depth and blocking

38 where recessed and semi-recessed cabinets are to be installed.

39 Verify that rough openings for cabinets are correctly sized and

40 located.

41

42 **3.02 INSTALLATION**

- 43
- 44 A. Install fire extinguisher cabinets and fire extinguishers in
- 45 locations and at mounting heights indicated, or if not
- 46 indicated, at heights to comply with applicable regulations of
- 47 governing authorities.
- 48 1. Prepare recesses in walls for fire extinguisher cabinets as
- 49 required by type and size of cabinet and style of trim and
- 50 to comply with manufacturers instructions.
- 51 2. Securely fasten mounting brackets and fire extinguisher
- 52 cabinets to structure, square and plumb, to comply with
- 53 manufacturer's instructions.
- 54
- 55

* * *

Section 10 51 13 - Metal Lockers**PART 1 - GENERAL****1.01 DESCRIPTION**

- A. Work Included:
Furnish and install double tier metal lockers.
- B. Related Work Specified Elsewhere:
New concrete base: Section 03 30 00.

1.02 SUBMITTALS

- Submit the following:
1. Materials list of items proposed to be provided in this Section.
 2. Manufacturer's specifications and other data needed to prove compliance with the specified requirements.
 3. Shop Drawings in sufficient detail to show fabrication, installation, anchorage and interface of the work of this Section with the work of adjacent trades.

PART 2 - PRODUCTS**2.01 MATERIALS**

- A. Sheet steel: Prime, high grade Class 1 mild annealed, cold-rolled steel free from imperfections. Gauges given are minimum acceptable.
- B. Bolts: Zinc plated or subjected to other rust retardant treatment.

2.02 FABRICATION AND MANUFACTURE

- A. Workmanship:
1. Deliver to site and location in undamaged condition.
 2. Completed units shall be free from sharp corners, bolt ends and other projections which can cause injury to clothing and persons.
 3. All materials shall be free from buckle, scale and other imperfections and capable of taking a high grade enamel finish.
- B. Doors:
1. One (1) piece, 14 gauge steel with full length stiffener panel.
 2. Formed channel reinforcement at hinge side, angle or channel reinforcement on other three (3) sides.
 3. Accessible lockers shall have a decal with the international symbol of accessibility applied to the face of the locker door.
- C. Frames:
1. 16 gauge steel formed channel or 7/8" x 7/8" x 1/8" angle.
 2. Corners welded.

- 1 D. Locking Devices:
- 2 1. Positive-automatic, pre-locking.
- 3 2. Single Point Latching with no sliding rods, springs, or
- 4 moving latches. Padlock hasp shall be securely welded to
- 5 the continuous strike midway up on the frame and centered
- 6 at the handle location. The hasp shall be formed to
- 7 protrude through an extruded aluminum recessed handle.
- 8 3. Provide Rubber silencers at latch point.
- 9 4. Recessed stainless steel lift type handle with padlock eye.
- 10 Provide lock hole cover plate when used with padlocks.
- 11 a. Handles for accessible lockers shall have a shape that
- 12 is easy to grasp with one hand and does not require
- 13 tight grasping, tight pinching or twisting of the wrist
- 14 to operate.
- 15
- 16 E. Vent Louvers: Manufacturer's standard louvers at top and bottom
- 17 of doors.
- 18
- 19 F. Hinges:
- 20 1. 2" 16 gauge (.050") minimum five (5) knuckle, full loop
- 21 tight pin riveted or welded to door frame and bolted to door
- 22 with two (2) bolts.
- 23 2. Door swing minimum 178 degrees.
- 24 3. Double tier lockers: Two (2) per door.
- 25
- 26 G. Body:
- 27 1. Locker sides, backs, tops, bottoms and shelves to be 24
- 28 gauge with necessary formation for rigid construction.
- 29 2. All bolts and units zinc plated, spaced 12" o.c. maximum.
- 30 3. Floors flush with bottom of locker.
- 31 4. Tops and bottoms reinforced with flanges, four (4) sides.
- 32
- 33 H. Base: New and existing concrete base, as noted.
- 34
- 35 I. Provide all required filler and closure plates.
- 36
- 37 J. Provide 24 gauge continuous sloping tops.
- 38
- 39 K. Equipment:
- 40 Hooks: Heavy-duty, ball pointed, aluminum or zinc plated.
- 41 Double tier lockers shall have one double prong ceiling hook and
- 42 three single prong wall hooks. Hooks shall be attached with two
- 43 bolts per hook.
- 44
- 45 L. Number Plates:
- 46 1. Polished Aluminum or chrome with black etched letters not
- 47 less than 3/8" high.
- 48 2. Number consecutively as directed.
- 49
- 50 M. Finish: All parts shall be thoroughly cleaned before painting
- 51 and given a bonding and rust inhibiting phosphate undercoat
- 52 followed by electrostatically applied enamel. Finish shall then
- 53 be baked at 300 degrees F. Color as selected by Architect from
- 54 manufacturer's standard colors.
- 55
- 56
- 57

1 **2.05 APPROVED MANUFACTURERS**

- 2
- 3 A. Lockers and benches shall be as manufactured by:
- 4 - Art Metal Products
- 5 - ASI Storage Solutions, Inc.
- 6 - General Storage Systems
- 7 - Lyon Workplace Products
- 8 - Lincora
- 9 - List Industries, Inc.
- 10 - Penco Products
- 11 - Pinnacle Lockers
- 12 - Republic Steel Corporation
- 13 - approved equal
- 14

15

16 **PART 3 - EXECUTION**

17

18 **3.01 INSTALLATION**

- 19
- 20 A. Install lockers on existing locker base.
- 21
- 22 B. If existing base is not usable, remove existing base and install
- 23 lockers on steel "Zee"-base. Anchor lockers to "Zee"-Base and
- 24 to rear and side walls using appropriate connectors and
- 25 fasteners as recommended by locker manufacturer, spaced as
- 26 recommended by manufacturer.
- 27
- 28 C. Cut and fit all materials in neat, satisfactory manner as
- 29 conditions require.
- 30
- 31 D. Provide shims and wood blocking as required.
- 32

33

34 **3.02 PLACEMENT OF ACCESSIBLE LOCKERS**

35

36 Lockers shall be placed in a location at least 24" away from any wall

37 or other obstacle and have a minimum clear floor space of 30" x 48"

38 with a 10" minimum for door swing. The area in front of the locker

39 must be clear within a 60" diameter turning circle to allow for

40 unobstructed access.

41

42 * * *

43

Section 12 21 00 - Horizontal Blinds**PART 1 - GENERAL****1.01 DESCRIPTION**

- A. Work Included:
Furnish and Install horizontal aluminum blinds including all accessories and hardware required for a complete and proper installation.

1.02 QUALITY ASSURANCE

Use adequate numbers of skilled workers who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

1.03 SUBMITTALS

- A. Submit the following:
1. Materials list of items proposed to be provided under this Section.
 2. Manufacturer's specifications and other data needed to prove compliance with the specified requirements.
 3. Samples of blades in the colors and materials scheduled.

PART 2 - PRODUCTS**2.01 HORIZONTAL BLINDS**

- A. Slats: Nominal .0060: thick aluminum, 1" wide with elliptical crown and radius corners. All cut edges and holes shall be free of burrs. Baked enamel finish. See Color and Material Schedule for color selection.
- B. Lift Cords shall be braided of high strength synthetic fibers. Cord shall have minimum breaking strength of 175 lbs. Cords shall be dyed to match slat color.
- C. Head channel and bottom rail finished to match slats.
- D. Provide all operating mechanism required for raising, lowering and tilting.
- E. Manufacturers:
- Levolor "Riviera Contract Blind"
 - Springs Window Fashions Divisions, Inc. "Bali Classics"
 - Hunter Douglas, Inc. "Model CL62"
- F. Provide hardware, accessories and other materials not specifically described, but required for a complete and proper installation.

1 **PART 3 - EXECUTION**

2
3 **3.01 INSPECTION**

- 4
5 A. Examine the areas and conditions under which work of this
6 section will be performed. Report to General Contractor
7 conditions detrimental to timely and proper completion of the
8 work. Do not proceed until unsatisfactory conditions have been
9 corrected.
10
11 B. Install work of this Section in strict accordance with the
12 manufacturer's recommendations anchoring all components firmly
13 into position, plumb, level and in proper operating condition.
14
15 C. Upon completion of the installation, put each blind through
16 complete operating cycles, adjusting as required to achieve
17 optimum operation.
18

19 * * *
20
21

1 Section 13 40 00 - Bullet Resistant Transaction Window
2
34 **PART 1 - GENERAL**
56 **1.01 DESCRIPTION**
7

8 A. Work Included:
9 Furnish and install bullet resistant sliding transaction
10 window.

11
12 B. Related Work Specified Elsewhere:
13 1. Section 04 20 00 - Unit Masonry
14 2. Section 09 21 16 - Gypsum Board Assemblies
15

16
17 **1.02 DESIGN**
18

19 A. Frames shall be of the "non-ricochet type". Design shall
20 permit the encapture and retention of an attacking projectile
21 lessening the potential of a random injury or lateral
22 penetration. The encapturing barrier shall be ARMORTEX® UL
23 LISTED BULLET RESISTANT COMPOSITE manufactured by ARMORTEX.
24 PROTECTION LEVEL SHALL BE UL LEVEL 2. Frames shall be of a
25 protection level equal to or greater than the glazing. Units
26 shall be manufactured in strict accordance with manufacturer's
27 specifications, design and details. No field alterations to
28 units shall be allowed unless approved by the manufacturer.
29

30 **1.03 QUALITY ASSURANCE**
31

32 A. References:
33 The publication below forms a part of this specification.
34 UNDERWRITERS LABORATORY UL 752 11th Edition dated Sept 5, 2005
35 Standard for Bullet Resistant Equipment
36
37

38 **1.04 SUBMITTALS**
39

40 A. Submit the following prior to fabrication:
41 1. Verification of UL listing of bullet resistant composite.
42 2. Catalog cuts, shop drawings, specifications, frame
43 profiles, size, type and spacing of frame anchors,
44 reinforcement size and locations, details of joints and
45 connections and welding details.
46 3. Printed data in sufficient detail to indicate compliance
47 with the contract documents.
48 4. Manufacturer's instructions for installation and
49 cleaning.
50

51 **1.05 WARRANTY**
52

53 Manufacturer shall warrant transaction windows to be free from
54 defects in materials and workmanship for a period of one (1) year
55 from date of final completion of Project.
56
57

PART 2 - PRODUCTS**2.01 MANUFACTURER**

In order to establish a standard of quality and design, this specification is based on bullet resistant frames and glazing assemblies as manufactured by

- Armortex, Schertz, Texas. Phone: 800-880-8306,
Fax: 210-661-8308. "Model SSTW-23"

Equal products by the following manufacturers which meet the requirements of this specification are also approved:

- Diebold, Inc., 800-999-3600
- Ross Engineering, 703-971-2442
- Norshield Security Products, 334-281-8440

2.02 FRAMES

Three sided hollow metal frame modules shall be of a "non-ricochet type" design, constructed of brake formed commercial grade cold rolled 16 ga. steel lined with UL LISTED BULLET RESISTANT ARMORTEX® COMPOSITE. Steel shall be free of scale, pitting, coil breaks and finish work shall be neat and free of defects. Corners shall be continuously welded the full length of the intersection. Knocked down and mechanical joints are not acceptable. Frame modules shall be capable of being joined with other frame modules to form a continuous hardline. Replacement of glazing shall be from the secure side of the window or wall unit and will not require the removal of the frame from the opening. The relationship of sliding to fixed glazing panels shall be as shown on the drawings.

2.03 SHELF

Provide a shelf not less than 2" thick with a recessed dip tray. The shelf to be full width of window; a minimum of 12" deep centered under the glazing fabricated from solid core stainless steel no less than 18 ga. with a #3 finish.

2.04 DIP TRAY

Armortex "Model RMDT1016" constructed of 16 ga. stainless steel, # 3 finish 10" x 16" from the outside edge of flanges with a clear open depth under the glazing of 1 5/8".

2.05 FINISH

Cold rolled steel is to be factory prime painted gray. Field paint and finish in accordance with and as directed in Section 09 90 00 - Painting.

2.06 GLAZING

The glazing must be UL Listed Level 2 laminated polycarbonate. All exposed edges of glazing shall be polished to a satin finish.

1 **2.07 FABRICATION**

- 2
- 3 A. All welds shall be in accordance with the requirements and
4 standard practices of the American Welding Society. All
5 exposed welds shall be ground flush and finished smooth.
6
- 7 B. Standard manufacturing tolerances shall be +/- 1/16" for frame
8 opening, diagonal dimensions of frame, overall frame width,
9 height, depth, etc . Aluminum or aluminum clad units are not
10 acceptable.

11

12

13 **PART 3 - EXECUTION**

14

15 **3.01 INSTALLATION**

16 Set frames and glaze in accordance with manufacturer's instructions.
17 Repair damaged units (if approved by the manufacturer and the
18 architect) or replace with new units.
19

20

21 **3.02 PROTECTION**

22 Touch up scratches or disfigurement caused by shipping and handling
23 of the product. Properly store frames, glazing material etc. in a
24 dry location and covered to protect from damage before and after
25 installation.
26

27

28

29 **3.03 CLEANING**

30 Upon completion, clean exposed surfaces of frames and glazing
31 products thoroughly in accordance with manufacturer's instructions.
32 Remove mastic smears and other unsightly marks.
33

34

35

36 * * *

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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
- Reference
- Standards
- Quality Assurance
- Continuity of Existing Services
- Protection of Finished Surfaces
- Sleeves and Openings
- Sealing and Firestopping
- Off Site Storage
- Codes
- Design Criteria
- Certificates and Inspections
- Submittals
- Operating and Maintenance Instructions
- Record Drawings

PART 2 - PRODUCTS

- Access Panels and Doors
- Identification
- Sealing and Firestopping

PART 3 - EXECUTION

- Demolition
- Cutting and Patching
- Equipment Access
- Coordination
- Identification
- Sleeves
- Sealing and Firestopping

RELATED WORK

This section applies to all Division 21 sections of fire suppression.

REFERENCE

Applicable provisions of Division 1 govern work under this section.

STANDARDS

Abbreviations of standards organizations referenced in this and other sections are as follows:

ANSI American National Standards Institute

- 1 ASME American Society of Mechanical Engineers
- 2 ASTM American Society for Testing and Materials
- 3 AWS American Welding Society
- 4 CGA Compressed Gas Association
- 5 CS Commercial Standards, Products Standards Sections, Office of Engineering Standards Service,
- 6 NBS
- 7 EPA Environmental Protection Agency
- 8 FM FM Global (Factory Mutual)
- 9 FS Federal Specifications, Superintendent of Documents, U.S. Government Printing Office
- 10 IAPMO International Association of Plumbing & Mechanical Officials
- 11 IEEE Institute of Electrical and Electronics Engineers
- 12 ISA Instrument Society of America
- 13 COMM State of Wisconsin Dept. of Commerce
- 14 MSS Manufacturer's Standardization Society of the Valve & Fitting Industry, Inc.
- 15 NBS National Bureau of Standards
- 16 NEC National Electric Code
- 17 NEMA National Electrical Manufacturers Association
- 18 NFPA National Fire Protection Association
- 19 UL Underwriters Laboratories Inc.

20

21 **QUALITY ASSURANCE**

22 Substitution of Materials: Refer to Section GC - General Conditions of the Contract, Equals and
 23 Substitutions.

24

25 All products and materials used are to be new, undamaged, clean and in good condition. Existing products
 26 and materials are not to be reused unless specifically indicated.

27

28 **CONTINUITY OF EXISTING SERVICES**

29 Do not interrupt or change existing services without prior written approval from the Owner's Project
 30 Representative. When interruption is required, coordinate scheduling of down-time with the Owner to
 31 minimize disruption to his activities. Unless specifically stated, all work involved in interrupting or
 32 changing existing services is to be done during normal working hours.

33

34 **PROTECTION OF FINISHED SURFACES**

35 Refer to Division 1, General Requirements, Protection of Finished Surfaces.

36

37 **SLEEVES AND OPENINGS**

38 Refer to Division 1, General Requirements, Sleeves and Openings.

39

40 **SEALING AND FIRESTOPPING**

41 Sealing and firestopping of sleeves/openings between piping, etc. and the sleeve or structural opening shall
 42 be the responsibility of the contractor whose work penetrates the opening. The contractor responsible shall
 43 hire individuals skilled in such work to do the sealing and fireproofing. These individuals hired shall
 44 normally and routinely be employed in the sealing and fireproofing occupation.

45

46 **OFF SITE STORAGE**

47 Prior approval by the A/E will be needed. Generally, sleeves, pipe/pipe fittings and similar rough-in
 48 material will not be accepted for off site storage. No material will be accepted for off site storage unless
 49 shop drawings for the material have been approved.

50

51 **CODES**

1 All operations and maintenance data shall comply with the submission and content requirements specified
2 under section GENERAL REQUIREMENTS.

- 3
- 4 • Certificates of inspection by regulatory agencies.
- 5 • Parts lists for equipment and specialties.
- 6 • Manufacturers installation, operation and maintenance recommendations for equipment and
7 specialties.
- 8 • Warranties
- 9 • Additional information as indicated in the technical specification sections

10 **RECORD DOCUMENTS**

11 Refer to Division 1, General Requirements, Record Documents.

12
13
14 In addition to the data indicated in the General Requirements, maintain fire protection layout record
15 drawings and hydraulic calculations on originals prepared by the installing contractor/subcontractor.
16 Include copies of these record drawings and calculations with the Operating and Maintenance manuals.

17 **PART 2 - PRODUCTS**

18 **ACCESS PANELS AND DOORS**

19 **LAY-IN CEILINGS:**

20 Removable lay-in ceiling tiles in 2 X 2 foot or 2 X 4 foot configuration provided under Division 09 are
21 sufficient; no additional access provisions are required unless specifically indicated.

22 **IDENTIFICATION**

23 **STENCILS:**

24 Not less than 1 inch high letters/numbers for pipe sizes 2 1/2" and larger for marking pipe. Apply flow
25 arrows to piping.

26 **ADHESIVE LABELS:**

27 Pressure-sensitive, adhesive backed, vinyl pipe markers with applicable labeling, 3/4" min. size for lettering
28 and surrounding tape on both ends. With flow arrows on piping. Conforming to ANSI, ANSI and NFPA
29 standards. Seton Opti-Code, MSI, Brady or approved equal. Clean piping before application.

30 **SNAP-AROUND MARKERS:**

31 One-piece, pre-formed, vinyl construction, snap-around or strap-around pipe markers with applicable
32 labeling, 3/4" min. size for lettering. Provide nylon ties on each end of pipe marker. Seton Setmark or
33 approved equal.

34 **SEALING AND FIRESTOPPING**

35 **FIRE AND/OR SMOKE RATED PENETRATIONS:**

36 Manufacturers: 3M, Hilti, STI/SpecSeal, Tremco, or approved equal.

37 All firestopping systems shall be provided by the same manufacturer.

38 Fire stop systems shall be UL listed or tested by an independent testing laboratory approved by the Dept. of
39 Commerce.

40 Submittals: Contractor shall submit product data for each firestop system. Submittals shall include
41 product characteristics, performance and limitation criteria, test data, MSDS sheets, installation details and
42 procedures for each method of installation applicable to this project. For non-standard conditions where no
43

1 UL tested system exists, submit manufacturer's drawings for UL system with known performance for
2 which an engineering judgement can be based upon.
3
4 Use a product that has a rating not less than the rating of the wall or floor being penetrated. Reference
5 architectural drawings for identification of fire and/or smoke rated walls and floors.
6
7 Use firestop putty, caulk sealant, intumescent wrapstrips, intumescent firestop collars, firestop mortar or a
8 combination of these products to provide a UL listed system for each application required for this project.
9 Provide mineral wool backing where specified in manufacturer's application detail.

10
11 **NON-RATED PENETRATIONS:**

12 **Pipe Penetrations:**

13 At pipe penetrations of non-rated interior partitions and floors, use urethane caulk in annular space
14 between pipe insulation and sleeve. For non-rated drywall, plaster or wood partitions where sleeve is not
15 required, use urethane caulk in annular space between pipe insulation and wall material.

16
17
18 **PART 3 - EXECUTION**
19

20 **DEMOLITION**

21 Perform all demolition as indicated on the drawings to accomplish new work. Where demolition work is to
22 be performed adjacent to existing work that remains in an occupied area, construct temporary dust partition
23 to minimize the amount of contamination of the occupied space. Where pipe is removed and not
24 reconnected with new work, cap ends of existing services as if they were new work. Coordinate work with
25 the User Agency to minimize disruption to the existing building occupants.

26
27 All pipe, sprinklers, wiring, associated conduit and similar items demolished, abandoned, or deactivated
28 are to be removed from the site by the Contractor except as specifically noted otherwise. Maintain the
29 condition of material and/or equipment that is indicated to be reused equal to that existing before work
30 began.

31
32 **CUTTING AND PATCHING**

33 Refer to Division 1, General Requirements, Cutting and Patching.

34
35 **EQUIPMENT ACCESS**

36 Install all piping, conduit and accessories to permit access to equipment for maintenance and service.

37
38 **COORDINATION**

39 Coordinate all work with other contractors prior to installation. Any work that is not coordinated and that
40 interferes with other contractor's work shall be removed or relocated at the installing contractor's expense.

41
42 Verify that all devices are compatible for the type of construction and surfaces on which they will be used.

43
44 **IDENTIFICATION**

45 Identify interior piping mains 2 1/2" and larger not less than once every 25 feet, not less than once in each
46 room, adjacent to each access door or panel, and on both sides of the partition where exposed piping passes
47 through walls or floors. Place flow directional arrows at each pipe identification location. Use one coat of
48 black enamel against a light background or white enamel against a dark background, or approved pipe
49 marking label systems, or provide snap-around type pipe markers.

50
51 **SLEEVES**

1 Provide galvanized sheet metal sleeves for fire rated pipe penetrations through interior and exterior walls to
2 provide a backing for sealant or firestopping. Patch wall around sleeve to match adjacent wall construction
3 and finish. Grout area around sleeve in masonry construction. In finished spaces where pipe penetration
4 through wall is exposed to view, sheet metal sleeve shall be installed flush with face of wall. In existing
5 poured concrete walls where penetration is core drilled, pipe sleeve is not required. Grout holes directly
6 around steel pipe.

7
8 Pipe sleeves are not required in interior non-rated drywall, plaster or wood partitions and sleeves are not
9 required in existing poured concrete walls where penetrations are core drilled.

10
11 **SEALING AND FIRESTOPPING**

12 **FIRE AND/OR SMOKE RATED PENETRATIONS:**

13 Install approved product in accordance with the manufacturer's instructions where a pipe penetrates a
14 fire/smoke rated surface. When pipe is insulated, use a product which maintains the integrity of the
15 insulation and vapor barrier.

16
17 **NON-RATED PARTITIONS:**

18 At all interior partitions, pipe penetrations are required to be sealed. Apply sealant to both sides of the
19 penetration in such a manner that the annular space between the pipe sleeve or cored opening and the pipe
20 or insulation is completely blocked.

21
22
23

END OF SECTION

1 Do not hang any item directly from a metal deck or run piping so its rests on the bottom chord of any truss
2 or joist.

3
4 Fasteners depending on soft lead for holding power or requiring explosive powder actuation will not be
5 accepted.

6
7 Support material under all conditions of operation, variations in installed and operating weight of
8 equipment and piping, to prevent excess stress, and allow for proper expansion and contraction.

9
10 **SHOP DRAWINGS**

11 Schedule of all hanger and support devices indicating attachment methods and type of device for each pipe
12 size and type of service. Provide details on the working drawings submitted for approval with all pertinent
13 information listed.

14
15 **DESIGN CRITERIA**

16 Materials and application of pipe hangers and supports shall be in accordance with MSS Standard Practice
17 SP-58 and SP-69 unless noted otherwise.

18 Materials and application of pipe hangers and supports shall be in accordance with NFPA and be UL/FM
19 listed and approved.

20

21

22

23 **PART 2 - PRODUCTS**

24

25 **MANUFACTURERS**

26 B-Line, Anvil, Pate, Piping Technology, Roof Products & Systems or approved equal.

27

28 **STRUCTURAL SUPPORTS**

29 Provide all supporting steel required for the installation of fire protection materials, including angles,
30 channels, beams, etc.

31

32 **PIPE HANGERS AND SUPPORTS**

33 HANGERS FOR PIPE SIZES 1/2" THROUGH 4":

34 Carbon steel, adjustable swivel ring with 3/8" min. UL/FM approved hanger rods. B-Line B3170NF,
35 Anvil 69 or 70.

36 Carbon steel, adjustable clevis, standard, with UL/FM approved size hanger rods. B-Line B3100, Anvil
37 260.

38

39 **WALL SUPPORT:**

40 Carbon steel welded bracket with hanger. B-Line 3060 Series, Anvil 190 Series.

41 Steel channels with pipe clamps.

42

43 **VERTICAL SUPPORT:**

44 Carbon steel riser clamp. B-Line B3373, Anvil 261 for above floor use.

45

46 **PIPE HANGER RODS**

47 **STEEL HANGER RODS:**

48 Threaded both ends, threaded one end, or continuous threaded, complete with adjusting and lock nuts.

49

50 Size rods for individual hangers and trapeze support as indicated in the following schedule.

1 Pipe Size Diam. Of Rod
2 Up to and
3 Including 4" 3/8" or 9.5mm min.
4

5 **BEAM CLAMPS**

6 MSS SP-69 Types 19 & 23 malleable black iron clamp for attachment to beam flange to 0.62 inches thick
7 with a retaining ring and threaded rod of 3/8, 1/2, and 5/8 inch diameter. Furnish with a hardened steel cup
8 point set screw. B-Line B3036L/B3034, Anvil 86/92.
9

10 MSS SP-69 Type 28 or Type 29 forged steel jaw type clamp with a tie rod to lock clamp in place, suitable
11 for rod sizes to 1-1/2 inch diameter. B-Line B3054, Anvil 228.
12

13 **CONCRETE INSERTS**

14 **DRILLED FASTENERS:**

15 Carbon steel expansion anchors, vibration resistant, with ASTM B633 zinc plating. Use drill bit of same
16 manufacturer as anchor. Hilti, Rawl, Redhead.
17

18
19 **PART 3 - EXECUTION**
20

21 **INSTALLATION**

22 Size, apply and install supports in compliance with manufacturer's recommendations.
23

24 Install supports to provide for free expansion of the piping system. Support all piping from the structure
25 using concrete inserts, beam clamps, ceiling plates or wall brackets. Fasten ceiling plates and wall brackets
26 securely to the structure and test to demonstrate the adequacy of the fastening.
27

28 Coordinate hanger and support installation to properly group piping of all trades.
29

30 Perform welding in accordance with standards of the American Welding Society.
31

32 **HANGER AND SUPPORT SPACING**

33 Use hangers with minimum vertical adjustment.
34

35 Support riser piping independently of connected horizontal piping.
36

37 Adjust hangers to obtain the slope specified in the piping section of these specifications.
38

39 Space hangers for pipe as follows:
40

<u>Pipe Material</u>	<u>Pipe Size</u>	<u>Max. Horiz. Spacing</u>	<u>Max. Vert. Spacing</u>
Steel	1" through 1-1/4"	12'-0"	15'-0"
Steel	1-1/2" through 8"	15'-0"	15'-0"

44
45 Unsupported length from the last hanger and an end sprinkler shall be as follows:
46

47 1" piping	Not greater than 36"
48 1-1/4" piping	Not greater than 48"
49 1-1/2" piping	Not greater than 60"
50 or larger.	

51 **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 fire protection 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

PART 2 - PRODUCTS

- Fire Protection Piping
- Unions and Flanges
- Mechanical Grooved Pipe Connections
- Sprinkler Heads

PART 3 - EXECUTION

- Installation
- General
- Preparation
- Erection
- Threaded Pipe Joints
- Mechanical Grooved Pipe Connections
- Unions and Flanges
- Piping System Leak Tests

RELATED WORK

- Section 21 05 00 – Common Work Results for Fire Suppression
- Section 21 05 29 – Hangers and Supports for Fire-Suppression Piping

REFERENCE

Applicable provisions of Division 1 govern work under this section.

REFERENCE STANDARDS

- ANSI B16.1 Cast Iron Pipe Flanges and Flanged Fittings
- ANSI B16.3 Malleable Iron Threaded Fittings
- ANSI B16.4 Cast Iron Threaded Fittings
- ANSI B16.5 Pipe Flanges and Flanged Fittings
- ANSI B16.9 Factory Made Wrought Steel Buttweld Fittings
- ANSI B16.11 Forged Steel Fittings, Socket Welded and Threaded
- ASTM A53 Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless
- ASTM A105 Forgings, Carbon Steel, for Piping Components
- ASTM A126 Gray Cast Iron Castings for Valves, Flanges, and Pipe Fittings

- 1 ASTM A135 Electric Resistance Welded Steel Pipe
- 2 ASTM A181 Forgings, Carbon Steel for General Purpose Piping
- 3 ASTM A234 Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated
- 4 Temperatures
- 5 ASTM A536 Ductile Iron Castings
- 6 ASTM A795 Black and Hot Dipped Zinc Coated (Galvanized) Welded and Seamless Steel Pipe for
- 7 Fire Protection Use
- 8 AWS A5.8 Brazing Filler Metal
- 9 AWS D10.9 Qualification of Welding Procedures and Welders for Piping and Tubing, Level AR3
- 10 NFPA 13 Installation of Sprinkler Systems. (Latest edition)
- 11 NFPA 14 Installation of Standpipe and Hose Systems. (Latest edition)
- 12 UL Underwriters' Laboratories Listing
- 13 FM Factory Mutual Approval

14

15 **SHOP DRAWINGS**

16 Schedule from the contractor indicating the ANSI/ASTM specification number of the pipe being proposed
 17 along with its type and grade, if known at the time of submittal, and sufficient information to indicate the
 18 type and rating of fittings for each service.

19

20 **QUALITY ASSURANCE**

21 Substitution of Materials: Refer to Section GC – General Conditions of the Contract, Equals and
 22 Substitutions.

23

24 Order all steel pipe with each length marked with the name or trademark of the manufacturer and type of
 25 pipe; with each shipping unit marked with the purchase order number, metal or alloy designation, temper,
 26 size, and name of supplier.

27

28 Any installed material not meeting the specification requirements must be replaced with material that meets
 29 these specifications without additional cost to the Owner.

30

31 **DELIVERY, STORAGE, AND HANDLING**

32 Promptly inspect shipments to insure that the material is undamaged and complies with specifications.

33

34 Cover pipe to prevent corrosion or deterioration while allowing sufficient ventilation to avoid
 35 condensation. Do not store materials directly on grade. Protect pipe, tube, and fitting ends so they are not
 36 damaged. Where end caps are provided or specified, take precautions so the caps remain in place. Protect
 37 fittings, flanges, and unions by storage inside or by durable, waterproof, above ground packaging.

38

39 Offsite storage agreements will not relieve the contractor from using proper storage techniques.

40

41 Storage and protection methods must allow inspection to verify products.

42

43 **DESIGN CRITERIA**

44 Use only new material, free of defects, rust and scale, and meeting the latest revision of ASTM
 45 specifications as listed in this specification.

46

47 Construct all piping systems for the highest pressures and temperatures in the respective system but not
 48 less than 175 psig.

49

50 Where ASTM A53 or A795 type F pipe is specified, grade A type E or S, or grade B type E or S may be
 51 substituted at Contractor's option. Where ASTM A135 grade A pipe is specified, grade B pipe may be

1 substituted at Contractor's option. Where the grade or type is not specified, Contractor may choose from
2 those commercially available.

3 4 5 **PART 2 - PRODUCTS**

6 7 **FIRE PROTECTION PIPING**

8 **STEEL PIPE:**

9 Black steel pipe welded and seamless, Type F, Grade A, ASTM A53; black welded and seamless steel pipe
10 for fire protection use, Type F, ASTM A795; electric resistance welded steel pipe, Grade A, ASTM A135.

11
12 Threaded lightwall pipe and plastic pipe are not acceptable.

13
14 Pipe Wall Thickness: Schedule 40 for rolled groove, cut groove and threaded. Schedule 30 for rolled
15 groove, 8" and larger cut groove and 8" and larger threaded piping. Schedule 10 up to and including 6" for
16 rolled groove.

17
18 Fittings: 2" and Under - Cast iron threaded fittings, Class 125 or 250, ASTM A126/ANSI B16.4. Malleable
19 iron threaded fittings, Class 150 or 300, ASTM A197/ANSI B16.3. Mechanical grooved fittings with
20 EPDM gaskets, ASTM A536 ductile iron, ASTM A47 malleable iron or ASTM A53 fabricated steel.

21 22 **UNIONS AND FLANGES**

23 **2" AND SMALLER STEEL:**

24 ASTM A197/ANSI B16.3 malleable iron unions with brass seats. Use black malleable iron on black steel
25 piping and galvanized malleable iron on galvanized steel piping.

26 27 **2-1/2" AND LARGER:**

28 ASTM A181 or A105, Class 150, grade 1 hot forged steel flanges of threaded, welding neck, or slip-on
29 pattern on black steel and threaded only on galvanized steel. ANSI B16.1 or ANSI B16.5, Class 150 cast
30 iron threaded flanges. Use raised face flanges ANSI B16.5 for mating with other raised face flanges or
31 equipment with flat ring or full face gaskets. Use ANSI B16.1 flat face flanges with full face gaskets for
32 mating with other flat face flanges on equipment.

33 34 **MECHANICAL GROOVED PIPE CONNECTIONS**

35 Mechanical grooved pipe couplings and fittings, ASTM F1476, as manufactured by Victaulic, Anvil or
36 Star Fittings may be used with steel pipe. Mechanical grooved components and assemblies to be rated for
37 minimum 175 psi working pressure unless noted otherwise.

38
39 All mechanical grooved pipe material including gaskets, couplings, fittings and flange adapters to be from
40 the same manufacturer.

41
42 Couplings and fittings to be malleable iron, ASTM A47, or ductile iron A536 with painted finish. Fittings
43 used on galvanized steel pipe to have galvanized finish, ASTM A153.

44
45 Gaskets to be EPDM, ASTM D2000. Gaskets for dry systems to be flush seal design. Heat treated carbon
46 steel oval neck track bolts and nuts, ASTM A-183, with zinc electroplated finish.

47
48 Flange adapters to be ductile iron, ASTM A536; except at lug type butterfly valves where standard
49 threaded flanges shall be used.

50 51 **SPRINKLER HEADS**

1 Manufacturer: Sprinkler head model numbers establish type and style of head. Products of the following
2 manufacturers determined to be equal by the Architect/Engineer will be accepted: Central Sprinkler
3 Corporation, Tyco, Reliable, Star Sprinkler, Victaulic and Viking.

4
5 Fusible link or glass bulb type, cast brass or bronze construction. Provide heads with nominal 1/2"
6 discharge orifice except where greater than normal density requires large orifice.

7
8 Select fusible link or glass bulb temperature rating to not exceed maximum ambient temperature rating
9 allowed under normal conditions at installed location. Provide ordinary temperature (165 degree) fusible
10 link or glass bulb type except at skylights, sealed display windows, unventilated attics and roof spaces,
11 adjacent to diffusers, unit heaters, uninsulated heating pipes or ducts, mechanical rooms, storage rooms, or
12 where otherwise indicated.

13
14 Provide quantity of spare heads as noted below and 1 wrench for each type of head and each temperature
15 range installed. Provide 6 spare heads per 300 or less installed heads, 12 per 1000 or less and 24 for more
16 than 1000. Provide steel cabinet for storage of heads and wrenches.

17
18 Concealed: Tyco Model RF11, white finish.

19
20 Upright: Tyco Model TY-FRB, brass finish.

21 22 **PART 3 - EXECUTION**

23 24 **GENERAL**

25 Install pipe and fittings in accordance with reference standards, manufacturers recommendations and
26 recognized industry practices.

27 28 **PREPARATION**

29 Cut pipe ends square. Ream ends of piping to remove burrs. Clean scale and dirt from interior and exterior
30 of each section of pipe and fitting prior to assembly.

31 32 **ERECTION**

33 Install all piping parallel to building walls and ceilings and at heights which do not obstruct any portion of
34 a window, doorway, stairway, or passageway. Where interferences develop in the field, offset or reroute
35 piping as required to clear such interferences. Coordinate locations of fire protection piping with piping,
36 ductwork, conduit and equipment of other trades to allow sufficient clearances. In all cases, consult
37 drawings for exact location of pipe spaces, ceiling heights, ceiling grid layout, light fixtures and grilles
38 before installing piping.

39
40 Maintain piping in clean condition internally during construction.

41
42 Install piping so that system can be drained. Where possible, slope to main drain valve. Where piping not
43 susceptible to freezing cannot be fully drained, install nipple and cap for drainage of less than 5 gallons or
44 ball valve with hose thread outlet and cap for drainage over 5 gallons. Pipe main drain valve to grade or to
45 air gap sewer receptor.

46
47 Mitered ells, notched tees, and orange peel reducers are not acceptable. On threaded piping, bushings are
48 not acceptable.

49
50 Do not route piping within exterior walls.

51

1 Do not route piping through transformer vaults or above transformers, panelboards, or switchboards,
2 including the required service space for this equipment, unless the piping is serving this equipment.
3

4 **THREADED PIPE JOINTS**

5 Use a thread lubricant or teflon tape when making joints; no hard setting pipe thread cement or caulking
6 will be allowed.
7

8 **MECHANICAL GROOVED PIPE CONNECTIONS**

9 Use pipe factory grooved in accordance with the coupling manufacturer's specifications or field grooved
10 pipe in accordance with the same specifications using specially designed tools available for the application.
11 Lubricate pipe and coupling gasket, align pipe, and secure joint in accordance with the coupling
12 manufacturer's specifications.
13

14 **UNIONS AND FLANGES**

15 Install a union, flange or grooved coupling combination at each connection to each piece of equipment and
16 at other items which may require removal for maintenance, repair, or replacement. Where a valve is located
17 at a piece of equipment, locate the flange or union or grooved coupling combination connections on the
18 equipment side of the valve. Concealed unions, flanges or couplings are not acceptable.
19

20 **PIPING SYSTEM LEAK TESTS**

21 Conduct pressure test with test medium of water. If leaks are found, repair the area with new materials and
22 repeat the test; caulking will not be acceptable.
23

24 Test piping in sections or entire system as required by sequence of construction. Do not conceal pipe until
25 it has been successfully tested. If required for the additional pressure load under test, provide temporary
26 restraints at fittings or expansion joints. Entire test must be witnessed by the Division's representative.
27

28 Use clean water and remove air from the piping being tested where possible. Measure and record test
29 pressure at the high point in the system.
30

31 Test system at 200 psi for 2 hours showing no leakage. Where system design is in excess of 150 psig,
32 test at a pressure 50 psig above system design pressure.
33

34 All pressure tests are to be documented on NFPA Contractor's Material and Test Certificate forms.
35

36 **INSTALLATION**

37 Install fire protection system components in accordance with NFPA, product listings and manufacturers
38 recommendations. Locate where accessible for servicing and replacement.
39

40 Sprinkler Heads: Locate sprinkler heads maintaining minimum clearances from obstructions, ceilings and
41 walls. Install sprinkler heads level in locations not subject to spray pattern interference. Provide fire
42 sprinkler head installations below ductwork, soffits, etc.
43

44
45

END OF SECTION

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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
- Reference
- Standards
- Quality Assurance
- Continuity of Existing Services
- Protection of Finished Surfaces
- Sleeves and Openings
- Sealing and Firestopping
- Submittals
- Off Site Storage
- Codes
- Request and Certification for Payment
- Certificates and Inspections
- Operating and Maintenance Data
- Record Drawings

PART 2 - PRODUCTS

- Access Panels and Doors
- Identification
- Sealing and Firestopping

PART 3 - EXECUTION

- Demolition
- Cutting and Patching
- Building Access
- Equipment Access
- Coordination
- Identification
- Lubrication
- Sleeves
- Sealing and Firestopping

RELATED WORK

Section 01 91 01 or 01 91 02 – Commissioning Process

REFERENCE

Applicable provisions of Division 1 govern work under this section.

This section applies to all Division 22 sections of plumbing.

1 **STANDARDS**

2 Abbreviations of standards organizations referenced in this and other sections are as follows:

3

4 ANSI American National Standards Institute

5 ASME American Society of Mechanical Engineers

6 ASPE American society of Plumbing Engineers

7 ASSE American Society of Sanitary Engineering

8 ASTM American Society for Testing and Materials

9 AWWA American Water Works Association

10 AWS American Welding Society

11 CISPI Cast Iron Soil Pipe Institute

12 CGA Compressed Gas Association

13 CS Commercial Standards, Products Standards Sections, Office of Eng. Standards Service, NBS

14 EPA Environmental Protection Agency

15 FS Federal Specifications, Superintendent of Documents, U.S. Government Printing Office

16 IAPMO International Association of Plumbing & Mechanical Officials

17 IEEE Institute of Electrical and Electronics Engineers

18 ISA Instrument Society of America

19 MICA Midwest Insulation Contractors Association

20 MSS Manufacturer's Standardization Society of the Valve & Fitting Industry, Inc.

21 NBS National Bureau of Standards

22 NEC National Electric Code

23 NEMA National Electrical Manufacturers Association

24 NFPA National Fire Protection Association

25 NSF National Sanitation Foundation

26 PDI Plumbing and Drainage Institute

27 UL Underwriters Laboratories Inc.

28

29 Standards referenced in this section:

30 ASTM E814 Standard Test Method for Fire Tests of Through-Penetration Fire Stops

31 ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials

32 UL1479 Fire Tests of Through-Penetration Firestops

33 UL723 Surface Burning Characteristics of Building Materials

34

35 **QUALITY ASSURANCE**

36 Substitution of Materials: Refer to Section GC - General Conditions of the Contract, Equals and
37 Substitutions.

38

39 All products and materials used are to be new, undamaged, clean and in good condition. Existing products
40 and materials are not to be reused unless specifically indicated.

41

42 **CONTINUITY OF EXISTING SERVICES**

43 Do not interrupt or change existing services without prior written approval from the Owner's Project
44 Representative. When interruption is required, coordinate scheduling of down-time with the Owner to
45 minimize disruption to his activities. Unless specifically stated, all work involved in interrupting or
46 changing existing services is to be done during normal working hours.

47

48 **PROTECTION OF FINISHED SURFACES**

49 Refer to Division 1, General Requirements, Protection of Finished Surfaces.

50

51 **SLEEVES AND OPENINGS**

1 Refer to Division 1, General Requirements, Sleeves and Openings.

2

3 **SEALING AND FIRESTOPPING**

4 Sealing and firestopping of sleeves/openings between piping, etc. and the sleeve or structural opening shall
5 be the responsibility of the contractor whose work penetrates the opening. The contractor responsible shall
6 hire individuals skilled in such work to do the sealing and fireproofing. These individuals hired shall
7 normally and routinely be employed in the sealing and fireproofing occupation.

8

9 **OFF SITE STORAGE**

10 Prior approval by A/E will be needed. Generally, sleeves, pipe/pipe fittings and similar rough-in material
11 will not be accepted for off site storage. No material will be accepted for off site storage unless shop
12 drawings for the material have been approved.

13

14 **CODES**

15 Comply with requirements of Wisconsin Administrative Code.

16

17 **CERTIFICATES AND INSPECTIONS**

18 Refer also to Division 1, General Conditions, Permits, Regulations, Utilities and Taxes.

19

20 Obtain and pay for all required State installation inspections except those provided by the
21 Architect/Engineer in accordance with Wis. Admin. Code. Deliver originals of these certificates to the
22 Owner's Project Representative. Include copies of the certificates in the Operating and Maintenance
23 Instructions.

24

25 **SUBMITTALS**

26 Refer to Division 1, General Conditions, Submittals.

27

28 Not more than two weeks after award of contract but before any shop drawings are submitted, contractor to
29 submit the following plumbing system data sheet. List piping material type for each piping service on the
30 project, ASTM number, schedule or pressure class, joint type, manufacturer and model number where
31 appropriate. List valves and specialties for each piping service, fixture and equipment with manufacturer
32 and model number. The approved plumbing system data sheet(s) will be made available to the Owner's
33 Representative for their use on this project.

34

35 **PLUMBING SYSTEM DATA SHEET**

36 Item Pipe Service/Sizes Manufacturer/Model No. Remarks

37 Pipe

38 Fittings

39 Unions

40 Hangers & Supports

41 Insulation

42 Plbg. Specialties:

43 Floor Drains

44 Cleanouts

45

46 Shop drawing submittals are to be bound, labeled, contain the project manual cover page and a material
47 index list page showing item designation, manufacturer and additional items supplied with the installation.
48 Submit for all equipment and systems as indicated in the respective specification sections, marking each
49 submittal with that specification section number. Mark general catalog sheets and drawings to indicate
50 specific items being submitted and proper identification of equipment by name and/or number, as indicated
51 in the contract documents. Include wiring diagrams of electrically powered equipment.

1
2 Submit sufficient quantities of data sheets and shop drawings to allow the following distribution:
3

- 4 • Operating and Maintenance Manuals 2 copies
- 5 • Architect/Engineer 2 copies

6
7 **OPERATION AND MAINTENANCE DATA**

8 All operations and maintenance data shall comply with the submission and content requirements specified
9 under section GENERAL REQUIREMENTS.

10 In addition to the general content specified under GENERAL REQUIREMENTS supply the following
11 additional documentation:

- 12 1. Records of tests performed a to certify compliance with system requirements
- 13 2. Certificates of inspection by regulatory agencies
- 14 3. Valve schedules
- 15 4. Parts lists for valves and specialties.
- 16 5. Additional information as indicated in the technical specification sections

17
18
19 **TRAINING OF OWNER PERSONNEL**

20 Instruct Owner's personnel in the proper operation and maintenance of systems and equipment provided as
21 part of this project. Include not less than 0.5 hours of instruction, using the Operating and Maintenance
22 manuals during this instruction. Demonstrate startup, operation and shutdown procedures for all
23 equipment. All training to be during normal working hours.

24
25 **RECORD DRAWINGS**

26 Refer to Division 1, General Requirements, Record Drawings.

27
28
29 **PART 2 - PRODUCTS**

30
31 **ACCESS PANELS AND DOORS**

32 **LAY-IN CEILINGS:**

33 Removable lay-in ceiling tiles in 2 X 2 foot or 2 X 4 foot configuration provided under Section 09500 are
34 sufficient; no additional access provisions are required unless specifically indicated.

35
36 **PLASTER WALLS AND CEILINGS:**

37 16 gauge frame with not less than a 20 gauge hinged door panel, prime coated steel for general
38 applications, concealed hinges, screwdriver operated cam latch, UL listed for use in fire rated partitions if
39 required by the application. Use the largest size access opening possible, consistent with the space and the
40 item needing service; minimum size is 12" by 12".

41
42 **IDENTIFICATION**

43 **STENCILS:**

44 Not less than 1 inch high letters/numbers for marking pipe.

45
46 **SNAP-AROUND PIPE MARKERS:**

47 One-piece, preformed, vinyl construction, snap-around or strap-around pipe markers with applicable
48 labeling and flow direction arrows, 3/4" min. size for lettering. Provide nylon ties on each end of pipe
49 markers. Equal to Seton Setmark.

50
51 **SEALING AND FIRESTOPPING**

52 **FIRE AND/OR SMOKE RATED PENETRATIONS:**

53 Manufacturers: 3M, Hilti, Rectorseal, STI/SpecSeal, Tremco, or approved equal.

1
2 All firestopping systems shall be provided by the same manufacturer.
3
4 Fire stop systems shall be UL listed or tested by an independent testing laboratory approved by the
5 Department of Commerce.
6
7 Submittals: Contractor shall submit product data for each firestop system. Submittals shall include
8 product characteristics, performance and limitation criteria, test data, MSDS sheets, installation details and
9 procedures for each method of installation applicable to this project. For non-standard conditions where no
10 UL tested system exists, submit manufacturer's drawings for UL system with known performance for
11 which an engineering judgement can be based upon.
12
13 Use a product that has a rating not less than the rating of the wall or floor being penetrated. Reference
14 architectural drawings for identification of fire and/or smoke rated walls and floors.
15
16 Use firestop putty, caulk sealant, intumescent wrapstrips, intumescent firestop collars, firestop blocks,
17 firestop mortar or a combination of these products to provide a UL listed system for each application
18 required for this project. Provide mineral wool backing where specified in manufacturer's application
19 detail.
20
21 **NON-RATED PENETRATIONS:**
22 At pipe penetrations of non-rated interior partitions and floors, use urethane caulk in annular space
23 between pipe insulation and sleeve. For non-rated drywall, plaster or wood partitions where sleeve is not
24 required use urethane caulk in annular space between pipe insulation and wall material
25
26

27 **PART 3 - EXECUTION**

28 **DEMOLITION**

29 Perform all demolition as indicated on the drawings to accomplish new work. Where demolition work is to
30 be performed adjacent to existing work that remains in an occupied area, construct temporary dust partition
31 to minimize the amount of contamination of the occupied space. Where pipe is removed and not
32 reconnected with new work, cap ends of existing services as if they were new work. Coordinate work with
33 the Owner to minimize disruption to the existing building occupants.
34
35

36 All pipe, fixtures, equipment, wiring and associated conduit, insulation and similar items demolished,
37 abandoned, or deactivated are to be removed from the site by the Contractor except as specifically noted
38 otherwise. All designated equipment is to be turned over to the user agency for their use at a place and time
39 so designated. Maintain the condition of material and/or equipment that is indicated to be reused equal to
40 that existing before work began.
41

42 **CUTTING AND PATCHING**

43 Refer to Division 1, General Requirements, Cutting and Patching.
44

45 **BUILDING ACCESS**

46 Arrange for the necessary openings in the building to allow for admittance or removal of all apparatus.
47 When the building access was not previously arranged and must be provided by this contractor, restore any
48 opening to its original condition after the apparatus has been brought into the building.
49

50 **EQUIPMENT ACCESS**

1 Install all piping, conduit and accessories to permit access to equipment for maintenance and service.
2 Coordinate the exact location of wall and ceiling access panels and doors with the General Contractor,
3 making sure that access is available for all equipment and specialties. Access doors in general construction
4 are to be furnished by the Plumbing Contractor and installed by the General Contractor.
5

6 Provide color coded thumb tacks or screws, depending on the surface, for use in accessible ceilings which
7 do not require access panels.
8

9 **COORDINATION**

10 Coordinate all work with other contractors prior to installation. Any work that is not coordinated and that
11 interferes with other contractor's work shall be removed or relocated at the installing contractor's expense.
12

13 Verify that all devices are compatible for the type of construction and surfaces on which they will be used.
14

15 **IDENTIFICATION**

16 Identify interior piping not less than once every 30 feet, not less than once in each room, adjacent to each
17 access door or panel, and on both side of the partition where accessible piping passes through walls or
18 floors. Place flow directional arrows at each pipe identification location. Use one coat of black enamel
19 against a light background or white enamel against a dark background.
20

21 **SLEEVES**

22 Provide galvanized sheet metal sleeves for pipe penetrations through interior and exterior walls to provide
23 a backing for sealant or firestopping. Patch wall around sleeve to match adjacent wall construction and
24 finish. Grout area around sleeve in masonry construction. In finished spaces where pipe penetration
25 through wall is exposed to view, sheet metal sleeve shall be installed flush with face of wall. In existing
26 poured concrete walls where penetration is core drilled, pipe sleeve is not required.
27

28 Pipe sleeves are not required in interior non-rated drywall, plaster or wood partitions and sleeves are not
29 required in existing poured concrete walls where penetrations are core drilled.
30

31 For floor penetrations through existing floors in mechanical and wet locations listed below, core drill
32 opening and provide 1-1/2" x 1-1/2" x 1/8" galvanized steel angles fastened to floor surrounding the
33 penetration or group of penetrations to prevent water from entering the penetration. Provide urethane caulk
34 between angles and floor and fasten angles to floor a minimum of 8" on center. Seal corners water tight
35 with urethane caulk. Or, core drill sleeve openings large enough to insert schedule 40 sleeve and grout area
36 around sleeve with hydraulic setting non-shrink grout/cement.
37

38 Pipe sleeves are not required in cored floor pipe penetrations through existing floors that are not located in
39 mechanical rooms, food service areas or wet locations listed above.
40

41 **SEALING AND FIRESTOPPING**

42 **FIRE AND/OR SMOKE RATED PENETRATIONS:**

43 Install approved product in accordance with the manufacturer's instructions where a pipe penetrates a
44 fire/smoke rated surface. When pipe is insulated, use a product which maintains the integrity of the
45 insulation and vapor barrier.
46

47
48 Where firestop mortar is used to infill large fire-rated floor openings that could be required to support
49 weight, provide permanent structural forming. Firestop mortar alone is not adequate to support substantial
50 weight.
51

52 **NON-RATED PARTITIONS:**

1 At all interior partitions, pipe penetrations are required to be sealed. Apply sealant to both sides of the
2 penetration in such a manner that the annular space between the pipe sleeve or cored opening and the pipe
3 or insulation is completely blocked.

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END OF SECTION

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**SECTION 22 05 14
PLUMBING SPECIALTIES**

PART 1 - GENERAL

SCOPE

This section includes specifications for floor drains, cleanouts and other miscellaneous plumbing specialties.

PART 1 - GENERAL

- Scope
- Related Documents
- Reference
- Reference Standards
- Quality Assurance
- Shop Drawings
- Operation and Maintenance Data

PART 2 - PRODUCTS

- Floor Drains
- Hub Drains
- Cleanouts

PART 3 - EXECUTION

- Installation

RELATED DOCUMENTS

- Section 22 11 00 - Facility Water Distribution
- Section 22 13 00 - Facility Sanitary Sewerage
- Section 22 14 00 - Facility Storm Drainage

REFERENCE

Applicable provisions of Division 1 shall govern work under this section.

REFERENCE STANDARDS

- ANSI A112.14.1 - Backwater Valves
- ANSI A112.21.1 - Floor Drains

QUALITY ASSURANCE

Substitution of Materials: Refer to Section GC - General Conditions of the Contract, Equals and Substitutions.

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.

SHOP DRAWINGS

Include data concerning dimensions, capacities, materials of construction, ratings, certifications, weights, manufacturer's installation requirements, manufacturer's performance limitations, and appropriate identification.

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

FLOOR DRAINS

Manufacturer: Josam, Smith, Wade, Watts, Zurn.

1 FD-1: enameled heavy duty cast iron two piece body with double drainage flange, weep holes, heavy duty
2 adjustable 9" round coated cast iron tractor grate strainer, with sediment bucket, bottom outlet. Zurn Z-
3 556-Y. Outlet size as indicated on drawings.

4
5 **HUB DRAINS**

6 Manufacturer: Josam, Smith, Wade, Watts, Zurn.

7
8 HD-1: 3" min. cast iron hub section up 3" min. above floor level, with full-sized deep seal P-trap and with
9 the addition of a ball float type backwater valve. Z-1099.

10
11 **PART 3 - EXECUTION**

12
13
14 **INSTALLATION**

15 Coordinate location and setting of plumbing specialties with adjacent construction. Install in accordance
16 with manufacturers recommendations.

17 Set floor drains and hub drains level and plumb adjusted to finished floor elevation. Locate where
18 serviceable. Provide deep seal traps on floor drains.

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21
22 **END OF SECTION**

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**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 materials. Included are the following topics:

PART 1 - GENERAL

- Scope
- Related Work
- Reference
- Reference Standards
- Quality Assurance
- Description
- Shop Drawings
- Design Criteria

PART 2 - PRODUCTS

- Manufacturers
- Structural Supports
- Pipe Hangers and Supports
- Beam Clamps
- Riser Clamps
- Concrete Inserts

PART 3 - EXECUTION

- Installation
- Hanger and Support Spacing
- Riser Clamps
- Concrete Inserts

RELATED WORK

Section 01 91 01 or 01 91 02 – Commissioning Process
Section 22 07 00 - Plumbing Insulation for insulation protection at support devices.

REFERENCE

Applicable provisions of Division 1 shall govern work under this section.

REFERENCE STANDARDS

- MSS SP-58
- MSS SP-69

REFERENCE

Applicable provisions of Division 1 govern work under this section.

QUALITY ASSURANCE

Substitution of Materials: Refer to Section GC - General Conditions of the Contract, Equals and Substitutions.

DESCRIPTION

1 Provide all supporting devices as required for the installation of mechanical equipment and materials. All
2 supports and installation procedures are to conform to the latest requirements of the ANSI Code for
3 building piping.

4

5 Do not hang any plumbing item directly from a metal deck or run piping so its rests on the bottom chord of
6 any truss or joist.

7

8 Fasteners depending on soft lead for holding power or requiring powder actuation will not be accepted.

9

10 Support material under all conditions of operation, variations in installed and operating weight of
11 equipment and piping, to prevent excess stress, and allow for proper expansion and contraction.

12

13 Protect insulation at all hanger points; see Related Work above.

14

15 **SHOP DRAWINGS**

16 Schedule of all hanger and support devices indicating attachment methods and type of device for each pipe
17 size and type of service.

18

19 All submittals are to comply with submission and content requirements specified within section [17 00 00].

20

21 **DESIGN CRITERIA**

22 Materials and application of pipe hangers and supports shall be in accordance with MSS Standard Practice
23 SP-58 and SP-69 unless noted otherwise.

24

25

26

PART 2 - PRODUCTS

27

28 **MANUFACTURERS**

29 Anvil, B-Line, Pate, Piping Technology, Roof Products & Systems or approved equal.

30

31 **STRUCTURAL SUPPORTS**

32 Provide all supporting steel required for the installation of plumbing materials, including angles, channels,
33 beams, etc. All of this steel may not be specifically indicated on the drawings.

34

35 **PIPE HANGERS AND SUPPORTS**

36 **HANGERS FOR PIPE SIZES 1/2" THROUGH 2":**

37 Carbon steel, adjustable swivel ring. B-Line B3170NF, Anvil 69 or 70.

38 Carbon steel, adjustable clevis, standard. B-Line B3100, Anvil 260.

39

40 **HANGERS FOR PIPE SIZES 2" AND LARGER:**

41 Carbon steel, adjustable clevis, standard. B-Line B3100, Anvil 260.

42

43 **MULTIPLE OR TRAPEZE HANGERS:**

44 Steel channels with welded spacers and hanger rods.

45

46 **WALL SUPPORT:**

47 Carbon steel welded bracket with hanger. B-Line 3068 Series, Anvil 194 Series.

48

49 Perforated, epoxy painted finish, 16-12 gauge, min., steel channels securely anchored to wall structure,
50 with interlocking, split-type, bolt secured, galvanized pipe/tubing clamps. B-Line type S channel with B-
51 2000 series clamps, Anvil type PS 200 H with PS 1200 clamps. When copper piping is being supported,

1 provide flexible elastomeric/thermoplastic isolation cushion material to completely encircle the piping and
2 avoid contact with the channel or clamp, equal to B-Line B1999 Vibra Cushion or provide manufacturers
3 clamp and cushion assemblies, B-Line BVT series, Anvil PS 1400 series.

4

5 **VERTICAL SUPPORT:**

6 Carbon steel riser clamp. B-Line B3373, Anvil 261 for above floor use.

7

8 **FLOOR SUPPORT:**

9 Carbon steel pipe saddle, stand and bolted floor flange. B-Line B3088T/B3093.

10

11 **COPPER PIPE SUPPORTS:**

12 All supports, fasteners, clamps, etc. directly connected to copper piping shall be copper plated or
13 polyvinylchloride coated. Where steel channels are used, provide isolation collar between
14 supports/clamps/fasteners and copper piping.

15

16 **PIPE HANGER RODS**

17 **STEEL HANGER RODS:**

18 Threaded both ends, threaded one end, or continuous threaded, complete with adjusting and lock nuts.

19

20 Size rods for individual hangers and trapeze support as indicated in the following schedule.

21

22 Total weight of equipment, including valves, fittings, pipe, pipe content, and insulation, are not to exceed
23 the limits indicated.

24

25	Maximum Load (Lbs.)	Rod Diameter
26	<u>(650°F Maximum Temp.)</u>	<u>(inches)</u>
27	610	3/8
28	1130	1/2
29	1810	5/8
30	2710	3/4
31	3770	7/8
32	4960	1
33	8000	1-1/4

34

35 **BEAM CLAMPS**

36 MSS SP-69 Types 19 & 23 malleable black iron clamp for attachment to beam flange to 0.62 inches thick
37 with a retaining ring and threaded rod of 3/8, 1/2, and 5/8 inch diameter. Furnish with a hardened steel cup
38 point set screw. B-Line B3036L/B3034, Anvil 86/92.

39

40 MSS SP-69 Type 28 or Type 29 forged steel jaw type clamp with a tie rod to lock clamp in place, suitable
41 for rod sizes to 1-1/2 inch diameter. B-Line B3054, Anvil 228.

42

43 **CONCRETE INSERTS**

44 **DRILLED FASTENERS:**

45 Carbon steel expansion anchors, vibration resistant, with ASTM B633 zinc plating. Use drill bit of same
46 manufacturer as anchor. Hilti, Rawl, Redhead.

47

48

49

PART 3 - EXECUTION

50

51 **INSTALLATION**

1 Size, apply and install supports and anchors in compliance with manufacturers recommendations.
2
3 Install supports to provide for free expansion of the piping system. Support all piping from the structure
4 using concrete inserts, beam clamps, ceiling plates, wall brackets, or floor stands. Fasten ceiling plates and
5 wall brackets securely to the structure and test to demonstrate the adequacy of the fastening.
6

7 Coordinate hanger and support installation to properly group piping of all trades.
8

9 Where piping can be conveniently grouped to allow the use of trapeze type supports, use standard
10 structural shapes or continuous insert channels for the supporting steel. Where continuous insert channels
11 are used, pipe supporting devices made specifically for use with the channels may be substituted for the
12 specified supporting devices provided that similar types are used and all data is submitted for prior
13 approval.
14

15 Size and install hangers and supports, except for riser clamps, for installation on the exterior of piping
16 insulation. Where a vapor barrier is not required, hangers may be installed either on the exterior of pipe
17 insulation or directly on piping.
18

19 Perform welding in accordance with standards of the American Welding Society.
20

21 **HANGER AND SUPPORT SPACING**

22 Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
23

24 Place a hanger within 12 inches of each horizontal elbow, valve, strainer, or similar piping specialty item.
25

26 Use hangers with 1-1/2 inch minimum vertical adjustment.
27

28 Where several pipes can be installed in parallel and at the same elevation, provide multiple or trapeze
29 hangers.
30

31 Support riser piping independently of connected horizontal piping.
32

33 Adjust hangers to obtain the slope specified in the piping section of these specifications.
34

35 Space hangers for pipe as follows:
36

<u>Pipe Material</u>	<u>Pipe Size</u>	<u>Max. Horiz. Spacing</u>	<u>Max. Vert. Spacing</u>
38 Cast Iron	2" and larger	5'-0"	15'-0"
39 Copper	1/2" through 3/4"	5'-0"	10'-0"
40 Copper	1" through 1-1/4"	6'-0"	10'-0"
41 Copper	1-1/2" through 2-1/2"	8'-0"	10'-0"
42 Copper	3"	10'-0"	10'-0"
43 Copper	4" and larger	12'-0"	10'-0"

44 **RISER CLAMPS**

45 Support vertical piping with clamps secured to the piping and resting on the building structure or secured
46 to the building structure below at each floor.
47
48

49 **CONCRETE INSERTS**

50 Select size based on the manufacturer's stated load capacity and weight of material that will be supported.
51 Use inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.

1 Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inch size. Where
2 concrete slabs form finished ceiling, provide inserts that are flush with the slab surface.

3

4 **ANCHORS**

5 Install where indicated on the drawings and details. Where not specifically indicated, install anchors at
6 ends of principal pipe runs and at intermediate points in pipe runs between expansion loops. Make
7 provisions for preset of anchors as required to accommodate both expansion and contraction of piping.

8

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END OF SECTION

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SECTION 22 07 00
PLUMBING INSULATION

PART 1 - GENERAL

SCOPE

This section includes insulation specifications for plumbing piping. Included are the following topics:

PART 1 - GENERAL

- Scope
- Related Work
- Reference Standards
- Quality Assurance
- Description
- Definitions
- Shop Drawings
- Operation and Maintenance Data

PART 2 - PRODUCTS

- Materials
- Insulation & Jackets
- Accessories

PART 3 - EXECUTION

- Installation
- Piping, Valve and Fitting Insulation

RELATED WORK

- Section 22 05 00 - Common Work Results for Plumbing
- Section 22 11 00 - Facility Water Distribution
- Section 22 14 00 - Facility Storm Drainage

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 C303 Density of Preformed Block Insulation
- 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 C591 Preformed Rigid Cellular Polyurethane Thermal Insulation

1	ASTM C610	Expanded Perlite Block and Thermal Pipe Insulation
2	ASTM C612	Mineral Fiber Block and Board Thermal Insulation
3	ASTM C921	Properties of Jacketing Materials for Thermal Insulation
4	ASTM C1136	Flexible Low Permeance Vapor Retarders for Thermal Insulation
5	ASTM E84	Surface Burning Characteristics of Building Materials
6	MICA	National Commercial & Industrial Insulation Standards
7	NFPA 225	Surface Burning Characteristics of Building Materials
8	UL 723	Surface Burning Characteristics of Building Materials

9

10 **QUALITY ASSURANCE**

11 Substitution of Materials: Refer to Section GC - General Conditions of the Contract, Equals and
 12 Substitutions.

13

14 Label all insulating products delivered to the construction site with the manufacturer's name and
 15 description of materials.

16

17 **DESCRIPTION**

18 Furnish and install all insulating materials and accessories as specified or as required for a complete
 19 installation. The following types of insulation are specified in this section:

20

- 21 • Pipe Insulation

22

23 Install all insulation in accordance with the latest edition of MICA (Midwest Insulation Contractors
 24 Association) Standard and manufacturer's installation instructions. Exceptions to these standards will only
 25 be accepted where specifically modified in these specifications, or where prior written approval has been
 26 obtained from the DFD Project Representative.

27

28 **DEFINITIONS**

29 Concealed: shafts, furred spaces, space above finished ceilings, utility tunnels and crawl spaces. All other
 30 areas, including walk-through tunnels, shall be considered as exposed.

31

32 **SHOP DRAWINGS**

33 Submit a schedule of all insulating materials to be used on the project, including adhesives, fastening
 34 methods, fitting materials along with material safety data sheets and intended use of each material. Include
 35 manufacturer's technical data sheets indicating density, thermal characteristics, jacket type, and
 36 manufacturer's installation instructions.

37

38 **OPERATION AND MAINTENANCE DATA**

39 All operations and maintenance data shall comply with the submission and content requirements specified
 40 under section GENERAL REQUIREMENTS.

41

42

43 **PART 2 - PRODUCTS**

44

45 **MATERIALS**

46 Materials or accessories containing asbestos will not be accepted.

47

48 Use composite insulation systems (insulation, jackets, sealants, mastics, and adhesives) that have a flame
 49 spread rating of 25 or less and smoke developed rating of 50 or less, with the following exceptions:

50

1 Insulation which is not located in an air plenum may have a flame spread rating not over 25 and a
2 smoke developed rating no higher than 150.

3

4 **INSULATION AND JACKETS**

5 Manufacturers: Armstrong, Certainteed Manson, Childers, Dow, Extol, Halstead, H.B. Fuller, Imcoa,
6 Knauf, Owens-Corning, Pittsburgh Corning, Rubatex, Johns-Mansville, or approved equal.

7

8 Insulating materials shall be fire retardant, moisture and mildew resistant, and vermin proof. Insulation
9 shall be suitable to receive jackets, adhesives and coatings as indicated.

10

11 **RIGID FIBERGLASS INSULATION:**

12 Minimum nominal density of 3 lbs. per cu. ft., and thermal conductivity of not more than 0.23 at 75
13 degrees F, minimum compressive strength of 25 PSF at 10% deformation, rated for service to 450 degrees
14 F.

15

16 White kraft reinforced foil vapor barrier all service jacket, factory applied to insulation with a self-sealing
17 pressure sensitive adhesive lap, maximum permeance of .02 perms and minimum beach puncture resistance
18 of 50 units.

19

20 **PVC FITTING COVERS AND JACKETS:**

21 White PVC film, gloss finish one side, semi-gloss other side, FS LP-535D, Composition A, Type II, Grade
22 GU. Ultraviolet inhibited indoor/outdoor grade to be used where exposed to high humidity, ultraviolet
23 radiation, in kitchens or food processing areas or installed outdoors. Jacket thickness to be .02 inch (20
24 mil).

25

26 **INSULATION INSERTS AND PIPE SHIELDS**

27 Manufacturers: B-Line, Pipe Shields, Value Engineered Products

28

29 Construct inserts with calcium silicate, minimum 140 psi compressive strength. Piping 12" and larger,
30 supplement with high density 600 psi structural calcium silicate insert. Provide galvanized steel shield.
31 Insert and shield to be minimum 180 degree coverage on bottom of supported piping and full 360 degree
32 coverage on clamped piping. On roller mounted piping and piping designed to slide on support, provide
33 additional load distribution steel plate.

34

35 Where contractor proposes shop/site fabricated inserts and shields, submit schedule of materials,
36 thicknesses, gauges and lengths for each pipe size to demonstrate equivalency to pre-engineered pre-
37 manufactured product described above. On low temperature systems, extruded polystyrene may be
38 substituted for calcium silicate provided insert and shield length and gauge are increased to compensate for
39 lower insulation compressive strength.

40

41 Precompressed 20# density molded fiberglass blocks, Hamfab or equal, of same thickness as adjacent
42 insulation may be substituted for calcium silicate inserts with one 1"x 6" block for piping through 2-1/2"
43 and three 1" x 6" blocks for piping through 4". Submit shield schedule to demonstrate equivalency to pre-
44 engineered/pre-manufactured product described above.

45

46 Wood blocks will not be accepted.

47

48 **ACCESSORIES**

49 All products shall be compatible with surfaces and materials on which they are applied, and be suitable for
50 use at operating temperatures of the systems to which they are applied.

51

1 Adhesives, sealants, and protective finishes shall be as recommended by insulation manufacturer for
2 applications specified.

3
4 Insulation bands to be 3/4 inch wide, constructed of aluminum or stainless steel. Minimum thickness to be
5 .015 inch for aluminum and .010 inch for stainless steel.

8 **PART 3 - EXECUTION**

10 **INSTALLATION**

11 Install insulation, jackets and accessories in accordance with manufacturers instructions and under ambient
12 temperatures and conditions recommended by manufacturer. Surfaces to be insulated must be clean and
13 dry.

14
15 Do not insulate systems or equipment which are specified to be pressure tested or inspected, until testing,
16 inspection and any necessary repairs have been successfully completed.

17
18 Install insulation with smooth and even surfaces. Poorly fitted joints or use of filler in voids will not be
19 accepted. Cover and seal exposed fiberglass insulation when insulation is terminated, no raw fiberglass
20 insulation is allowed. Provide neat and coated terminations at all nameplates, uninsulated fittings, or at
21 other locations where insulation terminates. Install with longitudinal joints facing wall or ceiling.

22
23 Use full-length material (as delivered from manufacturer) wherever possible. Scrap piecing of insulation
24 or pieces cut undersize and stretched to fit will not be accepted.

25
26 Insulation shall be continuous through sleeves and openings. Vapor barriers shall be maintained continuous
27 through all penetrations.

28
29 Provide a complete vapor barrier for insulation on the following systems:

- 30
- 31 • Cold water (potable and non-potable)
- 32 • Storm Water and Clearwater Waste
- 33

34 **PIPING, VALVE, AND FITTING INSULATION**

35 **GENERAL:**

36 Install insulation with butt joints and longitudinal seams closed tightly. Provide minimum 2" lap on jacket
37 seams and 2" tape on butt joints, firmly cemented with lap adhesive. Additionally secure with staples along
38 seams and butt joints. Coat staples with vapor barrier mastic on systems requiring vapor barrier.

39
40 Water supply piping insulation shall be continuous throughout the building and installed adjacent to and
41 within building walls to a point directly behind the fixture that is being supplied.

42
43 Install insulation continuous through pipe hangers and supports with hangers and supports on the exterior
44 of insulation. Where a vapor barrier is not required, hangers and supports may be attached directly to
45 piping with insulation completely covering hanger or support and jacket sealed at support rod penetration.
46 Where riser clamps are required to be attached directly to piping requiring vapor barrier, extend insulation
47 and vapor barrier jacketing/coating around riser clamp.

48 **INSULATION INSERTS AND PIPE SHIELDS:**

49 Provide insulation inserts and pipe shields at all hanger and support locations. Inserts may be omitted on
50 3/4" and smaller copper piping provided 12" long 22 gauge pipe shields are used.
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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. Cover insulation with fabric reinforcing and mastic or where temperatures do not exceed 150 degrees, PVC fitting covers. Secure PVC fitting covers with tack fasteners and 1-1/2" band of mastic over ends, throat, seams or penetrations. On systems requiring vapor barrier, use vapor barrier mastic.

PROTECTIVE JACKETS:

Provide a protective PVC jacket for the following insulated piping: exposed piping within 7' 0" of floor.

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 existing remodeled piping as indicated in the following schedule:

Service	Insulation Types	Insulation Thickness by Pipe Size				
		1" and smaller	1-1/4" to 2"	2-1/2" to 4"	5" to 6"	8" and larger
Cold Water	Rigid Fiberglass	0.5"	0.5"	1"	1"	1"
All Horizontal Clearwater Waste Piping	Rigid Fiberglass	0.5"	0.5"	0.5"	0.5"	0.5"

The following piping and fittings are not to be insulated:

- Chrome plated exposed supplies and stops (except where specifically noted).
- Water hammer arrestors.
- Piping unions and flanges for systems not requiring a vapor barrier.

END OF SECTION

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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
- Reference
- Reference Standards
- Shop Drawings
- Quality Assurance
- Delivery, Storage, and Handling
- Design Criteria

PART 2 - PRODUCTS

- Domestic Water
- Dielectric Unions
- Unions
- Mechanical Grooved Pipe Connections

PART 3 - EXECUTION

- General
- Preparation
- Erection
- Copper Pipe Joints
- Threaded Pipe Joints
- Mechanically Formed Tee Fittings
- Domestic Water
- Dielectric Unions
- Unions
- Piping System Leak Tests

RELATED WORK

22 05 29 - Hangers and Supports for Plumbing Piping and Equipment

REFERENCE

Applicable provisions of Division 1 govern work under this section.

REFERENCE STANDARDS

- ANSI B16.22 Wrought Copper and Wrought Copper Alloy Solder Joint Pressure Fittings
- ANSI B16.29 Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings - DWV
- ASTM B32 Solder Metal
- ASTM B88 Seamless Copper Water Tube
- ASTM B280 Seamless Copper Tube for Air Conditioning and Refrigeration Field Service
- ASTM B813 Liquid and Paste Fluxes for Soldering Applications of Copper and Copper Alloy Tube
- AWS A5.8 Brazing Filler Metal

SHOP DRAWINGS

1 Schedule from the contractor indicating the ASTM, AWWA or CISPI specification number of the pipe
2 being proposed along with its type and grade if known at the time of submittal, and sufficient information
3 to indicate the type and rating of fittings for each service.

4
5 Statement from manufacturer on his letterhead that pipe furnished meets the ASTM, AWWA or CISPI
6 specification contained in this section.

7
8 **QUALITY ASSURANCE**

9 Substitution of Materials: Refer to Section GC – General Conditions of the Contract, Equals and
10 Substitutions.

11
12 Order all copper and steel pipe with each length marked with the name or trademark of the manufacturer
13 and type of pipe; with each shipping unit marked with the purchase order number, metal or alloy
14 designation, temper, size, and name of supplier.

15
16 Any installed material not meeting the specification requirements must be replaced with material that meets
17 these specifications without additional cost to the State.

18
19 **DELIVERY, STORAGE, AND HANDLING**

20 Promptly inspect shipments to insure that the material is undamaged and complies with specifications.

21
22 Cover pipe to prevent corrosion or deterioration while allowing sufficient ventilation to avoid
23 condensation. Do not store materials directly on grade. Protect pipe, tube, and fitting ends so they are not
24 damaged. Where end caps are provided or specified, take precautions so the caps remain in place. Protect
25 fittings, flanges, and unions by storage inside or by durable, waterproof, above ground packaging.

26
27 Offsite storage agreements will not relieve the contractor from using proper storage techniques.

28
29 Storage and protection methods must allow inspection to verify products.

30
31 **DESIGN CRITERIA**

32 Use only new material, free of defects, rust and scale, and meeting the latest revision of ASTM, AWWA or
33 CISPI specifications as listed in this specification.

34
35 Construct all piping for the highest pressures and temperatures in the respective system.

36
37 Where ASTM B88, type L H (drawn) temper copper tubing is specified, ASTM B88, type K H (drawn)
38 temper copper tubing may be substituted at Contractor's option.

39
40
41 **PART 2 - PRODUCTS**

42
43 **DOMESTIC WATER**

44 **ABOVE GROUND:**

45 Type L copper water tube, H (drawn) temper, ASTM B88; wrought copper pressure fittings, ANSI B16.22;
46 lead free (<.2%) solder, ASTM B32; flux, ASTM B813; copper phosphorous brazing alloy, AWS A5.8
47 BCuP. Mechanically formed brazed tee connections may be used in lieu of specified tee fittings for branch
48 takeoffs up to one-half (1/2) the diameter of the main.

49
50 **DIELECTRIC UNIONS**

1 Watts Regulator Company, Lochinvar, Wilkins or EPCO Sales, Inc., dielectric unions 2" and smaller;
2 dielectric flanges 2" and larger; with iron female pipe thread to copper solder joint or brass female pipe
3 thread end connections, non-asbestos gaskets, having a pressure rating of not less than 175 psig at 180
4 degrees.

5
6 **UNIONS**

7 Unions and gasket materials to have a pressure rating of not less than 150 psig at 180 degrees. Gasket
8 material for flanges and flanged fittings shall be teflon type. Treated paper gaskets are not acceptable.

9
10 **2" AND SMALLER COPPER:**

11 ANSI B16.18 cast bronze union coupling or ANSI B15.24 Class 150 cast bronze flanges.

12
13
14 **PART 3 - EXECUTION**

15
16 **GENERAL**

17 Install pipe and fittings in accordance with reference standards, manufacturers recommendations and
18 recognized industry practices.

19
20 **PREPARATION**

21 Cut pipe ends square. Ream ends of piping to remove burrs. Clean scale and dirt from interior and exterior
22 of each section of pipe and fitting prior to assembly.

23
24 **ERECTION**

25 Install all piping parallel to building walls and ceilings and at heights which do not obstruct any portion of
26 a window, doorway, stairway, or passageway. Where interferences develop in the field, offset or reroute
27 piping as required to clear such interferences. Coordinate locations of plumbing piping with piping,
28 ductwork, conduit and equipment of other trades to allow sufficient clearances. In all cases, consult
29 drawings for exact location of pipe spaces, ceiling heights, door and window openings, or other
30 architectural details before installing piping.

31
32 Maintain piping in clean condition internally during construction.

33
34 Provide clearance for installation of insulation, access to valves and piping specialties.

35
36 Install all valves and piping specialties, including items furnished by others, as specified and/or detailed.
37 Provide access to valves and specialties for maintenance. Make connections to all equipment, fixtures and
38 systems installed by others where same requires the piping services indicated in this section.

39
40 **COPPER PIPE JOINTS**

41 Remove all slivers and burrs remaining from the cutting operation by reaming and filing both pipe
42 surfaces. Clean fitting and tube with metal brush, emery cloth or sandpaper. Remove residue from the
43 cleaning operation, apply flux and assemble joint to socket stop. Apply flame to fitting until solder melts
44 when placed at joint. Remove flame and feed solder into joint until full penetration of cup and ring of
45 solder appears. Wipe excess solder and flux from joint.

46
47 **THREADED PIPE JOINTS**

48 Use a thread lubricant or teflon tape when making joints; no hard setting pipe thread cement or caulking
49 will be allowed.

50
51 **MECHANICALLY FORMED TEE FITTINGS**

1 Form mechanically extracted collars in a continuous operation, consisting of drilling a pilot hole and
2 drawing out the tube surface to form a collar having a height of not less than three times the thickness of
3 the tube wall. Use an adjustable collaring device. Notch and dimple the branch tube. Braze the joint with
4 neutral flame oxy-acetylene torch, applying heat properly so that pipe and tee do not distort; remove
5 distorted connections.

6
7 **DOMESTIC WATER**

8 Maintain piping system in clean condition during installation. Remove dirt and debris from assembly of
9 piping as work progresses. Cap open pipe ends where left unattended or subject to contamination.

10
11 Install interior water piping with drain valves where indicated and at low points of system to allow
12 complete drainage. Install shutoff valves where indicated and at the base of risers to allow isolation of
13 portions of system for repair. Do not install water piping within exterior walls.

14
15 Prior to use, isolate and fill system with potable water. Allow to stand 24 hours. Flush each outlet
16 proceeding from the service entrance to the furthest outlet for minimum of 1 minute and until water
17 appears clear. Fill system with a solution of water and chlorine containing at least 50 parts per million of
18 chlorine and allow to stand for 24 hours. Alternately a solution containing at least 200 parts per million of
19 chlorine may be used and allowed to stand for 3 hours. Flush system with potable water until chlorine
20 concentration is no higher than source water level.

21
22 Wait 24 hours after final flushing. Take samples of water for lab testing. The number and location of
23 samples shall be representative of the system size and configuration and are subject to approval by
24 Engineer. Test shall show the absence of coliform bacteria. If test fails, repeat disinfection and testing
25 procedures until no coliform bacteria are detected. Submit test report indicating date and time of test along
26 with test results.

27
28 **DIELECTRIC UNIONS**

29 Install dielectric unions at each point where a copper-to-steel pipe connection is required in domestic water
30 systems.

31
32 **UNIONS**

33 Install a union at each connection to each piece of equipment and at other items which may require removal
34 for maintenance, repair, or replacement. Where a valve is located at a piece of equipment, locate the flange
35 or union connection on the equipment side of the valve. Concealed unions or flanges are not acceptable.

36
37 **PIPING SYSTEM LEAK TESTS**

38 Isolate or remove components from system which are not rated for test pressure. Test piping in sections or
39 entire system as required by sequence of construction. Do not insulate or conceal pipe until it has been
40 successfully tested.

41
42 If required for the additional pressure load under test, provide temporary restraints at fittings or expansion
43 joints. Backfill underground water mains prior to testing with the exception of thrust restrained valves
44 which may be exposed to isolate potential leaks.

45
46 For hydrostatic tests, use clean water and remove all air from the piping being tested by means of air vents
47 or loosening of flanges/unions. Measure and record test pressure at the high point in the system.

48
49 Inspect system for leaks. Where leaks occur, repair the area with new materials and repeat the test;
50 caulking will not be acceptable.

1 Entire test must be witnessed by the Owner's representative.

2

3

<u>System</u>	<u>Test</u>	<u>Initial Test</u>		<u>Final Test</u>	
	<u>Medium</u>	<u>Pressure</u>	<u>Duration</u>	<u>Pressure</u>	<u>Duration</u>

5 Above Ground Domestic Water	Water	N/A		100 psig	8 hr
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6 Above Ground Non-potable Water	Water	N/A		100 psig	8 hr
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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
- Reference
- Reference Standards
- Shop Drawings
- Quality Assurance
- Delivery, Storage, and Handling
- Design Criteria

PART 2 - PRODUCTS

- Sanitary Waste and Vent

PART 3 - EXECUTION

- General
- Preparation
- Erection
- Threaded Pipe Joints
- Solvent Welded Pipe Joints
- Mechanical Hubless Pipe Connections
- Sanitary Waste and Vent
- Piping System Leak Tests
- Construction Verification Items

RELATED WORK

- 22 05 29 - Hangers and Supports for Plumbing Piping and Equipment
- 22 05 14 - Plumbing Specialties

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
- 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 A234 Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures
- ASTM A888 Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications
- ASTM B32 Solder Metal

- 1 ASTM B813 Liquid and Paste Fluxes for Soldering Applications of Copper and Copper Alloy Tube
- 2 ASTM C564 Standard Specifications for Rubber Gaskets for Cast Iron Soil Pipe and Fittings
- 3 ASTM C1540 Standard Specifications for Heavy Duty Shielded Couplings Joining Hubless Cast Iron
- 4 Soil Pipe and Fittings
- 5 ASTM D1785 Poly Vinyl Chloride (PVC) Plastic Pipe
- 6 ASTM D2241 Poly Vinyl Chloride (PVC) Pressure-Rated Pipe (SDR Series)
- 7 ASTM D2466 Poly Vinyl Chloride (PVC) Plastic Pipe Fittings, Schedule 40
- 8 ASTM D2564 Solvent Cements for Poly Vinyl Chloride (PVC) Plastic Pipe and Fittings
- 9 ASTM D2665 Poly Vinyl Chloride (PVC) Plastic Drain, Waste and Vent Pipe and Fittings
- 10 ASTM D2729 Poly Vinyl Chloride (PVC) Sewer Pipe and Fittings
- 11 ASTM D2855 Making Solvent Cemented Joints with Poly Vinyl Chloride (PVC) Pipe and Fittings
- 12 ASTM D3034 Type PSM Poly Vinyl Chloride (PVC) Sewer Pipe and Fittings
- 13 ASTM D3139 Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
- 14 ASTM D3212 Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
- 15 ASTM D3222 Unmodified Poly Vinylidene Fluoride (PVDF) Molding Extrusion and Coating Materials
- 16 ASTM D3311 Drain, Waste and Vent (DWV) Plastic Fitting Patterns
- 17 AWS A5.8 Brazing Filler Metal
- 18 CISPI 301 Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste and Vent
- 19 Piping Applications
- 20 CISPI 310 Couplings For Use In Connection With Hubless Cast Iron Soil Pipe And Fittings For
- 21 Sanitary And Storm Drain, Waste And Vent Piping Applications

22

23 **SHOP DRAWINGS**

24 Schedule from the contractor indicating the ASTM, or CISPI specification number of the pipe being
 25 proposed along with its type and grade if known at the time of submittal, and sufficient information to
 26 indicate the type and rating of fittings for each service.

27

28 Statement from manufacturer on his letterhead that pipe furnished meets the ASTM, or CISPI specification
 29 contained in this section.

30

31 **QUALITY ASSURANCE**

32 Substitution of Materials: Refer to Section GC – General Conditions of the Contract, Equals and
 33 Substitutions.

34

35 Order all copper, cast iron, steel and PVC pipe with each length marked with the name or trademark of the
 36 manufacturer and type of pipe; with each shipping unit marked with the purchase order number, metal or
 37 alloy designation, temper, size, and name of supplier.

38

39 Any installed material not meeting the specification requirements must be replaced with material that meets
 40 these specifications without additional cost to the State.

41

42 **DELIVERY, STORAGE, AND HANDLING**

43 Promptly inspect shipments to insure that the material is undamaged and complies with specifications.

44

45 Cover pipe to prevent corrosion or deterioration while allowing sufficient ventilation to avoid
 46 condensation. Do not store materials directly on grade. Protect pipe, tube, and fitting ends so they are not
 47 damaged. Where end caps are provided or specified, take precautions so the caps remain in place. Protect
 48 fittings, flanges, and unions by storage inside or by durable, waterproof, above ground packaging.

49

50 Offsite storage agreements will not relieve the contractor from using proper storage techniques.

51

52 Storage and protection methods must allow inspection to verify products.

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DESIGN CRITERIA

Use only new material, free of defects, rust and scale, and meeting the latest revision of ASTM, or CISPI specifications as listed in this specification.

Construct all piping for the highest pressures and temperatures in the respective system.

Non-metallic piping will be acceptable only for the services indicated. It will not be acceptable in ventilation plenum spaces, including plenum ceilings.

Where ASTM A53 type F pipe is specified, grade A type E or S, or grade B type E or S may be substituted at Contractor's option. Where the grade or type is not specified, Contractor may choose from those commercially available.

Where ASTM B88, type L H (drawn) temper copper tubing is specified, ASTM B88, type K H (drawn) temper copper tubing may be substituted at Contractor's option.

PART 2 - PRODUCTS

SANITARY WASTE AND VENT

INTERIOR ABOVE GROUND:

Hubless cast iron soil pipe and fittings, ASTM A888; with no-hub couplings, CISPI 310, CISPI 310, ASTM A74. Pipe and fittings shall be marked with the collective trademark of the Cast Iron Pipe Institute or receive prior approval of the Engineer.

PVC plastic pipe, Schedule 40, Class 12454-B (PVC 1120), ASTM D1785; PVC plastic drain, waste and vent pipe and fittings, ASTM D2665; socket fitting patterns, ASTM D3311; primer, ASTM F656; solvent cement, ASTM D2564.

Galvanized steel pipe, Schedule 40, Type F, Grade A, ASTM A53; with cast iron threaded drainage fittings, ASTM B16.12.

PART 3 - EXECUTION

GENERAL

Install pipe and fittings in accordance with reference standards, manufacturers recommendations and recognized industry practices.

PREPARATION

Cut pipe ends square. Ream ends of piping to remove burrs. Clean scale and dirt from interior and exterior of each section of pipe and fitting prior to assembly.

ERECTION

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. Coordinate locations of plumbing 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, door and window openings, or other architectural details before installing piping.

1
2 Where copper or steel piping is embedded in masonry or concrete, provide protective sleeve covering of
3 elastomeric pipe insulation.

4
5 Maintain piping in clean condition internally during construction.

6
7 Provide clearance for installation of insulation, access to valves and piping specialties.

8
9 Provide anchors, expansion joints, swing joints and/or expansion loops so that piping may expand and
10 contract without damage to itself, equipment, or building.

11
12 Do not route piping or above transformers, panelboards, or switchboards, including the required service
13 space for this equipment.

14
15 Install all valves and piping specialties, including items furnished by others, as specified and/or detailed.
16 Provide access to valves and specialties for maintenance. Make connections to all equipment, fixtures and
17 systems installed by others where same requires the piping services indicated in this section.

18 19 **THREADED PIPE JOINTS**

20 Use a thread lubricant or teflon tape when making joints; no hard setting pipe thread cement or caulking
21 will be allowed.

22 23 **SOLVENT WELDED PIPE JOINTS**

24 Install in accordance with ASTM D2855 "Making Solvent Cemented Joints with PVC Pipe and Fittings".
25 Saw cut piping square and smooth. Tube cutters may be used if they are fitted with wheels designed for use
26 with PVC pipe that do not leave a raised bead on pipe exterior. Support and restrain pipe during cutting to
27 prevent nicks and scratches. Bevel ends 10-15 degrees and deburr interior. Remove dust, drips, moisture,
28 grease and other superfluous materials from pipe interior and exterior. Check dry fit of pipe and fittings.
29 Reject materials which are out of round or do not fit within close tolerance. Use heavy body solvent
30 cement for large diameter fittings.

31
32 Maintain pipe, fittings, primer and cement between 40 and 100 degrees during application and curing.
33 Apply primer and solvent using separate daubers (3" and smaller piping only) or clean natural bristle
34 brushes about 1/2 the size of the pipe diameter. Apply primer to the fitting socket and pipe surface with a
35 scrubbing motion. Check for penetration and reapply as needed to dissolve surface to a depth of 4-5
36 thousandths. Apply solvent cement to the fitting socket and pipe in an amount greater than needed to fill
37 any gap. While both surfaces are wet, insert pipe into socket fitting with a quarter turn to the bottom of the
38 socket. Solvent cement application and insertion must be completed in less than 1 minute. Minimum of 2
39 installers is required on piping 4" and larger. Hold joint for 30 seconds or until set. Reference
40 manufacturers recommendations for initial set time before handling and for full curing time before pressure
41 testing. Cold weather solvent/cement may be utilized only under unusual circumstances and when
42 specifically approved by the Owner's Project Representative.

43 44 **MECHANICAL HUBLESS PIPE CONNECTIONS**

45 Place the gasket on the end of one pipe or fitting and the clamp assembly on the end of the other pipe or
46 fitting. Firmly seat the pipe or fitting ends against the integrally molded shoulder inside the neoprene
47 gasket. Slide the clamp assembly into position over the gasket. Tighten fasteners to manufacturers
48 recommended torque.

49 50 **SANITARY WASTE AND VENT**

1 Install interior piping pitched to drain at minimum slope of 1/4" per foot where possible and in no case less
2 than 1/8" per foot for piping 3" and larger.

3
4 Flush piping inlets (floor drains, hub drains, mop basins, fixtures, etc.) with high flow of water at
5 completion of project to demonstrate full flow capacity. Remove blockages and make necessary repairs
6 where flow is found to be impeded.

7
8 **PIPING SYSTEM LEAK TESTS**

9 Isolate or remove components from system which are not rated for test pressure. Test piping in sections or
10 entire system as required by sequence of construction. Do not insulate or conceal pipe until it has been
11 successfully tested.

12
13 For hydrostatic tests, use clean water and remove all air from the piping being tested by means of air vents
14 or loosening of flanges/unions. Measure and record test pressure at the high point in the system.

15
16 Inspect system for leaks. Where leaks occur, repair the area with new materials and repeat the test;
17 caulking will not be acceptable.

18
19 Entire test must be witnessed by the Owner's representative.

20
21

	<u>Test</u>	<u>Initial Test</u>		<u>Final Test</u>	
<u>System</u>	<u>Medium</u>	<u>Pressure</u>	<u>Duration</u>	<u>Pressure</u>	<u>Duration</u>
23 Sanitary Waste and Vent	Water	N/A		10' water	2 hr

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END OF SECTION

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SECTION 22 14 00
FACILITY STORM DRAINAGE

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
- Reference
- Reference Standards
- Shop Drawings
- Quality Assurance
- Delivery, Storage, and Handling
- Design Criteria
- Welder Qualifications

PART 2 - PRODUCTS

- Storm and Clear Water Waste

PART 3 - EXECUTION

- General
- Preparation
- Erection
- Welded Pipe Joints
- Threaded Pipe Joints
- Solvent Welded Pipe Joints
- Mechanical Hubless Pipe Connections
- Storm and Clearwater Waste and Vent
- Piping System Leak Tests
- Construction Verification Items

RELATED WORK

- 22 05 29 - Hangers and Supports for Plumbing Piping and Equipment
- 22 05 14 - Plumbing Specialties

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
- 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 A234 Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures
- ASTM A888 Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent

- 1 Piping Applications
- 2 ASTM B32 Solder Metal
- 3 ASTM B813 Liquid and Paste Fluxes for Soldering Applications of Copper and Copper Alloy Tube
- 4 ASTM C564 Rubber Gaskets for Cast Iron Soil Pipe and Fittings
- 5 ASTM C1540 Heavy Duty Shielded Couplings for Joining Hubless Cast Iron Soil Pipe and Fittings
- 6 ASTM D1785 Poly Vinyl Chloride (PVC) Plastic Pipe
- 7 ASTM D2241 Poly Vinyl Chloride (PVC) Pressure-Rated Pipe (SDR Series)
- 8 ASTM D2464 Threaded Poly Vinyl Chloride (PVC) Plastic Pipe Fittings, Schedule 80
- 9 ASTM D2466 Poly Vinyl Chloride (PVC) Plastic Pipe Fittings, Schedule 40
- 10 ASTM D2564 Solvent Cements for Poly Vinyl Chloride (PVC) Plastic Pipe and Fittings
- 11 ASTM D2657 Heat Fusion Joining of Polyolefin Pipe and Fittings
- 12 ASTM D2665 Poly Vinyl Chloride (PVC) Plastic Drain, Waste and Vent Pipe and Fittings
- 13 ASTM D2729 Poly Vinyl Chloride (PVC) Sewer Pipe and Fittings
- 14 ASTM D2855 Making Solvent Cemented Joints with Poly Vinyl Chloride (PVC) Pipe and Fittings
- 15 ASTM D3034 Type PSM Poly Vinyl Chloride (PVC) Sewer Pipe and Fittings
- 16 ASTM D3212 Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
- 17 ASTM D3311 Drain, Waste and Vent (DWV) Plastic Fitting Patterns
- 18 ASTM D4101 Propylene Plastic Injection and Extrusion Materials
- 19 ASTM F656 Primers for Use in Solvent Cement Joints of Poly Vinyl Chloride (PVC) Plastic Pipe and
- 20 Fittings
- 21 CISPI 301 Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste and
- 22 Vent Piping Applications
- 23 CISPI 310 Couplings For Use In Connection With Hubless Cast Iron Soil Pipe And Fittings For
- 24 Sanitary And Storm Drain, Waste And Vent Piping Applications

25

26 **SHOP DRAWINGS**

27 Schedule from the contractor indicating the ASTM, AWWA or CISPI specification number of the pipe
 28 being proposed along with its type and grade if known at the time of submittal, and sufficient information
 29 to indicate the type and rating of fittings for each service.

30

31 Statement from manufacturer on his letterhead that pipe furnished meets the ASTM, AWWA or CISPI
 32 specification contained in this section.

33

34 **QUALITY ASSURANCE**

35 Substitution of Materials: Refer to Section GC – General Conditions of the Contract, Equals and
 36 Substitutions.

37

38 Order all copper, cast iron, steel, PVC and polyethylene pipe with each length marked with the name or
 39 trademark of the manufacturer and type of pipe; with each shipping unit marked with the purchase order
 40 number, metal or alloy designation, temper, size, and name of supplier.

41

42 Any installed material not meeting the specification requirements must be replaced with material that meets
 43 these specifications without additional cost to the State.

44

45 **DELIVERY, STORAGE, AND HANDLING**

46 Promptly inspect shipments to insure that the material is undamaged and complies with specifications.

47

48 Cover pipe to prevent corrosion or deterioration while allowing sufficient ventilation to avoid
 49 condensation. Do not store materials directly on grade. Protect pipe, tube, and fitting ends so they are not
 50 damaged. Where end caps are provided or specified, take precautions so the caps remain in place. Protect
 51 fittings, flanges, and unions by storage inside or by durable, waterproof, above ground packaging.

1 Offsite storage agreements will not relieve the contractor from using proper storage techniques.

2

3 Storage and protection methods must allow inspection to verify products.

4

5 **DESIGN CRITERIA**

6 Use only new material, free of defects, rust and scale, and meeting the latest revision of ASTM, AWWA or
7 CISPI specifications as listed in this specification.

8

9 Construct all piping for the highest pressures and temperatures in the respective system.

10

11 Non-metallic piping will be acceptable only for the services indicated. It will not be acceptable in
12 ventilation plenum spaces, including plenum ceilings.

13

14 Where ASTM A53 type F pipe is specified, grade A type E or S, or grade B type E or S may be substituted
15 at Contractor's option. Where the grade or type is not specified, Contractor may choose from those
16 commercially available.

17

18 Where ASTM B88, type L H (drawn) temper copper tubing is specified, ASTM B88, type K H (drawn)
19 temper copper tubing may be substituted at Contractor's option.

20

21

22

PART 2 - PRODUCTS

23

24 **STORM AND CLEARWATER WASTE and VENT**

25 INTERIOR ABOVE GROUND:

26 Hubless cast iron soil pipe and fittings, ASTM A888; with no-hub couplings, CISPI 301, CISPI 310,
27 ASTM A74. Pipe and fittings shall be marked with the collective trademark of the Cast Iron Pipe Institute.

28

29 PVC plastic pipe, Schedule 40, Class 12454-B (PVC 1120), ASTM D1785; PVC plastic drain, waste and
30 vent pipe and fittings, ASTM D2665; fitting patterns, ASTM D3311; primer, ASTM F656; solvent cement,
31 ASTM D2564.

32

33 Galvanized steel pipe, Schedule 40, Type F, Grade A, ASTM A53; with cast iron threaded drainage
34 fittings, ASTM B16.12.

35

36

37

PART 3 - EXECUTION

38

39 **GENERAL**

40 Install pipe and fittings in accordance with reference standards, manufacturers recommendations and
41 recognized industry practices.

42

43 **PREPARATION**

44 Cut pipe ends square. Ream ends of piping to remove burrs. Clean scale and dirt from interior and exterior
45 of each section of pipe and fitting prior to assembly.

46

47 **ERECTION**

48 Install all piping parallel to building walls and ceilings and at heights which do not obstruct any portion of
49 a window, doorway, stairway, or passageway. Where interferences develop in the field, offset or reroute
50 piping as required to clear such interferences. Coordinate locations of plumbing piping with piping,
51 ductwork, conduit and equipment of other trades to allow sufficient clearances. In all cases, consult

1 drawings for exact location of pipe spaces, ceiling heights, door and window openings, or other
2 architectural details before installing piping.

3
4 Where copper or steel piping is embedded in masonry or concrete, provide protective sleeve covering of
5 elastomeric pipe insulation.

6
7 Maintain piping in clean condition internally during construction.

8
9 Provide clearance for installation of insulation, access to valves and piping specialties.

10
11 Provide anchors, expansion joints, swing joints and/or expansion loops so that piping may expand and
12 contract without damage to itself, equipment, or building.

13
14 Do not route piping through transformer vaults or above transformers, panelboards, or switchboards,
15 including the required service space for this equipment, unless the piping is serving this equipment

16
17 Install all valves and piping specialties, including items furnished by others, as specified and/or detailed.
18 Provide access to valves and specialties for maintenance. Make connections to all equipment, fixtures and
19 systems installed by others where same requires the piping services indicated in this section.

20 21 **WELDED PIPE JOINTS**

22 Make all welded joints by fusion welding in accordance with ASME Codes, ANSI B31, and State Codes
23 where applicable. "Weldolets" and "Threadolets" may be used for branch takeoffs up to one-half (1/2) the
24 diameter of the main.

25 26 **THREADED PIPE JOINTS**

27 Use a thread lubricant or teflon tape when making joints; no hard setting pipe thread cement or caulking
28 will be allowed.

29 30 **SOLVENT WELDED PIPE JOINTS**

31 Install in accordance with ASTM D2855 "Making Solvent Cemented Joints With PVC Pipe and Fittings".
32 Saw cut piping square and smooth. Tube cutters may be used if they are fitted with wheels designed for use
33 with PVC/CPVC pipe that do not leave a raised bead on pipe exterior. Support and restrain pipe during
34 cutting to prevent nicks and scratches. Bevel ends 10-15 degrees and deburr interior. Remove dust, drips,
35 moisture, grease and other superfluous materials from pipe interior and exterior. Check dry fit of pipe and
36 fittings. Reject materials which are out of round or do not fit within close tolerance. Use heavy body
37 solvent cement for large diameter fittings.

38
39 Maintain pipe, fittings, primer and cement between 40 and 100 degrees during application and curing.
40 Apply primer and solvent using separate daubers (3" and smaller piping only) or clean natural bristle
41 brushes about 1/2 the size of the pipe diameter. Apply primer to the fitting socket and pipe surface with a
42 scrubbing motion. Check for penetration and reapply as needed to dissolve surface to a depth of 4-5
43 thousandths. Apply solvent cement to the fitting socket and pipe in an amount greater than needed to fill
44 any gap. While both surfaces are wet, insert pipe into socket fitting with a quarter turn to the bottom of the
45 socket. Solvent cement application and insertion must be completed in less than 1 minute. Minimum of 2
46 installers is required on piping 4" and larger. Hold joint for 30 seconds or until set. Reference
47 manufacturers' recommendations for initial set time before handling and for full curing time before
48 pressure testing. Cold weather solvent/cement may be utilized only under unusual circumstances and when
49 specifically approved by the DSF Project Representative.

50 51 **MECHANICAL HUBLESS PIPE CONNECTIONS**

1 Place the gasket on the end of one pipe or fitting and the clamp assembly on the end of the other pipe or
2 fitting. Firmly seat the pipe or fitting ends against the integrally molded shoulder inside the neoprene
3 gasket. Slide the clamp assembly into position over the gasket. Tighten fasteners to manufacturers
4 recommended torque.
5

6 **STORM AND CLEARWATER WASTE and VENT**

7 Verify invert elevations and building elevations prior to installation. Install exterior piping pitched to drain
8 at indicated elevations and slope. Install interior piping pitched to drain at minimum slope of 1/8" per foot
9 where possible and in no case less than 1/16" per foot for piping 3" and larger.
10

11 Install exterior piping below predicted frost level and not less than 5' bury depth to top of pipe wherever
12 possible. Where piping is located above predicted frost level, provide frost protection in accordance with
13 COMM 82.30(11)(c).
14

15 **PIPING SYSTEM LEAK TESTS**

16 Isolate or remove components from system which are not rated for test pressure. Perform final testing for
17 medical and lab gas with all system components in place. Test piping in sections or entire system as
18 required by sequence of construction. Do not insulate or conceal pipe until it has been successfully tested.
19

20 If required for the additional pressure load under test, provide temporary restraints at fittings or expansion
21 joints. Backfill underground water mains prior to testing with the exception of thrust restrained valves
22 which may be exposed to isolate potential leaks.
23

24 For hydrostatic tests, use clean water and remove all air from the piping being tested by means of air vents
25 or loosening of flanges/unions. Measure and record test pressure at the high point in the system.
26

27 For air or nitrogen tests, gradually increase the pressure to not more than one half of the test pressure; then
28 increase the pressure in steps of approximately one-tenth of the test pressure until the required test pressure
29 is reached. Examine all joints and connections with a soap bubble solution or equivalent method. System
30 will not be approved until it can be demonstrated that there is no measurable loss of test pressure during the
31 test period.
32

33 Inspect system for leaks. Where leaks occur, repair the area with new materials and repeat the test;
34 caulking will not be acceptable.
35

36 Entire test must be witnessed by the Owner's representative.
37

	<u>Test</u>	<u>Initial Test</u>		<u>Final Test</u>	
<u>System</u>	<u>Medium</u>	<u>Pressure</u>	<u>Duration</u>	<u>Pressure</u>	<u>Duration</u>
40 Clearwater Waste and Vent	Water	N/A		10' water	2 hr
41 Storm and Clearwater Waste	Water	N/A		10' water	2 hr

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END OF SECTION

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SECTION 23 01 30.51
HVAC AIR DUCT CLEANING

PART 1 - GENERAL

SCOPE

This section includes specifications for cleaning duct and HVAC systems 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
Cleaners, Biocides and Encapsulants
Equipment
Access Doors

PART 3 - EXECUTION

General
Cleaning
Biocides and Encapsulants
Cleaning Report
Access Doors

RELATED WORK

Section 23 33 00 - Air Duct Accessories
Section 23 31 00 - HVAC Ducts and Casings
Section 23 05 93 - Testing, Adjusting, and Balancing for HVAC

REFERENCE

Applicable provisions of Division 1 govern work under this Section.

REFERENCE STANDARDS

NADCA 1992-01	Mechanical Cleaning of Non-Porous Air Conveyance System Components
	National Air Duct Cleaners Association
NADCA	Understanding Microbial contamination in HVAC Systems
NAIMA	Cleaning Fibrous Glass Insulated Air Duct Systems

QUALITY ASSURANCE

Refer to Division 1, Instructions to Bidders – Qualifications of Bidder and General Conditions - Equals and Substitutions.

The prospective duct cleaning Contractor shall submit to the Architect/Engineer the data hereinafter requested within ten (10) days after Bid Opening. Demonstrate prior experience on duct cleaning projects of similar nature and scope of that being bid, through the submission of letters of reference from building owners including the name, address, and telephone numbers of the contact persons who are specifically familiar with the referenced projects. At least three previous users of this service shall be submitted. Include descriptions of projects. Submit a description of all major duct cleaning equipment owned by the prospective Contractor which is available for use on this project.

SHOP DRAWINGS

Refer to Division 1, General Conditions, Submittals.

Include manufacturer's data and/or Contractor data for the following:

- List of equipment to be used.

- Product description and MSDS sheets for cleaners, biocides and encapsulants.
- Access doors.

PART 2 - PRODUCTS

GENERAL

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.

CLEANERS, BIOCIDES AND ENCAPSULANTS

Manufacturer: H.B. Fuller/Foster, Porter, or approved equal.

Cleaners and encapsulants shall be waterbase products specifically designed for application to HVAC duct interiors and capable of being applied with airless spray equipment. Encapsulants must be colored differently than substrate to be coated.

Encapsulants must provide tough washable elastic protective finish able to withstand light impact or abrasion without breaking down over time or releasing fibers.

EQUIPMENT

Particulate Collection Equipment: Fan/filter unit sized to create sufficient quantity of negative pressure for capture and filtration of air and contaminants dislodged during duct cleaning. Equipment to include prefiltration and HEPA final filtration with 99.97% collection efficiency for 0.3 micron size particles.

Portable pressure washers to be capable of 500 psig to 1000 psig operation.

Power brush systems designed specifically for duct cleaning.

PART 3 - EXECUTION

GENERAL

Use products and equipment in accordance with manufacturers instructions.

CLEANING

Clean ductwork systems and associated turning vanes, dampers, coils, VAV boxes, drain pans, plenums, diffusers, registers, grilles and louvers; air handling units and associated fans, coils, drain pans, plenums and dampers; fans; terminal units and other equipment described below:

System/Component	Location	Action
Supply Duct Systems	Throughout Building	Remove Liner, Clean, Encapsulant
Return Duct Systems	Throughout Building	Clean
Exhaust/Relief Duct Systems	Throughout Building	Clean
Exhaust Fans	Throughout Building	Clean

Visually inspect systems and site prior to cleaning. Document and report damaged system components to Owner's Construction Representative prior to cleaning. Mark damper and other component positions prior to cleaning and reset after cleaning to original position. Establish a specific, coordinated plan detailing how each area of the building will be protected during the various phases of work.

Protect building occupants, components and furnishings from cleaning activities. Use polyethylene sheeting covers and barriers where cleaning will disperse debris outside the HVAC systems. Install critical barriers within the building, at inlets/outlets and within the system to prevent migration of dust and debris to clean areas.

Use particulate collection equipment to remove and capture debris. Connect to system downstream of cleaning operations. Wherever possible, duct exhaust to the exterior of the building. Avoid discharge near air intakes and points of entry. Arrange source of makeup air to flow from clean area to work area

1 negatively pressurizing work area. Take measures to control offensive odors and vapors during the
2 cleaning process.

3
4 Clean systems using mechanical cleaning methods, such as vacuum cleaning, compressed air sweeping and
5 mechanical brushing, designed to extract contaminants from within the HVAC system and safely remove
6 contaminants from the facility. No cleaning methods are to be used which damage components of the
7 system or negatively alter the integrity of the system.

8
9 Clean fibrous glass thermal or acoustical insulation with HEPA vacuuming equipment. Document locations
10 of damage, deterioration, delamination, mold, fungus growth or excessive moisture which cannot be
11 restored by cleaning or resurfacing with repair coating. Report locations and conditions to
12 Architect/Engineer and Owner's Project Representative for determination of removal and/or replacement.

13
14 Where fibrous glass thermal or acoustical insulation is to be removed, scrape and brush metal clean.
15 Remove loose fasteners, weld pins where required for cleaning work and sheet metal covers associated
16 with insulation. Patch and seal fastener openings.

17
18 Verification of HVAC system cleanliness will be performed after cleaning and prior to application of
19 biocides and encapsulants. The Contractor shall notify the Owner's Construction Representative and
20 Architect/Engineer in advance of verification. Verification will consist of inspection by the Contractor,
21 Owner's Construction Representative and/or Architect/Engineer. If surfaces are visibly clean, no
22 contaminants are evident through visual inspection and coils are within 10% of design pressure drop, the
23 HVAC system shall be considered clean. However the Owner reserves the right to further verify system
24 cleanliness through third party gravimetric or wipe testing analysis per NADCA standards.

25
26 **ENCAPSULANTS**

27 Encapsulants are to be applied only after cleaning and verification have been completed and surfaces are
28 dry. System fans are to remain off and critical barriers maintained to prevent migration of encapsulants
29 from the HVAC systems.

30
31 Apply encapsulants to the following surfaces where microbial contamination is not suspected:

- 32
33 Damaged fibrous glass thermal or acoustical insulation.
34 Sheet metal where thermal or acoustical insulation has been removed.

35
36 Encapsulants shall be directly sprayed (not fogged), brushed or rolled onto surfaces to achieve a
37 continuous film of thickness recommended by manufacturer. Increase application rate on porous or rough
38 surfaces. Protect coils, fan blades, bearings, damper linkages and seals, fire/smoke dampers, humidifiers,
39 airflow sensors, pressure sensors, temperature sensors and humidity sensors during application of
40 encapsulants. Clean any overspray from these components immediately. Allow products to fully cure prior
41 to using HVAC systems. Operate systems during unoccupied hours flushing with fresh air to purge system
42 prior to occupied use.

43
44 **CLEANING REPORT**

45 Provide a report describing pre-cleaning inspection and damage, systems cleaned, methods and materials
46 used, problems encountered, final verification and any remaining problems noted. Submit three copies to
47 Owner's Construction Representative.

48
49 **ACCESS DOORS**

50 Install access doors where indicated on the drawings and in locations where access is required for cleaning
51 or inspection. See specification Section 23 33 00 for access door requirements.

52
53 Size and numbers of duct access doors to be sufficient to perform the intended service. Minimum access
54 door size shall be 8 x 8 inch size for hand access, 18 x 18 inch size for shoulder access, or other size as
55 indicated. Install access doors on both inlet and outlet sides of reheat coils as well as other duct mounted
56 coils if not existing.

57
58
59 **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
- Reference Standards
- Quality Assurance
- Continuity of Existing Services
- Protection of Finished Surfaces
- Sleeves and Openings
- Sealing and Firestopping
- Equipment Furnished By Others
- Provisions for Future
- Submittals
- Off Site Storage
- Request and Certification for Payment
- Certificates and Inspections
- Operating and Maintenance Data
- Record Drawings

PART 2 - PRODUCTS

- Access Panels and Doors
- Identification
- Sealing and Firestopping

PART 3 - EXECUTION

- Demolition
- Concrete Work
- Cutting and Patching
- Building Access
- Equipment Access
- Coordination
- Identification
- Lubrication
- Sleeves
- Sealing and Firestopping
- Owner Training

RELATED WORK

Section 23 05 13 - Common Motor Requirements 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
ADC	Air Diffusion Council
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

1	ASTM	American Society for Testing and Materials
2	AWWA	American Water Works Association
3	AWS	American Welding Society
4	EPA	Environmental Protection Agency
5	GAMA	Gas Appliance Manufacturers Association
6	IEEE	Institute of Electrical and Electronics Engineers
7	ISA	Instrument Society of America
8	MCA	Mechanical Contractors Association
9	MICA	Midwest Insulation Contractors Association
10	MSS	Manufacturer's Standardization Society of the Valve & Fitting Industry, Inc.
11	NBS	National Bureau of Standards
12	NEBB	National Environmental Balancing Bureau
13	NEC	National Electric Code
14	NEMA	National Electrical Manufacturers Association
15	NFPA	National Fire Protection Association
16	SMACNA	Sheet Metal and Air Conditioning Contractors' National Association. Inc.
17	UL	Underwriters Laboratories Inc.
18	ASTM E814	Standard Test Method for Fire Tests of Through-Penetration Fire Stops
19	ASTM E84	Standard Test Method for Surface Burning Characteristics of Building Materials
20	UL1479	Fire Tests of Through-Penetration Firestops
21	UL723	Surface Burning Characteristics of Building Materials

22
23 **QUALITY ASSURANCE**

24 Refer to Division 1, General Conditions, Equals and Substitutions.

25
26 Where equipment or accessories are used which differ in arrangement, configuration, dimensions, ratings,
27 or engineering parameters from those indicated on the contract documents, the contractor is responsible for
28 all costs involved in integrating the equipment or accessories into the system and for obtaining the
29 performance from the system into which these items are placed. This may include changes found
30 necessary during the testing, adjusting, and balancing phase of the project.

31
32 **CONTINUITY OF EXISTING SERVICES**

33 Do not interrupt or change existing services without prior written approval from the owner.

34
35 **PROTECTION OF FINISHED SURFACES**

36 Refer to Division 1, General Requirements, Protection of Finished Surfaces.

37
38 Furnish one can of touch-up paint for each different color factory finish which is to be the final finished
39 surface of the product. Deliver touch-up paint with other "loose and detachable parts" as covered in the
40 General Requirements.

41
42 **SLEEVES AND OPENINGS**

43 Refer to Division 1, General Requirements, Sleeves and Openings.

44
45 **SEALING AND FIRESTOPPING**

46 Sealing and firestopping of sleeves/openings between ductwork, piping, etc. and the sleeve, structural or
47 partition opening shall be the responsibility of the contractor whose work penetrates the opening. The
48 contractor responsible shall hire individuals skilled in such work to do the sealing and fireproofing. These
49 individuals hired shall normally and routinely be employed in the sealing and fireproofing occupation.

50
51 **EQUIPMENT FURNISHED BY OTHERS**

52 Custom packaged central air handling unit
53 Electric steam humidifiers

54
55 **SUBMITTALS**

56 Refer to Division 1, General Conditions, Submittals.

57
58 Submit for all equipment and systems as indicated in the respective specification sections, marking each
59 submittal with that specification section number. Mark general catalog sheets and drawings to indicate
60 specific items being submitted and proper identification of equipment by name and/or number, as indicated
61 in the contract documents.

62

1 Before submitting electrically powered equipment, verify that the electrical power and control
2 requirements for the equipment are in agreement with the motor starter schedule on the electrical drawings.
3 Include a statement on the shop drawing transmittal to the architect/engineer that the equipment submitted
4 and the motor starter schedule is in agreement or indicate any discrepancies. See related comments in
5 Section 23 05 13 in Part 1 under Electrical Coordination.
6

7 Include wiring diagrams of electrically powered equipment.
8

9 Submit sufficient quantities of shop drawings to allow the following distribution:

- 10 • Operating and Maintenance Manuals 2 copies
 - 11 • Testing, Adjusting and Balancing Contractor 1 copy
 - 12 • A/E 1 copy
- 13

14 **OPERATION AND MAINTENANCE DATA**

15 All operations and maintenance data shall comply with the submission and content requirements specified
16 under section GENERAL REQUIREMENTS.
17

18 **OFF SITE STORAGE**

19 Prior approval by the owner and the A/E will be needed.
20

21 Generally, ductwork, metal for making ductwork, duct lining, sleeves, pipe/pipe fittings and similar
22 rough-in material will not be accepted for off site storage. For material that can be stored off site, no
23 material will be accepted for off site storage unless shop drawings for that material have been approved.
24

25 **REQUEST AND CERTIFICATION FOR PAYMENT**

26 Within 10 days after Notice to Proceed, the successful bidder will submit to the owner in a form prescribed
27 below and by the General Conditions of the Contract - Scheduling and Coordination of Work, Reports,
28 Records and Data, Payments to Contractor, a cost breakdown of the proposed values for work performed
29 which, if approved by the owner, will become the basis for construction progress and monthly payments.
30 The cost breakdown items shall reflect actual work progress stages as closely as feasible.
31

32 In addition, if payment is requested for approved off-site stored material, then that material shall be listed
33 as a line item in the request and certification for payment cost breakdown.
34

35 **CERTIFICATES AND INSPECTIONS**

36 Refer also to Division 1, General Conditions, Permits, Regulations, Utilities and Taxes.
37

38 Obtain and pay for all required State installation inspections except those provided by the
39 Architect/Engineer in accordance with Wis Adm Code Section ILHR 50.12. Deliver originals of these
40 certificates to the Division Project Representative. Include copies of the certificates in the Operating and
41 Maintenance Instructions.
42

43 **OPERATING AND MAINTENANCE INSTRUCTIONS**

44 Refer to Division 1, General Requirements, Operating and Maintenance Instructions.
45

46 Assemble material in three-ring or post binders, using an index at the front of each volume and tabs for
47 each system or type of equipment. In addition to the data indicated in the General Requirements, include
48 the following information:
49

- 50 • Copies of all approved shop drawings.
 - 51 • Manufacturer's wiring diagrams for electrically powered equipment
 - 52 • Records of tests performed to certify compliance with system requirements
 - 53 • Certificates of inspection by regulatory agencies
 - 54 • Temperature control record drawings and control sequences
 - 55 • Parts lists for manufactured equipment
 - 56 • Valve schedules
 - 57 • Lubrication instructions, including list/frequency of lubrication done during construction
 - 58 • Warranties
 - 59 • Additional information as indicated in the technical specification sections
- 60

61 **TRAINING OF OWNER PERSONNEL**

1 Instruct owner personnel in the proper operation and maintenance of systems and equipment provided as
2 part of this project; video tape all training sessions. Include not less than 2 hours of instruction, using the
3 Operating and Maintenance manuals during this instruction. Demonstrate startup and shutdown
4 procedures for all equipment. All training to be during normal working hours.

5
6 **RECORD DRAWINGS**

7 Refer to Division 1, General Requirements, Record Drawings.

8
9 In addition to the data indicated in the General Requirements, maintain temperature control record
10 drawings on originals prepared by the installing contractor/subcontractor. Include copies of these record
11 drawings with the Operating and Maintenance manuals.

12
13
14 **PART 2 - PRODUCTS**

15
16 **ACCESS PANELS AND DOORS**

17 **LAY-IN CEILINGS:**

18 Removable lay-in ceiling tiles in 2 X 2 foot or 2 X 4 foot configuration provided under Section 09500 are
19 sufficient; no additional access provisions are required unless specifically indicated.

20
21 **PLASTER WALLS AND CEILINGS:**

22 16 gauge frame with not less than a 20 gauge hinged door panel, prime coated steel for general
23 applications, stainless steel for use in toilets, showers, and similar wet areas, concealed hinges, screwdriver
24 operated cam latch for general applications, key lock for use in public areas, UL listed for use in fire rated
25 partitions if required by the application. Use the largest size access opening possible, consistent with the
26 space and the equipment needing service; minimum size is 12" by 12".

27
28 **IDENTIFICATION**

29 **STENCILS:**

30 Not less than 1 inch high letters/numbers for marking pipe and equipment.

31
32 **SNAP-ON PIPE MARKERS:**

33 Cylindrical self-coiling plastic sheet that snaps over piping insulation and is held tightly in place without
34 the use of adhesive, tape or straps. Not less than 1 inch high letters/numbers and flow direction arrows for
35 piping marking. W. H. Brady, Seton, Marking Services, or equal.

36
37 **ENGRAVED NAME PLATES:**

38 White letters on a black background, 1/16 inch thick plastic laminate, beveled edges, screw mounting,
39 Setonply Style 2060 by Seton Name Plate Company or Emedolite- Style EIP by EMED Co., or equal by
40 Marking Services, or W. H. Brady.

41
42 **VALVE TAGS:**

43 Round brass tags with 1/2 inch numbers, 1/4 inch system identification abbreviation, 1-1/4 inch minimum
44 diameter, with brass jack chains or brass "S" hooks around the valve stem, available from EMED Co.,
45 Seton Name Plate Company, Marking Services, or W. H. Brady.

46
47 **SEALING AND FIRESTOPPING**

48 **FIRE AND/OR SMOKE RATED PENETRATIONS:**

49 **Manufacturers:**

50 3M, Hilti, Rectorseal, STI/SpecSeal, Tremco, or approved equal.

51
52 All firestopping systems shall be provided by the same manufacturer.

53
54 **Submittals:**

55 Contractor shall submit product data for each firestop system. Submittals shall include product
56 characteristics, performance and limitation criteria, test data, MSDS sheets, installation details and
57 procedures for each method of installation applicable to this project. For non-standard conditions where no
58 UL tested system exists, submit manufacturer's drawings for UL system with known performance for
59 which an engineering judgement can be based upon.

60
61 **Product:**

1 Fire stop systems shall be UL listed or tested by an independent testing laboratory approved by the
2 Department of Commerce.

3
4 Use a product that has a rating not less than the rating of the wall or floor being penetrated. Reference
5 architectural drawings for identification of fire and/or smoke rated walls and floors.

6
7 Contractor shall use firestop putty, caulk sealant, intumescent wrapstrips, intumescent firestop collars,
8 firestop blocks, firestop mortar or a combination of these products to provide a UL listed system for each
9 application required for this project. Provide mineral wool backing where specified in manufacturer's
10 application detail.

11
12 **NON-RATED PENETRATIONS:**

13 **Pipe Penetrations:**

14 At pipe penetrations of non-rated interior partitions, floors and exterior walls above grade, use urethane
15 caulk in annular space between pipe insulation and sleeve. For non-rated drywall, plaster or wood
16 partitions where sleeve is not required use urethane caulk in annular space between pipe insulation and
17 wall material.

18
19 **Duct Penetrations:**

20 Annular space between duct (with or without insulation) and the non-rated partition or floor opening shall
21 not be larger than 2". Where existing openings have an annular space larger than 2", the space shall be
22 patched to match existing construction to within 2" around the duct.

23
24 Where shown or specified, pack annular space with fiberglass batt insulation or mineral wool insulation.
25 Provide 4" sheet metal escutcheon around duct on both sides of partition or floor to cover annular space.

26
27
28 **PART 3 - EXECUTION**

29
30 **DEMOLITION**

31 Perform all demolition as indicated on the drawings to accomplish new work. Where demolition work is to
32 be performed adjacent to existing work that remains in an occupied area, construct temporary dust partition
33 to minimize the amount of contamination of the occupied space. Where pipe or duct is removed and not
34 reconnected with new work, cap ends of existing services as if they were new work. Coordinate work with
35 the owner to minimize disruption to the existing building occupants.

36
37 All pipe, wiring and associated conduit, insulation, ductwork, and similar items demolished, abandoned, or
38 deactivated are to be removed from the site by the Contractor. All piping and ductwork specialties are to
39 be removed from the site by the Contractor unless they are dismantled and removed or stored by the owner.
40 All designated equipment is to be turned over to the owner for their use at a place and time so designated.
41 Maintain the condition of material and/or equipment that is indicated to be reused equal to that existing
42 before work began.

43
44 **CONCRETE WORK**

45 All cast-in-place concrete will be performed by the Division 3 Contractor unless otherwise noted. Provide
46 all layout drawings, anchor bolts, metal shapes, and/or templates required to be cast into concrete or used
47 to form concrete for support of mechanical equipment.

48
49 **CUTTING AND PATCHING**

50 Refer to Division 1, General Requirements, Cutting and Patching.

51
52 **BUILDING ACCESS**

53 Arrange for the necessary openings in the building to allow for admittance of all apparatus. When the
54 building access was not previously arranged and must be provided by this contractor, restore any opening
55 to its original condition after the apparatus has been brought into the building.

56
57 **EQUIPMENT ACCESS**

58 Install all piping, conduit, ductwork, and accessories to permit access to equipment for maintenance and
59 service. Coordinate the exact location of wall and ceiling access panels and doors with the General
60 Contractor, making sure that access is available for all equipment and specialties. Access doors in general
61 construction are to be furnished by the Mechanical Contractor and installed by the General Contractor.

62

1 Provide color coded thumb tacks or screws, depending on the surface, for use in accessible ceilings which
2 do not require access panels.

3 4 **COORDINATION**

5 Verify that all devices are compatible for the surfaces on which they will be used. This includes, but is not
6 limited to, diffusers, register, grilles, and recessed or semi-recessed heating and/or cooling terminal units
7 installed in/on architectural surfaces.

8
9 Coordinate all work with other contractors prior to installation. Any installed work that is not coordinated
10 and that interferes with other contractor's work shall be removed or relocated at the installing contractor's
11 expense.

12
13 Cooperate with the test and balance agency in ensuring Section 23 05 93 specification compliance. Verify
14 system completion to the test and balance agency (flushing, pressure testing, filling of liquid systems,
15 proper pressurization and air venting of hydronic systems, clean filters, clean strainers, duct and pipe
16 systems cleaned, controls adjusted and calibrated, controls cycled through their sequences, etc.), ready for
17 testing, adjusting and balancing work. Install dampers, shutoff and balancing valves, flow measuring
18 devices, gauges, temperature controls, etc., required for functional and balanced systems. Demonstrate the
19 starting, interlocking and control features of each system so the test and balance agency can perform its
20 work.

21 22 **IDENTIFICATION**

23 Identify equipment in mechanical equipment rooms by stenciling equipment number and service with one
24 coat of black enamel against a light background or white enamel against a dark background. Use a primer
25 where necessary for proper paint adhesion.

26
27 Where stenciling is not appropriate for equipment identification, engraved name plates may be used.

28
29 Identify piping not less than once every 30 feet, not less than once in each room, adjacent to each access
30 door or panel, and on both side of the partition where exposed piping passes through walls, floors or roofs.
31 Place flow directional arrows at each pipe identification location. Use one coat of black enamel against a
32 light background or white enamel against a dark background for stenciling, or provide snap-on pipe
33 markers as specified in Part 2 – Products.

34
35 Identify valves with brass tags bearing a system identification and a valve sequence number. Valve tags
36 are not required at a terminal device unless the valves are greater than ten feet from the device or located in
37 another room not visible from the terminal unit. Provide a typewritten valve schedule indicating the valve
38 number and the equipment or areas supplied by each valve; locate schedules in each mechanical room and
39 in each Operating and Maintenance manual. Schedules in mechanical rooms to be framed under clear
40 plastic.

41
42 Use engraved name plates to identify control equipment.

43 44 **LUBRICATION**

45 Lubricate all bearings with lubricant as recommended by the manufacturer before the equipment is
46 operated for any reason. Once the equipment has been run, maintain lubrication in accordance with the
47 manufacturer's instructions until the work is accepted by OWNER. Maintain a log of all lubricants used
48 and frequency of lubrication; include this information in the Operating and Maintenance Manuals at the
49 completion of the project.

50 51 **SLEEVES**

52 **PIPE SLEEVES:**

53 Provide galvanized sheet metal sleeves for pipe penetrations through interior and exterior walls to provide
54 a backing for sealant or firestopping. Patch wall around sleeve to match adjacent wall construction and
55 finish. Grout area around sleeve in masonry construction.

56
57 Pipe sleeves are not required in interior non-rated drywall, plaster or wood partitions and sleeves are not
58 required in existing poured concrete walls where penetrations are core drilled.

59
60 Extend the top of sleeve 1 inch above the adjacent floor in piping floor penetrations located in the
61 mechanical rooms and wet locations listed below. In finished areas sleeves shall be flush with rough floor.

1 For floor pipe penetrations through existing floors in mechanical rooms core drill opening and provide 1-
2 1/2"x 1-1/2" x 1/8" galvanized steel angles fastened to floor surrounding the penetration or group of
3 penetrations to prevent water from getting to penetration. Provide urethane caulk between angles and floor
4 and fasten angles to floor minimum 8" on center. Seal corners water tight with urethane caulk. Or, core
5 drill sleeve opening large enough to insert schedule 40 sleeve and grout area around sleeve with hydraulic
6 setting, non-shrink grout. If the pipe penetrating the sleeve is supported by a pipe clamp resting on the
7 sleeve, weld a collar or struts to the sleeve that will transfer weight to existing floor structure
8

9 Pipe sleeves are not required in cored floor pipe penetrations through existing floors that are not located in
10 mechanical rooms, food service areas or wet locations listed above.

11 DUCT SLEEVES:

12 Duct sleeves are not required in non-rated partitions or floors.

13 Provide sleeve required for fire dampers in fire-rated partitions and floors. Reference fire damper details
14 on drawings.

15 For duct penetrations through mechanical room floors provide 1-1/2"x 1-1/2" x 1/8" galvanized steel
16 angles fastened to floor around the perimeter of the duct opening to prevent water from getting to floor
17 opening. Provide urethane caulk between angles and floor and fasten angles to floor 8" on center. Seal
18 corners water tight with urethane caulk.

19 SEALING AND FIRESTOPPING

20 FIRE AND/OR SMOKE RATED PENETRATIONS:

21 Install approved product in accordance with the manufacturer's instructions where pipes penetrate a
22 fire/smoke rated surface. When pipe is insulated, use a product which maintains the integrity of the
23 insulation and vapor barrier.

24 Where firestop mortar is used to infill large fire-rated floor openings that could be required to support
25 weight, provide permanent structural forming. Firestop mortar alone is not adequate to support any
26 substantial weight.

27 NON-RATED PARTITIONS:

28 At all interior partitions and exterior walls, pipe penetrations are required to be sealed. Apply sealant to
29 both sides of the penetration in such a manner that the annular space between the pipe sleeve or cored
30 opening and the pipe or insulation is completely blocked.

31 Duct penetrations through non-rated partitions shall require sheet metal escutcheons with fiberglass or
32 mineral wool insulation fill for spaces that include laboratories, clean rooms, animal rooms, kitchens, cart
33 wash rooms, janitor closets, cart wash rooms, toilet rooms, mechanical rooms, conference rooms, private
34 consultation rooms, and where noted on drawings elsewhere.

35 OWNER TRAINING

36 All training provided for owner shall comply with the format, general content requirements and submission
37 guidelines specified under Section 01 91 01 or 01 91 02.

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END OF SECTION

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SECTION 23 05 13
COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

SCOPE

This section 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 23 05 14 - Variable Frequency Drives
- 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.

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

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MOTOR HP	----Totally Enclosed Fan-Cooled----		
	-----Nominal Motor Speed-----		
	1200 rpm	1800 rpm	3600 rpm
20	92.4	93.0	91.0
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.

MOTORS USED ON VARIABLE FREQUENCY DRIVES

In addition to the requirements specified above, the motor must be suitable for use with the drive specified in Section 23 05 14, including but not limited to motor cooling.

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

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SECTION 23 05 14
VARIABLE FREQUENCY DRIVES

PART 1 GENERAL

Applicable provisions of Division 1 shall govern all work under this Section

SCOPE

This section includes variable frequency drives, bypass starters, and line reactors. Included are the following topics:

PART 1 - GENERAL

- Scope
- Related Work
- Reference
- Reference Standards
- Submittals
- Operating and Maintenance Data
- Equipment Startup
- Warranty

PART 2 - PRODUCTS

- Manufacturers
- Design and Construction
- Performance Requirements
- Control Features
- Protection Features
- Diagnostics
- Quality Assurance Tests
- Bypass Equipment
- AC Input Line Reactors
- Output Line Filters

PART 3 - EXECUTION

- Variable Frequency Drives (VFD)
- Construction Verification Items
- Functional Performance Testing
- Owner Training

RELATED WORK

- Section 23 21 23 - Hydronic Pumps
- Section 26 05 26 - Grounding and Bonding for Electrical Systems
- Section 26 05 29 - Hangers and Supports for Electrical Systems
- Section 26 05 53 - Identification for Electrical Systems
- Section 26 27 02 – Equipment Wiring Systems

REFERENCE

Applicable provisions of Division 1 govern work under this section.

REFERENCE STANDARDS

ANSI/IEEE 519 Guide for Harmonic Control and Reactive Compensation of Static Power Converters

SUBMITTALS

1 Submit shop drawings and product data under provisions of Division 1, General Conditions of the
2 Contract, and Section 16010.

3
4 Include physical, electrical, and performance characteristics of each variable frequency drive and
5 associated components, including dimensions; weight; input and output performance; voltage, phase,
6 current and overcurrent characteristics; installation instructions; protective features; wiring and block
7 diagrams indicating specified options; electrical noise attenuation equipment where required to meet the
8 criteria specified; line side voltage notch wave form and line side current harmonics; certified efficiency
9 versus load and speed curves; and required operating environment.

10
11 **OPERATION AND MAINTENANCE DATA**

12 All operations and maintenance data shall comply with the submission and content requirements specified
13 under section GENERAL REQUIREMENTS.

14
15 **EQUIPMENT STARTUP AND OWNER TRAINING**

16 Provide the services of a factory trained and certified technician to approve the installation; start-up, test,
17 and adjust for proper operation of the unit(s). Upon completion of the equipment startup, submit a
18 complete manufacturer's field report, including startup and test log, signed by the factory trained
19 technician. Coordinate with the Temperature Control Contractor and the Balancing Contractor. The startup
20 shall be coordinated with Division 26. Electrical and shall be completed within ten (10) working days from
21 the startup date as set by the owner.

22
23 **WARRANTY**

24 The warranty shall be for a period of twenty-four (24) months from the date of project Substantial
25 Completion. Further, the warranty shall include all parts, labor, travel time, administrative costs, overhead,
26 travel expenses, technical support and any and all other costs to provide the warranty service.

27
28
29 **PART 2 PRODUCTS**

30
31 **MANUFACTURERS**

32 ABB, Toshiba, Danfoss, GE Fuji, Safronics, Yaskawa, Eaton/Cutler Hammer, Mitsubishi, Allen Bradley

33
34 **DESIGN AND CONSTRUCTION**

35 The unit shall be variable torque, modular design for control of the motors as specified in Division 15 and
36 rated at the motor full load nameplate amps.

37
38 The unit shall be U.L. listed, solid state, micro processor-based with a pulse width modulated (PWM)
39 output wave form (none others are acceptable).

40
41 The VFD shall employ a full wave bridge rectifier and capacitors to minimize the ripple of the rectified
42 voltage to maintain near constant DC voltage. Insulated gate bipolar transistors (IGBT's) shall be
43 employed as the output switching device.

44
45 The VFD package shall contain the equivalent of 5% impedance to reduce harmonic distortion. The 5%
46 equivalent impedance shall be provided in the form of a DC bus choke, an input AC line reactor in each
47 phase, or a combination of the two methods.

48
49 Control circuitry shall be plug-in, plug-out modular basis with a corrosion resistant coating on printed
50 circuit boards.

51
52 Units to be suitable for an operating environment from 0°C to 40°C temperature and humidity up to 90%
53 non-condensing.

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Electrically and physically isolate control circuitry and conductors from power circuitry and power conductors. Control conductors and power conductors shall not be run in the same pathway.

The unit enclosure shall be NEMA 12 as required for the application minimum and all components shall be fully factory assembled and tested prior to leaving the manufacturing facility.

Include the following operating and monitoring devices mounted on the front cover:

- A disconnect switch or circuit breaker to de-energize both the drive and bypass circuit with door interlocked handle and lock-open padlocking provisions.
- Operating mode selector switch marked "hand-off-auto".
- Manual speed adjustment via keypad, mounted on the door.
- Manual bypass selector switch to select power through drive or bypass (if a bypass is provided).

Provide a manual bypass circuit and bypass starter to transfer from variable frequency drive operation to bypass operation (if a bypass is provided).

PERFORMANCE REQUIREMENTS

Units shall be suitable for input power of electrical system as scheduled on the drawings $\pm 10\%$, 3 phase, 60 Hertz nominal.

Use a current limiting control device to limit output current to 110% continuous for one minute; also refer to Protection Features in this section. Full load output current available from drive shall not be less than motor nameplate amperage. The full load amp rating of the VFD shall not be less than the values indicated in the NEC Table 430-150.

Output power shall be suitable for driving standard NEMA B design, three phase alternating current induction motors at full rated speed with capability of 6:1 turndown.

Additional performance capabilities to include the following:

- Ride through a momentary power outage of 15 cycles,
- Start into a rotating load without damage to drive components or motor,
- Capable of automatic restart into a rotating load after a preset, adjustable time delay following a power outage
- Input power factor: Min 0.95 throughout the speed range
- Minimum efficiency: 95% at 100% speed, 85% at 50% speed

CONTROL FEATURES

Use control circuits compatible with input signal from temperature control system in the automatic mode and from manual speed control in the manual mode. Vary motor speed in response to the input control signal. Include components necessary to accept the signal from the temperature control system in the form that it is sent. Refer to Division 23 00 00.

Include the following additional control features:

- Hand-Off-Automatic (HOA) selector switch to select local or remote start/stop and speed control
- Analog input, selectable 0-10v or 4-20 mA, for automatic control from the temperature control system
- Local speed control at the VFD
- Adjustable acceleration and deceleration rate so that the 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

- 1 • Manual transfer bypass circuit
- 2 • Field adjustment of minimum and maximum output frequency
- 3 • Two (2) sets of programmable form “C” contacts for remote indication of variable frequency drive
- 4 condition. Note: default programming to be set for “Drive Run & Fault”.
- 5 • Illuminated display keypad.
- 6 • External Fault indicator
- 7 • One (1) input for a N.O. dry contact type input for a 2-wire remote start/stop
- 8 • One (1) input for a N.C. dry contact type input for external faults: (freezestats, fire alarm, smokes,
- 9 etc). This input shall be factory wired to prevent both the VFD and bypass starter operation when
- 10 external fault is present.
- 11 • One (1) N.O. dry contact output for proving motor status. This output shall be programmed to
- 12 detect belt or coupling break that would remove the load from the motor. The dry contact will
- 13 open on loss of load or VFD being off.
- 14 • PID control loop capable of VFD control from an external device connected to a VFD analog
- 15 input.

16
17 The VFD controller shall convert VFD information into the BACnet MSTP / LonWorks FTT-10 protocol
18 that will be compatible with the building direct digital energy management system (EMS) supplied on the
19 project. This output shall be through a serial interface port capable of two-way communication with the
20 building EMS provided on this project. Final connection shall not require any additional intermediate
21 gateway devices to provide throughput of data. The following data shall be provided at a minimum:

- 22
- 23 • Fault condition
- 24 • Speed
- 25 • Amperage
- 26 • Frequency
- 27 • Voltage
- 28 • Bypass status (if supplied)
- 29

30 **PROTECTION FEATURES**

31 Use electronic protection circuitry in the power circuits to provide an orderly shutdown of the drive
32 without blowing fuses or tripping circuit breakers and prevent component loss under the following
33 abnormal conditions:

- 34 Activation of any safety device;
- 35 Instantaneous overcurrent and/or over voltage of output;
- 36 Power line overvoltage and undervoltage protection;
- 37 Phase loss;
- 38 Single and three phase short circuiting;
- 39 Ground faults;
- 40 Control circuit malfunction;
- 41 Overtemperature; and
- 42 Output current over limit.
- 43

44 Provide the following additional protective features:

- 45
- 46 • Input transient overvoltage protection up to 3000 volts per ANSI 37.90A;
- 47 • DC bus fusing or other electronic controls which limit the rate of rise of the DC bus current and
- 48 de-energizes the drive at a predetermined current level;
- 49 • Fusing for the control circuit transformer;
- 50 • Grounded control chassis; and
- 51 • Devices and/or control circuitry to ensure that the variable frequency drive and bypass starter are
- 52 not both energized and driving motor simultaneously.
- 53

54 **DIAGNOSTICS**

- 1 Provide an English character display (no error codes) with indicators for the following:
- 2 Phase loss
- 3 Ground fault
- 4 Overcurrent
- 5 Overvoltage
- 6 Undervoltage
- 7 Over temperature
- 8 Overload
- 9 DC bus status

10

11 **QUALITY ASSURANCE TESTS**

12 Use a factory heat stress test to verify proper operation of all functions and components under full load.

13

14 Field performance test of variable frequency drives to determine compliance with this specification will be
15 performed at the owner's discretion and may include any specified feature, including operation of
16 protective devices through a simulated fault. Contractor will pay for initial testing. Should drive be found
17 deficient by this testing, drive manufacturer will be required to make any and all changes necessary to
18 bring unit(s) into compliance with the specified performance and demonstrate this performance by
19 retesting. Cost of changes and retest will be by this contractor.

20

21 Variable frequency drive manufacturer or designated representative to perform a field test of each drive, in
22 the presence of the owner, for the following items:

23

- 24 • Provide general inspection to verify proper installation;
- 25 • Demonstrate drive reaction to simulated power interruptions of two seconds and sixty seconds;
- 26 • Demonstrate adequate protection during switching from variable frequency drive operation to
27 bypass starter operation and back again;

28

29

30

PART 3 EXECUTION

31

32 **VARIABLE FREQUENCY DRIVES**

33 Install where indicated on drawings and in accordance with approved submittals and manufacturer's
34 published recommendations. Installation to be by the Division 26 00 00 - Electrical contractor.

35

36 Input power wiring shall be installed in a separate conduit, output power wiring shall be installed in a
37 separate conduit and control wiring shall be installed in a separate conduit. Do not mix input power, output
38 power, or control wiring in a common conduit. Separate conduits for input and output power wiring shall
39 be provided for each motor. Input and output power wiring for more than one motor shall not share a
40 common conduit. Power wiring shall be furnished and installed by the Div. 26 contractor. If provided, do
41 not mount output line filter above the drive.

42

43 Control signal for drive will be provided under Division 23.

44

45 Temperature Control Contractor will furnish and install the required temperature control wiring in metal
46 conduit and in accordance with Division 26 00 00 - Electrical of this specification.

47

48 **CONSTRUCTION VERIFICATION ITEMS**

49 Contractor is responsible for utilizing the construction verification checklists supplied under specification
50 Section 01 91 01 or 01 91 02 in accordance with the procedures defined for construction verification
51 checklists.

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FUNCTIONAL PERFORMANCE TESTING

Contractor is responsible for utilizing the functional performance test procedures supplied under specification Section 01 91 01 or 01 91 02 in accordance with the procedures defined for functional performance test procedures.

OWNER TRAINING

All training provided for owner shall comply with the format, general content requirements and submission guidelines specified under Section 01 91 01 or 01 91 02.

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 two hours.

END OF SECTION

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**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
- Pressure Gauges
- Expansion Loops
- Strainers
- Flow Sensing Devices
- Differential Pressure Gauge
- Expansion Tanks
- Air Separators
- Air Vents

PART 3 - EXECUTION

- Thermometers
- Thermometer Sockets
- Test Wells
- P/T (Pressure/Temperature) Test Plugs
- Pressure Gauges
- Expansion Loops
- Strainers
- Flow Sensing Devices
- Differential Pressure Gauge
- Expansion Tanks
- Air Separators
- Air Vents
- Construction Verification Items

RELATED WORK

- Section 23 21 13 - Hydronic Piping
- 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

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.

1 Required for all items in this section. Include materials of construction, dimensional data,
2 ratings/capacities/ranges, pressure drop data where appropriate, and identification as referenced in this
3 section and/or on the drawings.

4
5 **OPERATION AND MAINTENANCE DATA**

6 All operations and maintenance data shall comply with the submission and content requirements specified
7 under section GENERAL REQUIREMENTS.

8
9 **DESIGN CRITERIA**

10 All piping specialties are to be rated for the highest pressures and temperatures in the respective system in
11 accordance with ANSI B31, but not less than 125 psig unless specifically indicated otherwise.

12
13
14 **PART 2 - PRODUCTS**

15
16 **THERMOMETERS**

17 Manufacturers: Ashcroft, Marsh, Taylor, H. O. Trerice, U. S. Gauge, Weiss, Weksler.

18
19 Stem Type, cast aluminum case, nine inch scale, clear acrylic window. adjustable angle brass stem with
20 stem of sufficient length so the end of the stem is near the middle of a pipe without reducing the thickness
21 of any insulation, red indicating fluid, black lettering against a white background, with scale ranges as
22 follows:

Service	Scale Range, °F	Min. Increment, °F
Hot Water	30 - 240	2
Chilled Water	0 - 100	1

23
24
25
26
27
28 **THERMOMETER SOCKETS**

29 Brass with threaded connections suitable for thermometer stems and temperature control sensing elements
30 in pipeline. Furnish with extension necks for insulated piping systems.

31
32 **TEST WELLS**

33 Similar to thermometer sockets except with a brass cap that thread into the inside of the test well to prevent
34 dirt from accumulating. Secure cap to body with a short chain. Furnish with extension necks, where
35 appropriate, to accommodate the pipeline insulation.

36
37 **P/T (PRESSURE/TEMPERATURE) TEST PLUGS**

38 Brass plug with 1/4" NPT threads, EPDM or neoprene valve core, knurled cap with cap strap. Use
39 extended length plugs to clear insulated piping. Adaptors shall have 1/4" FPT connection for standard
40 pressure gauges.

41
42 **PRESSURE GAUGES**

43 Manufacturers: Ametek/U. S. Gauge Division, Ashcroft, Marsh, Taylor, H. O. Trerice, Weiss, Weksler.

44
45 Cast aluminum case of not less than 4.5 inches in diameter, double strength glass window, black lettering
46 on a white background, phosphor bronze bourdon tube with bronze bushings, recalibration from the front
47 of the dial, 99% accuracy over the middle half of the scale, 98.5% accuracy over the remainder of the scale,
48 with scale range as follows:

Service	Scale Range, psig	Min. Increment, psig
Hot Water	0-100	5
Chilled Water	0-100	5

49
50
51
52
53
54 **PRESSURE SNUBBERS:**

55 Bronze construction, suitable for system working pressure, 1/4" size.

56
57 **COIL SYPHONS:**

58 Bronze or steel construction, suitable for system working pressure, 1/4" size.

59
60 **GAUGE VALVES:**

1 Use valves as specified in Section 23 05 23 - General-Duty Valves for HVAC Piping. For water systems,
2 use 1/4" ball valves. For steam systems, use 1/4" gate valves suitable for system working pressure.

3
4 **EXPANSION LOOPS**

5 Provide expansion loops indicated on the drawings and details.

6
7 **STRAINERS**

8 Manufacturers: Armstrong, Hoffman, Illinois, Keckley, Metraflex, Mueller Steam, or Sarco.

9
10 **WATER SYSTEMS:**

11 Y type; cast iron body; stainless steel screens; bolted or threaded screen retainer tapped for a blowoff
12 valve; threaded body in sizes through 2 inch and rated at not less than 175 psi WOG; flanged body in sizes
13 over 2 inch and rated at not less than 125 psi WOG at 240°F. Screen to be 20 mesh for line sizes 2 inch
14 and less, 0.125 inch perforations for line sizes 2-1/2 inch through 4 inch, and 0.25 inch perforations for line
15 sizes 5 inch and larger.

16
17 Basket type: Cast iron body with clamped cover; stainless steel screens; body tapped for a blowoff valve;
18 125 psig flanged body for 2 1/2" and larger; 0.125 inch perforations for line sizes 2-1/2 inch through 4
19 inch, and 0.25 inch perforations for line sizes 5 inch and larger.

20
21 **FLOW SENSING DEVICES**

22 For water flow sensing devices 2 inch and smaller, use balance valves as specified in Section 23 05 23 -
23 General-Duty Valves for HVAC Piping.

24
25 **PITOT TYPE FLOW SENSORS:**

26 Dieterich Standard/Annubar, Preso, or approved equal.

27
28 Multi-port averaging type flow sensor designed to sense the velocity of a fluid flowing in a pipe and
29 produce a pressure output that is proportional to the fluid velocity. Sensor to consist of a type 316 stainless
30 steel probe with a diamond or elliptical shape; brass body gate, needle, or ball instrument connection
31 valves with appropriate fitting for connection to a meter; single forged steel weld type installation fitting
32 for pipe sizes through 6 inch, double forged steel weld type installation fittings for use on opposite ends of
33 the sensor for larger pipe sizes if recommended by the manufacturer for the application; non-asbestos
34 packing in a type 316 stainless steel packing gland; carbon steel mounting hardware; ball or gate type
35 isolation valve extended from the system pipe to accommodate pipeline insulation; accurate within 2% of
36 the actual flow with a turndown ratio of 10:1 or better; permanently stamped nameplate attached to the
37 sensor indicating the flow/differential pressure characteristics of the sensor; suitable for use on systems to
38 150 psig at 366°F and 200 psig at 100°F.

39
40 Include one differential pressure meter kit that includes a six inch diameter gauge having an accuracy of
41 3% of full scale or better and suitable for the differential pressures of the valves supplied for this project,
42 color coded hoses not less than ten feet in length with brass connectors suitable for connection to the
43 low and high pressure connections on the balance valves, instrument valving so meter can be vented and
44 drained, pressure and temperature rating at least equal to that of the valves. Provide meter and all
45 accessories in a durable case with carrying handle.

46
47 **DIFFERENTIAL PRESSURE GAUGE**

48 Barton 247A, Midwest 809, or approved equal.

49
50 Bellows type differential pressure meter kit that includes a six inch diameter gauge with a 270° arc having
51 an accuracy of ±1% of full scale or better and suitable for the differential pressures of the flow meters
52 supplied for this project, over range protection on the meter, color coded hoses not less than ten feet in
53 length with brass connectors suitable for connection to the low and high pressure connections on the
54 balance valves, inline strainers, instrument valving so meter can be vented and drained, pressure and
55 temperature rating at least equal to that of the valves. Provide meter and all accessories in a durable case
56 with carrying handle.

57
58 **EXPANSION TANKS**

59 Manufacturers: Amtrol/Thrush, Armstrong Pumps, Bell and Gossett, Taco, Wessels.

60
61 **BLADDER TYPE:**

1 Steel construction, tested and stamped in accordance with Section 8D of the ANSI/ASME Code and
2 furnished with the National Board Form U-1, rated for not less than 125 psig working pressure, precharged
3 with air to the initial fill pressure indicated on the drawings, butyl diaphragm suitable for fluid
4 temperatures to 220°F, and furnished with a tank drain connection, system connection, mounting saddles
5 for horizontal installation or base for vertical installation, prime coated, size/capacity as indicated on the
6 drawings. Tank and bladder construction must allow field replacement of the bladder on its failure.

8 **AIR SEPARATORS**

9 Manufacturers: Amtrol/Thrush, Armstrong Pumps, Bell and Gossett, Taco.

11 2 inch and larger: Welded steel construction, ASME constructed and stamped for a working pressure not
12 less than 125 psig at 220°F, threaded or flanged connections for 2 inch size, flanged or grooved
13 connections if grooved piping is allowed for all sizes over 2 inch, suitable for use with expansion tanks
14 specified above, drain connection at the bottom of unit, vent/tank connection at the top of unit, suitable for
15 the system flow rates as indicated on the drawings.

17 **AIR VENTS**

18 **MANUAL KEY TYPE VENTS:**

19 Bell and Gossett Model 4V; Eaton/Dole Model 9, 9B, or 14A.

21 Bronze body with nonferrous internal parts, screwdriver operated, designed to relieve air from the system
22 when vent is opened, rated at not less than 125 psig at 220°F.

24 **MANUAL BALL VALVE VENTS:**

25 Provide 1/4" ball valves for manual venting of air handling unit coils and where indicated elsewhere on
26 drawings and details. Reference specifications section 23 05 23.

28 **AUTOMATIC VENTS:**

29 Thrush Model 720, Bell and Gossett Model 107, Watson McDaniel Model AV813W

31 Cast iron body with nonferrous internal parts, designed to vent air automatically with float principle
32 without allowing air to enter the system, rated at not less than 125 psig at 220°F.

35 **PART 3 - EXECUTION**

37 **THERMOMETERS**

38 **STEM TYPE:**

39 Install in piping systems as indicated on the drawings and/or details using a separable socket in each
40 location.

42 **DIAL TYPE FOR AIR TEMPERATURE MEASUREMENT:**

43 Install in ductwork where detailed or specified. Support capillary inside duct so it measures a uniform
44 sample of air. Mount readout so it is readily visible on a portion of ductwork that is not externally
45 insulated or on a sheetmetal angle support secured to a nearby structural element.

47 **THERMOMETER SOCKETS**

48 Install at each point where a thermometer or temperature control sensing element is located in a pipeline.

50 **TEST WELLS**

51 Install in piping systems as indicated on the drawings and/or details wherever provisions are needed for
52 inserting a thermometer at a later date.

54 **P/T (PRESSURE/TEMPERATURE) TEST PLUGS**

55 Install in piping systems as indicated on the drawings and/or details. Do not insulate over test plugs.

57 **PRESSURE GAUGES**

58 Install in locations where indicated on the drawings and/or details, including any gauge piping, with scale
59 range appropriate to the system operating pressures.

61 **PRESSURE SNUBBERS:**

1 Install in gauge piping for all gauges used on water services.
2
3 **COIL SYPHONS:**
4 Install in gauge piping for all gauges used on steam services.
5
6 **GAUGE VALVES**
7 Install at each gauge location as close to the main as possible and at each location where a gauge tapping is
8 indicated.
9
10 **EXPANSION LOOPS**
11 Install where indicated on the drawings or details, locating anchors and guides as detailed.
12
13 **STRAINERS**
14 Install all strainers where indicated on the project details, allowing sufficient space for the screens to be
15 removed. Rotate screen retainer where required by the installation so blowdown can remove accumulated
16 dirt from the strainer body.
17
18 **WATER SYSTEMS:**
19 Install a ball valve for blowdown in the tapped screen retainer; valve to be the same size as the tapping.
20
21 **FLOW SENSING DEVICES**
22
23 **PITOT TUBE FLOW SENSORS:**
24 Install where indicated on the drawings and details for flow sensing in hydronic piping systems. Butterfly
25 valves installed at the location of a flow sensing device are to have a memory stop.
26
27 **VORTEX SHEDDING FLOW SENSORS:**
28 Install where indicated on the drawings and details for flow sensing in hydronic piping systems. Do not
29 install close to elbows, valves, or other piping specialties which might affect the reading of the sensor;
30 follow manufacturer's installation instructions. Provide for a minimum of 15 pipe diameters upstream and
31 5 pipe diameters downstream; follow manufacturer's installation instructions to provide for longer straight
32 runs if necessary to provide accuracy specified for the meter. Contact the AE if design adjustments need to
33 be made to provide enough room for a proper installation, Provide a flanged spool piece that can be used as
34 a direct replacement for the meter when the meter is removed for service. For meters supplied under
35 Section 23 0914 OR 23 09 15, coordinate with the supplying sub-contractor for installation and sizing
36 information. Butterfly valves installed at the location of a flow sensing device are to have a memory stop.
37
38 **DIFFERENTIAL PRESSURE GAUGE**
39 Handle as a loose and detachable part as outlined in the General Requirements.
40
41 **EXPANSION TANK**
42 Install tanks where indicated on the drawings, coordinating concrete base installation with the General
43 Contractor or fabricating steel supports to suit the application. Install all specified tank accessories.
44
45 **BLADDER TANKS:**
46 Verify proper air charge; recharge as necessary. Install an isolation valve in the piping connecting the tank to
47 the system. In the piping between the tank and the isolation valve, install a pressure gauge and a drain
48 valve with a hose adapter. Install a drain valve with hose adapter in the drain connection of the tank. Make
49 sure that all drains are accessible and a hose can be attached.
50
51 **AIR SEPARATORS**
52 Mount in hot and/or chilled water lines as indicated on the drawings/details.
53
54 **AIR VENTS**
55 **MANUAL KEY TYPE VENTS:**
56 Install at all high points where air may collect and not be carried by the system fluid. Use a soft Type L
57 copper "pigtail" so the vent can be positioned for venting and collecting any water that might escape.
58
59 **MANUAL BALL VALVE VENTS:**
60 Install on air handling coils and where indicated elsewhere as shown on drawings and details.
61

1 **AUTOMATIC VENTS:**
2 Install on the top of air separators on systems using bladder type expansion tanks. Install at other locations
3 as indicated on the drawings or details. All locations to have a ball valve installed upstream of the vent for
4 maintenance purposes.

5
6 **CONSTRUCTION VERIFICATION ITEMS**
7 Contractor is responsible for utilizing the construction verification checklists supplied under specification
8 Section 01 91 01 or 01 91 02 in accordance with the procedures defined for construction verification
9 checklists.

10
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12 **END OF SECTION**

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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
 - Ball Valves
 - Butterfly Valves
 - Balance Valves
 - Drain Valves
 - Spring Loaded Check Valves
 - Combination Shut-off, Check, and Balancing Valves
 - Water Relief Valves

PART 3 - EXECUTION

- General
- Shut-off Valves
- Balancing Valves
- Calibrated Balancing Valves
- Drain Valves
- Safety Relief Valves
- Spring Loaded Check Valves
- Combination Shut-off, Check, and Balancing Valves
- Automatic Non-return Stop Valves
- Pressure Reducing Valves
- Gas Pressure Regulators

RELATED WORK

Section 23 05 15 - Piping Specialties

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

1 Where valves are specified for individual mechanical services (i.e. hot water heating) all valves shall be of
2 the same manufacturer unless prior written approval is obtained from owner.
3

4 **PART 2 - PRODUCTS**

5 **MANUFACTURERS**

6
7 Anvil, Apollo, Armstrong, Bell & Gossett, Cash-Acme, Dresser Consolidated, Conval, Crane, Anderson
8 Greenwood and Crosby, Danfoss-Flomatic, DeZurik, Durco, Fisher, Grinnell, Griswold, Hammond,
9 Hancock, Hoffman, Jamesbury, Keystone, Kunkle, Leslie, Lunkenheimer/Cincinnati, Metraflex,
10 Milwaukee, Mueller, Newco, Nexus, Nibco, Powell, RP&C, Sarco, Spence, Stockham, Taco, Tasco,
11 Thrush-Amtrol, Vogt, Watts, or approved equal.
12

13 **WATER SYSTEM VALVES**

14 All water system valves to be rated at not less than 125 psig water working pressure at 240°F unless noted
15 otherwise.
16

17 **BALL VALVES:**

18 2" and smaller: Two piece bronze body; threaded or soldered ends, as appropriate to the pipe material;
19 stainless steel or chrome plated brass/bronze ball; conventional port; glass filled teflon seat; threaded
20 packing gland follower; blowout-proof stem; 600 psig WOG.
21

22
23 Valve stems shall allow operators to clear insulation without interference. Provide stem extensions when
24 valve operators interfere with pipe insulation.
25

26 Apollo 70-100/200 series, Hammond 8301/8311, Milwaukee BA100/150, Nibco T/S 585-70, Stockham
27 S206/216.
28

29 2-1/2" and over: Ball valves will not be accepted in sizes over 2 inch.
30

31 **BUTTERFLY VALVES:**

32 2" and smaller: Use ball valves; butterfly valves will not be accepted in sizes 2 inch and smaller.
33

34 2-1/2" and larger: Cast iron body; stainless steel shaft; Teflon, nylatron, or acetal bearings; EPDM resilient
35 seat. Disk to be bronze, aluminum-bronze, nickel plated ductile iron, cast iron with welded nickel edge, or
36 stainless steel. Pressure rated to 150 psig. Valve assembly to be bi-directionally bubble tight to 150 psig
37 with no downstream flange/pipe attached. Polyimide or polyamide coated valves are not acceptable.
38

39 Valve stems shall allow operators to clear insulation without interference. Provide stem extensions when
40 valve operators interfere with pipe insulation.
41

42 Use threaded lug type valves for installation with class 125/150 flanges.
43

44 Centerline series 200, DeZurik BGS II, Keystone Fig. 222, Nibco LD2000 (2-1/2"-12")/LD1000 (14" and
45 above), Victaulic 300 series (2-1/2"-12")/709 series (14"-24").
46

47 Provide ten-position lever actuators for valves 6" and smaller.
48

49 Where butterfly valves are indicated or specified to be installed at the location of a flow sensing device,
50 provide the butterfly valves with a memory stop.
51

52 **BALANCE VALVES:**

53 2" and smaller: Bronze or copper alloy body with calibrated ball, globe or venturi/valve arrangement,
54 integral pointer and calibrated scale to register degree of valve opening, memory stop, drain tapping,
55 threaded or soldered ends, with or without integral unions, P/T or Shraeder pressure taps with integral
56 check valves and seals, adjustable memory stop, suitable for 200 psig water working pressure at 250°F.
57

58 Armstrong CBV, Bell & Gossett Circuit Setter Plus, Griswold Quickset, Nexus Orturi, Nibco 1710 Series,
59 Taco Accu-Flo, Tour & Anderson STAS/STAD, Victaulic series 786/787.
60

61 Include one bellows type differential pressure meter kit that includes a six inch diameter gauge with 270°
62 arc readout and having an accuracy of ±1% of full scale or better and suitable for the differential pressures

1 of the valves supplied for this project, over-range protection, color coded hoses not less than ten feet in
2 length with brass connectors suitable for connection to the low and high pressure connections on the
3 balance valves, instrument valving so meter can be vented and drained, pressure and temperature rating at
4 least equal to that of the valves. Provide meter and all accessories in a durable case with carrying handle.
5

6 2-1/2" and larger: Use butterfly valves as specified in this section along with a flow sensing device as
7 specified in Section 23 05 15.
8

9 **DRAIN VALVES:**

10 Use 3/4 inch ball valve with threaded hose adapter except strainer blowdown valves to be the same size as
11 the blowdown connection.
12

13 **SPRING LOADED CHECK VALVES:**

14 2" and smaller: Class 125, bronze body, threaded, solder or wafer ends, bronze trim, stainless steel spring,
15 teflon seat unless only bronze available.
16

17 APCO 300 series, ConBraCo 61 series, Mueller 303BP, Nibco T-480-Y/S-480-Y, Val-Matic 1400 series.
18

19 2-1/2" and larger: Class 125, cast iron or semi-steel body, wafer or globe flanged type, bronze trim, bronze
20 or EPDM seat, stainless steel spring, stainless steel stem if stem is required. Valves with ductile iron in
21 contact with the working fluid will not be accepted.
22

23 APCO 600 series, Metraflex 900 series, Milwaukee 1800 series, Mueller Steam 101M-AP/105M-AP,
24 Nibco F910 series, Val-Matic 1800 series, Victaulic series 716.
25

26 **COMBINATION SHUT-OFF, CHECK, AND BALANCE VALVES:**

27 2 inch and larger: Cast or ductile iron body, threaded or flanged or grooved end connections, stainless
28 steel spring, bronze disc with EPDM seat, calibrated memory stop, backseating valve stem, inlet and outlet
29 pressure tappings, capable of being repacked under full line pressure, and suitable for a minimum working
30 pressure of 175 psig at 240°F when used in hot water heating systems.
31

32 Armstrong Flo-Trex, Bell & Gossett Triple Duty, Taco Multi Purpose Valve, Thrush-Amtrol Tri-Flow.
33

34 **WATER RELIEF VALVES:**

35 Iron or bronze body, direct pressure actuated, teflon seat, stainless steel stem and spring, suitable for 125
36 psig water working pressure at 240° F and ASME stamped, with Btu capacity and set point as scheduled.
37
38

39 **PART 3 - EXECUTION**

40 **GENERAL**

41 Properly align piping before installation of valves in an upright position; operators installed below the
42 valves will not be accepted.
43
44

45 Install valves in strict accordance with valve manufacturer's installation recommendations. Do not support
46 weight of piping system on valve ends.
47

48 Install all temperature control valves.
49

50 Install all valves with the stem in the upright position. Valves may be installed with the stem in the
51 horizontal position only where space limitations do not allow installation in an upright position or where
52 large valves are provided with chain wheel operators. Where valves 2-1/2" and larger are located more than
53 12'-0" above mechanical room floors, install valve with stem in the horizontal position and provide a chain
54 wheel operator. Valves installed with the stems down, will not be accepted.
55

56 Install stem extensions when shipped loose from valve.
57

58 Prior to flushing of piping systems, place all valves in the full-open position.
59

60 **SHUT-OFF VALVES**

61 Install shut-off valves at all equipment, at each branch take-off from mains, and at each automatic valve for
62 isolation or repair.

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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.

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

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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
- Anchors

PART 3 - EXECUTION

- Installation
- Hanger and Support Spacing
- Anchors
- Equipment Curbs

RELATED WORK

Section 23 07 00 - HVAC Insulation

REFERENCE

Applicable provisions of Division 1 shall govern work under this section.

REFERENCE STANDARDS

MSS SP-58 Pipe Hangers and Supports - Materials, Design and Manufacture.
MSS SP-59 Pipe Hangers and Supports - Selection and Application.

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.

1
2 All submittals are to comply with submission and content requirements specified in specification Section
3 01 91 01 or 01 91 02.

4
5 **DESIGN CRITERIA**

6 Materials and application of pipe hangers and supports shall be in accordance with MSS Standard Practice
7 SP-58 and SP-69 unless noted otherwise.

8
9 Piping connected to base mounted pumps, compressors, or other rotating or reciprocating equipment is to
10 have vibration isolation supports for a distance of one hundred pipe diameters or three supports away from
11 the equipment, whichever is greater. Standard pipe hangers/supports as specified in this section are
12 required beyond the 100 pipe diameter/3 support distance.

13
14 Piping flexible connections and vibration isolation supports are required for piping connected to coils that
15 are in a fan assembly where the entire assembly is mounted on vibration supports; the vibration isolation
16 supports are required for a distance of one hundred pipe diameters or three supports away from the
17 equipment, whichever is greater. Piping flexible connection and vibration isolation supports are not
18 required when the fan section is separately and independently isolated by means of vibration supports and
19 duct flexible connections. Standard pipe hangers/supports as specified in this section are required when
20 there are no vibration isolation devices in the piping and beyond the 100 pipe diameter/3 support distance.

21 Piping supported by laying on the bottom chord of joists or trusses will not be accepted.

22
23 Fasteners depending on soft lead for holding power or requiring powder actuation will not be accepted.

24
25 Allow sufficient space between adjacent pipes and ducts for insulation, valve operation, routine
26 maintenance, etc.

27
28
29
30 **PART 2 - PRODUCTS**

31
32 **PIPE HANGER AND SUPPORT MANUFACTURERS**

33 Anvil, B-Line, Fee and Mason, Kindorf, Michigan Hanger, Unistrut, or approved equal. Anvil figure
34 numbers are listed below; equivalent material by other manufacturers is acceptable.

35
36 **STRUCTURAL SUPPORTS**

37 Provide all supporting steel required for the installation of mechanical equipment and materials, whether or
38 not it is specifically indicated or sized, including angles, channels, beams, etc. to suspend or floor support
39 tanks and equipment.

40
41 **PIPE HANGERS AND SUPPORTS**

42 **HANGERS FOR STEEL PIPE SIZES 1/2" THROUGH 2":**

43 Carbon steel, adjustable, clevis, black finish. Anvil figure 65 or 260.

44
45 **HANGERS FOR STEEL PIPE SIZES 2-1/2" AND OVER:**

46 Carbon steel, adjustable, clevis, black finish. Anvil figure 260.

47
48 **MULTIPLE OR TRAPEZE HANGERS:**

49 Steel channels with welded spacers and hanger rods if calculations are submitted.

50
51 **COPPER PIPE SUPPORT:**

52 Carbon steel ring, adjustable, copper plated or polyvinylchloride coated.

53
54 **INSULATION PROTECTION SHIELDS:**

55 Galvanized carbon steel of not less than 18 gauge for use on insulated pipe 2-1/2 inch and larger.

56 Minimum shield length is 12 inches. Equal to Grinnell figure 167.

57
58 **STEEL HANGER RODS:**

59 Threaded both ends, threaded one end, or continuous threaded, black finish.

60
61 Size rods for individual hangers and trapeze support as indicated in the following schedule.

1 Total weight of equipment, including valves, fittings, pipe, pipe content, and insulation, are not to exceed
2 the limits indicated.

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21	22	23
24	25	26
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30	31	32
33	34	35
36	37	38
39	40	41
42	43	44
45	46	47
48	49	50
51	52	53
54	55	56
57	58	59
60	61	

14 Provide rods complete with adjusting and lock nuts.

16 ANCHORS

17 Use welding steel shapes, plates, and bars to secure piping to the structure.

20 PART 3 - EXECUTION

22 INSTALLATION

23 Install supports to provide for free expansion of the piping and duct system. Support all piping from the
24 structure using concrete inserts, beam clamps, ceiling plates, wall brackets, or floor stands. Fasten ceiling
25 plates and wall brackets securely to the structure and test to demonstrate the adequacy of the fastening.

26 Piping shall be supported independently from ductwork and all other trades.

27 Where piping can be conveniently grouped to allow the use of trapeze type supports, use standard
28 structural shapes for the supporting steel.

29 Perform all welding in accordance with standards of the American Welding Society. Clean surfaces of
30 loose scale, rust, paint or other foreign matter and properly align before welding. Use wire brush on welds
31 after welding. Welds shall show uniform section, smoothness of weld metal and freedom from porosity
32 and clinkers. Where necessary to achieve smooth connections, joints shall be dressed smooth.

37 HANGER AND SUPPORT SPACING

38 Place a hanger within 12 inches of each horizontal elbow, valve, strainer, or similar piping specialty item.

39 Where several pipes can be installed in parallel and at the same elevation, provide multiple or trapeze
40 hangers.

41 Support riser piping independently of connected horizontal piping.

42 Adjust hangers to obtain the slope specified in the piping section of this specification.

43 Space hangers for pipe as follows:

44	45	46	47
48	49	50	51
52	53	54	55
56	57	58	59
60	61		

55 ANCHORS

56 Install where indicated on the drawings and details. Where not specifically indicated, install anchors at
57 ends of principal pipe runs and at intermediate points in pipe runs between expansion loops. Make
58 provisions for preset of anchors as required to accommodate both expansion and contraction of piping.

61 END OF SECTION

1
2 **SECTION 23 05 48**
3 **VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT**

4
5 **PART 1 - GENERAL**

6
7 **SCOPE**

8 This section includes specifications for vibration isolation material for equipment, piping systems, and duct
9 systems. Included are the following topics:

10
11 **PART 1 - GENERAL**

12 Scope
13 Related Work
14 Reference
15 Quality Assurance
16 Design Criteria
17 Shop Drawings

18 **PART 2 - PRODUCTS**

19 Materials
20 Vibration Isolation Manufacturers
21 Type 1: Neoprene Pad
22 Type 3: Unhoused Spring with Neoprene
23 Type 5: Spring Hanger with Neoprene
24 Type 6: Precompressed Spring with Neoprene
25 Type 7: Spring Hanger with Neoprene
26 Flexible Piping Connections
27 Performance

28 **PART 3 - EXECUTION**

29 Installation
30 Packaged Air Handling Units and Centrifugal Fans
31 Isolation Devices Outdoors or in High Humidity Areas

32
33 **RELATED WORK**

34 Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment
35 Section 23 21 23 - Hydronic Pumps
36 Section 23 73 13 - Modular Indoor Central-Station Air-Handling Units
37 Section 23 33 00 - Air Duct Accessories

38
39 **REFERENCE**

40 Applicable provisions of Division 1 govern work under this section.

41
42 **QUALITY ASSURANCE**

43 Refer to division 1, General Conditions, Equals and Substitutions.

44
45 **DESIGN CRITERIA**

46 Isolate all motor driven mechanical equipment from the building structure and from the systems which they
47 serve to prevent equipment vibrations from being transmitted to the structure. Consider equipment weight
48 distribution to provide uniform isolator deflections.

49
50 For equipment with variable speed capability, select vibration isolation devices based on the lowest speed.

51
52 Provide flexible piping connections for all piping to rotating or reciprocating equipment mounted on
53 vibration isolators except do not use flexible piping connectors on any type of gas piping or with inline
54 pumps. Piping connected to a coil which is in an assembly mounted on vibration isolators is to have
55 flexible piping connections and piping vibration hangers as specified below. Piping connected to a coil
56 which is in an assembly where the fan is separately isolated by means of vibration isolators and duct
57 flexible connections does not require flexible piping connectors or piping vibration hangers.

58
59 Credit will be given for the inherent flexibility and vibration absorption characteristics of mechanical
60 grooved pipe connections providing that supporting calculations are submitted for approval.

1 Coordinate the selection of devices with the isolator and equipment manufacturers.

2
3 **SHOP DRAWINGS**

4 Refer to division 1, General Conditions, Submittals.

5
6 Include isolator type, materials of construction, isolator free and operating heights, and isolation efficiency
7 based on the lowest operating speed of the equipment supported.
8

9
10 **PART 2 - PRODUCTS**

11
12 **MATERIALS**

13 Use materials that will retain their isolation characteristics for the life of the equipment served. Use
14 industrial grade neoprene for elastomeric materials.

15
16 Treat all isolators to resist corrosion. For isolation devices exposed to the weather or used in high humidity
17 areas, hot dip galvanize steel parts, apply a neoprene coating on all steel parts, or use stainless steel parts;
18 include limit stops to resist wind.

19
20 Provide pairs of neoprene side snubbers or restraining springs where side torque or thrust may develop.

21
22 Use isolators with a ratio of lateral to vertical stiffness not less than 1.0 or greater than 2.0.

23
24 **VIBRATION ISOLATOR MANUFACTURERS**

25 Mason Industries, Amber/Booth Co., Vibration Mounting & Controls, Peabody Noise Control, or approved
26 equal.

27
28 **TYPE 1: NEOPRENE PAD**

29 Neoprene waffle pad, 40 durometer with 16 gauge shims between layers.

30
31 **TYPE 3: UNHOUSED SPRING WITH NEOPRENE**

32 Combination freestanding, unhooused spring and neoprene with rib molded antifriction base. Include
33 leveling bolts for securing to the equipment. Springs to be laterally stable under load and selected so they
34 have an additional travel to solid equal to 50% of the rated deflection. Use height saving brackets when
35 appropriate to the application.

36
37 **TYPE 5: SPRING HANGER WITH NEOPRENE**

38 Vibration hanger with a steel spring and 0.3" deflection neoprene element in series. Use neoprene element
39 molded with a rod isolation bushing that passes through the hanger box. Select spring diameters and size
40 hanger box lower holes large enough to permit the hanger rod to swing through a 30 degree arc before
41 contacting the hole and short circuiting the spring. Select springs so they have a minimum additional travel
42 to solid equal to 50% of the rated deflection.

43
44 **TYPE 6: PRECOMPRESSED SPRING HANGER WITH NEOPRENE**

45 Vibration hanger similar to Type 5 but precompressed to the rated deflection to keep the piping or
46 equipment at a fixed elevation during installation. Design hanger with a release mechanism to free the
47 spring after the installation is complete and the hanger is subjected to its full load.

48
49 **TYPE 7: SPRING HANGER WITH NEOPRENE**

50 Steel spring hanger located in a neoprene cup manufactured with a grommet to prevent short circuiting of
51 the hanger rod. Neoprene cup to contain a steel washer designed to properly distribute the load on the
52 neoprene and prevent its extrusion. Design spring diameter and size hanger box lower hole sufficiently
53 large to permit the hanger rod to swing through a 30° arc before contacting the hole perimeter and short
54 circuiting the spring. Select spring so it has a minimum additional travel to solid equal to 50% of the rated
55 deflection. Provide hanger with an eye bolt on the spring end and provision to attach the housing to the flat
56 iron duct straps.

57
58 **FLEXIBLE PIPING CONNECTIONS**

59 Suitable for pressure, temperature, and fluid involved; minimum pressure rating for any system is 125 psig
60 at the design temperature of the fluid. Use 12 inch minimum line length of flexible hose or length required
61 to absorb 3/4" lateral movement, whichever is greater.

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MANUFACTURERS:

Flexonics, Mason, Mercer Rubber, Metraflex, or approved equal.

WATER AND/OR PUMPED CONDENSATE:

Multiple plies of nylon tire cord fabric reinforced with an EPDM cover and liner. Do not use steel wire or rings as pressure reinforcement. Use threaded or soldered connections for sizes 2" and smaller and floating steel or ductile iron flanges for sizes 2-1/2" and larger; design the steel flange end so the steel flange is recessed to lock a steel wire bead ring in the raised face of the EPDM flange. Construct straight-through connections with twin spheres. Use control rods when recommended by the manufacturer. Use liner that is compatible with propylene glycol when used on heat recovery chiller condenser loop.

PERFORMANCE

Select vibration isolation devices as indicated below or to provide not less than 95% isolation efficiency, whichever is greater.

TYPE OF EQUIPMENT	----- Floor Span or Column Spacing-----							
	--On Grade--	---20 Feet---		---30 Feet---		---40 Feet---		
	Iso. Type	Min. Static Defl. In.	Iso. Type	Min. Static Defl. In.	Iso. Type	Min. Static Defl. In.	Iso. Type	Min. Static Defl. In.
REFRIGERATION MACHINES:								
Scroll	1	0.10	1	0.1	1	.01	1	.01
AIR-COOLED FLUID COOLER								
2.50		Bolt to pad		3	0.75	3	1.50	3
PACKAGED AIR HANDLING UNITS:								
Suspended								
Thru 5 hp	-	-	5	1.00	5	1.00	5	1.00
7-1/2 hp and over								
Thru 400 rpm	-	-	5	1.50	5	1.50	5	1.50
401 rpm and over	-	-	5	1.00	5	1.00	5	1.50
Floor mounted								
Thru 5 hp	3	0.35	3	0.75	3	0.75	3	0.75
7-1/2 hp and over								
Thru 400 rpm	3	0.35	3-S	1.50	3-S	1.50	3-S	1.50
7-1/2 hp thru 40 hp								
401 rpm and over	3	0.35	3	0.75	3	0.75	3-S	1.50
50 hp and larger								
401 rpm and over	3	0.35	3	0.75	3-S	1.50	3-S	2.50

PIPING CONNECTED TO ROTATING OR RECIPROCATING EQUIPMENT:

Flexible piping connections, and type 5 or 6 hangers for a distance of 100 pipe diameters or a distance of three hangers away from the equipment, whichever is greater. Type 6 hangers shall be utilized for the first two upstream and downstream hangers. The Type 5 and/or type 6 hangers must have the same deflection as the hangers supporting the rotating or reciprocating equipment. Where piping is floor supported, the above requirement apply, but use type 3 mounts instead of type 5 or 6 hangers.

1
2 **DUCTWORK IN**
3 **MECHANICAL EQUIPMENT**
4 **ROOMS:**

5 Use type 7 hanger with .75" minimum deflection for all ducts with a
6 cross sectional area greater than 2.0 square feet and, where either the
7 air velocity is great than 3500 fpm or, the pressure class is 4" water
8 column or higher.

9
10 **PART 3 - EXECUTION**

11
12 **INSTALLATION**

13 Install vibration isolation devices for motor driven equipment in accordance with the manufacturer's
14 installation instructions.

15
16 Set steel and inertia bases for one inch clearance between the concrete floor or housekeeping pad and the
17 base.

18
19 Do not allow installation practices to short circuit any isolation device.

20
21 Install flexible piping connections on the equipment side of shut-off valves.

22
23 **PACKAGED AIR HANDLING UNITS AND CENTRIFUGAL FANS**

24 Attach horizontal thrust restraints at the centerline of thrust and symmetrically on either side of the unit.
25 Thrust restraints are not required when the fan section is not isolated from the remainder of the air
26 handling unit by means of duct flexible connections.

27
28 **ISOLATION DEVICES OUTDOORS OR IN HIGH HUMIDITY AREAS**

29 Use only hot dip galvanized, stainless steel, or neoprene coated steel parts.
30
31

32
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 23 05 00 Common Work Results for HVAC
- Section 23 07 00 HVAC Insulation

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.

DESCRIPTION

The Mechanical Contractor will separately contract with an independent test and balance agency 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 or NEBB.

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.

1 Verify that provisions are being made to accomplish the specified testing, adjusting and balancing work. If
2 problems are found, handle as specified in Part 3 under Deficiencies.

3 **QUALITY ASSURANCE**

4 **QUALIFICATIONS**

5 An independent Firm specializing in the Testing and Balancing of HVAC systems for a minimum of 3
6 years. A Firm not engaged in the commerce of furnishing or providing equipment or material generally
7 related to HVAC work other than that specifically related to installing Testing and Balancing components
8 necessary for work in this section such as, but not limited to sheaves, pulleys, and balancing dampers.
9

10
11 A certified member of AABC or certified by NEBB in the specific area of work performed. Maintain
12 certification for the entire duration of the project. If certification of firm or any staff performing work is
13 terminated or expires during the duration of the project, contact owner immediately.

14
15 Technicians on this project must have satisfactorily completed work on a minimum of (3) three projects of
16 at least 50% in size, and of similar complexity.

17
18 Submit Qualifications of firm and project staff to owner upon request.

19 **PRE-INSTALLATION MEETING AND SCHEDULING**

20
21 The test and balance agency is required to attend a pre-installation meeting with all other project
22 contractors before the construction process is started. The test and balance agency shall give the Lead
23 Contractor a detailed schedule of testing and balancing tasks for incorporation into the project schedule.
24 Reference General Conditions Article 12 for Lead Contractor responsibilities for scheduling.
25

26 **PRE-BALANCE CONFERENCE**

27 90 days prior to beginning testing, adjusting and balancing, schedule and conduct a conference with the
28 Architect/Engineer, OWNER's Project Representative and the mechanical system and temperature control
29 system installing Contractors. Provide AE and Commissioning Provider (CxP) with a complete copy of the
30 TAB plan for the project. The objective is final coordination and verification of system operation and
31 readiness for testing, adjusting and balancing procedures and scheduling procedures with the above
32 mentioned parties. Indicate work required to be completed prior to testing, adjusting, and balancing and
33 identify the party responsible for completion of that work.
34

35 **SUBMITTALS**

36 See also Related Work in this section.

37
38 Submit testing, adjusting and balancing reports bearing the seal and signature of the NEBB or AABC
39 Certified Test and Balance Supervisor. The reports certify that the systems have been tested, adjusted and
40 balanced in accordance with the referenced standards; are an accurate representation of how the systems
41 have been installed and are operating; and are an accurate record of all final quantities measured to
42 establish normal operating values of the systems.
43

44 Submission:

45
46 Distribute electronic copies of the Report to the Contractor, the Lead Contractor, the Owner, the Agency
47 Contact, the Prime A/E, the Project Manager, Jim Polfuss (James.Polfuss@wisconsin.gov), John Chapman
48 (John.Chapman@wisconsin.gov), Jim Kropp (James.Kropp@wisconsin.gov) and Penny Olson
49 (Penny.Olson@wisconsin.gov)

50
51 Enter a RFI, with a copy of the Testing and Balancing Report Summary as an upload, indicating that the
52 Testing and Balancing Report is posted on the WisBuild Project Overview page and requesting review of
53 the report.

54
55 Format: Cover page identifying project name, project number and descriptive title of contents. Divide the
56 contents of the report into the below listed divisions:

- 57 • General Information
- 58 • Summary
- 59 • Air Systems
- 60 • Hydronic Systems
- 61 • Special Systems
- 62

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Contents: Provide the following minimum information, forms and data:

General Information: Inside cover sheet identifying Test and Balance Agency, 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 or AABC 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 or AABC 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 OWNER upon request. Calibration and maintenance of all instruments to be in accordance with the requirements of NEBB or AABC Standards

PART 3 - EXECUTION

DAILY REPORTS

Submit to owner's 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 owner's 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 Agency in providing specified system performance.

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

1 such that access panels are required for the work of this section and the panels have not been provided,
2 inform the owner's project representative.
3
4 Cut insulation, ductwork and piping for installation of test probes to the minimum extent necessary for
5 adequate performance of procedures. Patch using materials identical to those removed, maintaining vapor
6 barrier integrity and pressure rating of systems.
7
8 In air systems employing filters, blank off sufficient filter area to simulate a pressure drop that is midway
9 between that of a clean filter and that of a dirty filter.
10
11 Measure and record system measurements at the fan and/or pump to determine total flow. Adjust
12 equipment as required to yield specified total flow at terminals. Proceed taking measurements in mains and
13 branches as required for final terminal balancing. Perform terminal balancing to specified flows balancing
14 branch dampers, deflectors, extractors and valves prior to adjustment of terminals.
15
16 Measure and record static air pressure conditions across fans, coils and filters. Indicate in report if cooling
17 coil measurements were made on a wet or dry coil and if filter measurements were made on a clean or dirty
18 filter. Spot check static air pressure conditions directly ahead of terminal units.
19
20 Adjust outside air, return air and relief air dampers for design conditions at both the minimum and
21 maximum settings and record both sets of data. Balance modulating dampers at extreme conditions and
22 record both sets of data. Balance variable air volume systems at maximum air flow rate, full cooling, and
23 minimum flow rate, full heating; record all data.
24
25 Adjust register, grille and diffuser vanes and accessories to achieve proper air distribution patterns and
26 uniform space temperatures free from objectionable noise and drafts within the capabilities of the installed
27 system.
28
29 Provide fan and motor drive sheave adjustments necessary to obtain design performance. Provide drive
30 changes specifically noted on drawings, if any. If work of this section indicates that any drive or motor is
31 inadequate for the application, advise the owner's project representative by giving the representative
32 properly sized motor/drive information (in accordance with manufacturers original service factor and
33 installed motor horsepower requirements); Confirm any change will keep the duct/piping system within its
34 design limitations with respect to speed of the device and pressure classification of the distribution system.
35 Required motor/drive changes not specifically noted on drawings or in specifications will be considered an
36 extra cost and will require an itemized cost breakdown submitted to owner's project representative. Prior
37 authorization is needed before this work is started.
38
39 Areas or rooms designed to maintain positive, negative or balanced air pressures with respect to adjacent
40 spaces, as indicated by the design air quantities, require special attention. Adjust fan drives, distribution
41 dampers, terminals and controls to maintain indicated pressure relationship.
42
43 Final air system measurements to be within the following range of specified cfm:
44 Fans 0% to +10%
45 Supply grilles, registers, diffusers 0% to +10%
46 Return/exhaust grilles, registers 0% to -10%
47 Room pressurization air -5% to +5%
48
49 Final water system measurements must be within the following range of specified gpm:
50 Heating flow rates 0% to -10%
51 Cooling flow rates -5% to +5%
52
53 Contact the temperature control Contractor for assistance in operation and adjustment of controls during
54 testing, adjusting and balancing procedures. Cycle controls and verify proper operation and setpoints.
55 Include in report description of temperature control operation and any deficiencies found.
56
57 Permanently mark equipment settings, including damper and valve positions, control settings, and similar
58 devices allowing settings to be restored. Set and lock memory stops.
59
60 Leave systems in proper working order, replacing belt guards, closing access doors and electrical boxes,
61 and restoring temperature controls to normal operating settings.
62

1 Verify and record, in the T&B Report, "K" factors for all VAV air terminal devices and air flow stations.

2
3 Coordinate air handling unit minimum outside air set points with the Temperature Control Contractor.

4
5 Coordinate Fume Hood Monitor calibration with the Fume Hood Manufacturer.

6
7 **VAV SUPPLY AND EXHAUST DUCT SYSTEM STATIC PRESSURE SET POINT**

8 For VAV supply and exhaust systems with VAV air terminal devices, determine the minimum required
9 duct static pressure at the DDC static pressure sensor location(s) needed to insure that all VAV air
10 terminals are operating at their design airflows with the most demanding VAV terminal wide open.
11 Provide these static pressure numbers to the DDC temperature controls contractor and record them in the
12 T&B report for each system.

13
14 **HYDRONIC SYSTEM DIFFERENTIAL PRESSURE CONTROL SET POINT**

15 For hydronic systems with variable speed pumping, determine the minimum required system differential
16 pressure set point needed to insure that all terminal devices are operating at their design water flows with
17 the most demanding terminals device control valve wide open. Provide the differential control setting set
18 point to the DDC temperature control contractor and record them in the T&B report for each system.

19
20 For HVAC pumps 10 horsepower or less, valve throttling alone may be used for hydronic system
21 balancing.

22
23 Throttling of triple-duty valves shall not exceed 50% closed. Where additional throttling would be
24 necessary to achieve the system design flow the impellor shall be trimmed.

25
26 Verify Triple duty valve utilized on systems with Variable Frequency Drives are 100% open when
27 balancing work is complete.

28
29 The pressure drop across triple duty valves shall not exceed 25 ft. w.g. Where additional throttling would
30 be necessary to achieve the system design flow the impellor shall be trimmed.

31
32 For HVAC pumps greater than 10 horsepower through 60 horsepower, trim the impellor where valve
33 throttling will result in a draw that exceeds 3 horsepower.

34
35 Future fouling of an open piping system may be considered when determining impellor trim requirements.

36
37 Verify butterfly valves utilized for hydronic system balancing are provided with position-lock operators
38 (memory stops) in accordance with Section 23 05 23. The adjustment and marking of lever-lock operators
39 that use throttling notches will not be accepted. Lock all memory stops so the valves can be reopened to
40 their balanced positions if they are used for isolation purposes.

41
42 **DEFICIENCIES**

43 Division 23 00 00 contractor to correct any installation deficiencies found by the test and balance agency
44 that were specified and/or shown on the Contract Documents to be performed as part of that division of
45 work. Test and balance agency will notify the owner's Project Representative of these items and
46 instructions will be issued to the Division 23 00 00 contractor for correction of the deficient work. All
47 corrective work to be done at no cost to the owner. Retest mechanical systems, equipment, and devices
48 once corrective work is complete as specified.

49
50 **FUNCTIONAL PERFORMANCE TESTING**

51 Contractor is responsible for performing the functional performance test procedures and completing the
52 functional performance test form required under specification Section 01 91 01 or 01 91 02 Commissioning
53 Process.. Notify the A/E and commissioning provider 5 business days prior to performing functional
54 performance testing so that they may witness. Reference 01 91 01 or 01 91 02 and functional performance
55 test form FPT-23 05 93 for specific requirements.

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58 **END OF SECTION**

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**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 Standards
- Quality Assurance
- Description
- Definitions
- Shop Drawings
- Operation and Maintenance Data
- Environmental Requirements

PART 2 - PRODUCTS

- Materials
- Insulation Types
- 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
- Ductwork Protective Coverings
- Duct Insulation Schedule
- Equipment Insulation
- Equipment Insulation Schedule
- Construction Verification Items

RELATED WORK

- Section 23 05 00 - Common Work Results for HVAC
- Section 23 21 13 - Hydronic Piping
- Section 23 05 29 - Hangers 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

- 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 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

1	ASTM C533	Calcium Silicate Block and Pipe Thermal Insulation
2	ASTM C534	Preformed Flexible Elastomeric Thermal Insulation
3	ASTM C547	Mineral Fiber Preformed Pipe Insulation
4	ASTM C552	Cellular Glass Block and Pipe Thermal Insulation
5	ASTM C553	Mineral Fiber Blanket and Felt Insulation
6	ASTM C578	Preformed, Block Type Cellular Polystyrene Thermal Insulation
7	ASTM C591	Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation
8	ASTM C610	Expanded Perlite Block and Thermal Pipe Insulation
9	ASTM C612	Mineral Fiber Block and Board Thermal Insulation
10	ASTM C921	Properties of Jacketing Materials for Thermal Insulation
11	ASTM C1136	Flexible Low Permeance Vapor Retarders for Thermal Insulation
12	ASTM D412	Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers-Tension
13	ASTM D1000	Methods for Pressure-Sensitive Adhesive-Coated Tapes Used for Electrical and Electronic Applications
14		
15	ASTM D1621	Standard Test Method for Compressive Properties Of Rigid Cellular Plastics
16	ASTM D1622	Standard Test Method for Apparent Density of Rigid Cellular Plastics
17	ASTM D1940	Method of Test for Porosity of Rigid Cellular Plastics
18	ASTM D2126	Method for Response of Rigid Cellular Plastics to Thermal and Humid Aging
19	ASTM D2240	Standard Test Method for Rubber Property—Durometer Hardness
20	ASTM E84	Surface Burning Characteristics of Building Materials
21	ASTM E814	Standard Test Method for Fire Tests of Penetration Firestop Systems
22	MICA	National Commercial & Industrial Insulation Standards
23	NFPA 225	Surface Burning Characteristics of Building Materials
24	UL 723	Surface Burning Characteristics of Building Materials

25
26 **QUALITY ASSURANCE**

27 Refer to division 1, General Conditions, Equals and Substitutions

28
29 Label all insulating products delivered to the construction site with the manufacturer's name and
30 description of materials.

31
32 Insulation systems shall be applied by experienced contractors. Within the past five (5) years, the
33 contractor shall be able to document the successful completion of a minimum of three (3) projects of at
34 least 50% of the size and similar scope of the work specified in this section.

35
36 **DESCRIPTION**

37 Furnish and install all insulating materials and accessories as specified or as required for a complete
38 installation. The following types of insulation are specified in this section:

- 39 • Pipe Insulation
- 40 • Duct Insulation
- 41 • Equipment Insulation

42
43 Install all insulation in accordance with the latest edition of MICA (Midwest Insulation Contractors
44 Association) Standard and manufacturer's installation instructions. Exceptions to these standards will only
45 be accepted where specifically modified in these specifications, or where prior written approval has been
46 obtained from the owner Project Representative.

47
48 **DEFINITIONS**

49 Concealed: shafts, furred spaces, space above finished ceilings, utility tunnels and crawl spaces. All other
50 areas, including walk-through tunnels, shall be considered as exposed.

51
52 **SHOP DRAWINGS**

53 Refer to division 1, General Conditions, Submittals.

54
55 Submit a schedule of all insulating materials to be used on the project, including adhesives, fastening
56 methods, fitting materials along with material safety data sheets and intended use of each material. Include
57 manufacturer's technical data sheets indicating density, thermal characteristics, jacket type, and
58 manufacturer's installation instructions.

1 **OPERATION AND MAINTENANCE DATA**

2 All operations and maintenance data shall comply with the submission and content requirements specified
3 under section GENERAL REQUIREMENTS.

4
5 **ENVIRONMENTAL REQUIREMENTS**

6 Do not store insulation materials on grade or where they are at risk of becoming wet. Do not install
7 insulation products that have been exposed to water.

8
9 Protect installed insulation work with plastic sheeting to prevent water damage.

10
11 **PART 2 - PRODUCTS**

12
13
14 **MATERIALS**

15 Manufacturers: Armacell, Certainteed, Manson, Childers, Dow, Extol, Fibrex, Halstead, H.B. Fuller,
16 Imcoa, Johns Manville, Knauf, Owens-Corning, Partek, Pittsburgh Corning, Rubatex, VentureTape or
17 approved equal.

18 Materials or accessories containing asbestos will not be accepted.

19
20
21 Use composite insulation systems (insulation, jackets, sealants, mastics, and adhesives) that have a flame
22 spread rating of 25 or less and smoke developed rating of 50 or less, with the following exceptions:

23
24 Pipe insulation which is not located in an air plenum may have a flame spread rating not over 25 and a
25 smoke developed rating no higher than 450 when tested in accordance with UL 723 and ASTM E84.

26
27 **INSULATION TYPES**

28 Insulating materials shall be fire retardant, moisture and mildew resistant, and vermin proof. Insulation
29 shall be suitable to receive jackets, adhesives and coatings as indicated.

30
31 **FLEXIBLE FIBERGLASS INSULATION:** duct

32 Minimum nominal density of 0.75 lbs. per cu. ft., and thermal conductivity of not more than 0.3 at 75
33 degrees F, rated for service to 250 degrees F.

34
35 **RIGID FIBERGLASS INSULATION:**

36 Minimum nominal density of 3 lbs. per cu. ft., and thermal conductivity of not more than 0.23 at 75
37 degrees F, minimum compressive strength of 25 PSF at 10% deformation, rated for service to 450 degrees
38 F.

39
40 **ELASTOMERIC INSULATION:**

41 Flexible closed cell, minimum nominal density of 5.5 lbs. per cu. ft., thermal conductivity of not more than
42 0.27 at 75 degrees F, minimum compressive strength of 4.5 psi at 25% deformation, maximum water vapor
43 permeability of 0.17 perm inch, maximum water absorption of 6% by weight, rated for service range of -20
44 degrees F to 220 degrees F on piping and 180 degrees F where adhered to equipment.

45
46 **EXTRUDED POLYSTYRENE INSULATION:**

47 Rigid closed cell, minimum nominal density of 1.6 lbs. per cu. ft., thermal conductivity of not more than
48 0.285 at 75 degrees F, minimum compressive strength of 20 psi, maximum water vapor permeability of 1.5
49 perm inch, maximum water absorption of .5 % by volume, rated for service range of -290 degrees F to 165
50 degrees F.

51
52 **POLYISOCYANURATE INSULATION:**

53 Rigid closed cell polyisocyanurate, minimum nominal density of 2.0 lbs. per cu. ft., thermal conductivity of
54 not more than 0.19 at 75 degrees F aged 180 days, minimum compressive strength of 24 psi parallel and 13
55 psi perpendicular, maximum water vapor permeability of 4 perm inch, maximum water absorption of 2%
56 by volume, rated for service range of -290 degrees F to 300 degrees F.

57
58 Pipe insulation shall be preformed in two (2) half cylinder sections. Cut V-groove sheet insulation is not
59 acceptable. Provide three (3) stainless steel bands for each section of insulation.

60
61 **JACKETS**

1 **ALL SERVICE JACKETS (ASJ):**

2 Heavy duty, fire retardant material with white kraft reinforced foil vapor barrier, factory applied to
3 insulation with a self-sealing pressure sensitive adhesive lap, maximum permeance of .02 perms and
4 minimum beach puncture resistance of 50 units.

5
6 **SELF-ADHERING JACKETS (SAJ):**

7 5-ply, self-adhering multiple laminated waterproofing material with reflective aluminum foil, high density
8 polymer films and cold weather acrylic adhesive providing zero (0.0) permeability. Minimum 6 mils
9 material thickness, 35lb puncture resistance when tested in accordance with ASTM D1000 and flame
10 spread/smoke developed rating of 10/20 when tested in accordance with UL 723.

11
12 Vapor retarding tape shall be specifically designed and manufactured for use with the self-adhering jacket
13 specified above. Tape shall be provided by the same manufacturer that provides jacketing. Vapor retarding
14 tapes used with self-adhering jackets shall have a maximum permeance of 0.0 perms.

15
16 **VAPOR RETARDING JACKETS (VRJ):**

17 Polyvinylidene chloride (PVDC) vapor retarding jacket material with minimum 6 mils material thickness
18 and maximum permeance of 0.01 perms. Material shall not support the growth of mold or mildew. Dow
19 Saran or equivalent.

20
21 Vapor retarding tape shall be specifically designed and manufactured for use with the vapor retarding
22 jacket specified above. Tape shall be provided by the same manufacturer that provides jacketing. Vapor
23 retarding tapes used with vapor retarding jackets shall have a maximum permeance of 0.01 perms.

24
25 **INSULATION INSERTS AND PIPE SHIELDS**

26 Manufacturers: B-Line, Pipe Shields, Value Engineered Products

27
28 Construct inserts with calcium silicate or polyisocyanurate (service temperatures below 300 degrees F
29 only), minimum 140 psi compressive strength. Piping 12" and larger, supplement with high density 600 psi
30 structural calcium silicate insert. Provide galvanized steel shield. Insert and shield to be minimum 180
31 degree coverage on bottom supported piping and full 360 degree coverage on clamped piping. On roller
32 mounted piping and piping designed to slide on support, provide additional load distribution steel plate.

33
34 Where contractor proposes shop/site fabricated inserts and shields, submit schedule of materials,
35 thicknesses, gauges and lengths for each pipe size to demonstrate equivalency to
36 preengineered/premanufactured product described above. On low temperature systems, high density rigid
37 polyisocyanurate may be substituted for calcium silicate provided insert and shield length and shield gauge
38 are increased to compensate for lower insulation compressive strength.

39
40 Precompressed 20# density molded fiberglass blocks, Hamfab or equal, of the same thickness as adjacent
41 insulation may be substituted for calcium silicate inserts with one 1"x6" block for piping through 2-1/2"
42 and three 1"x6" blocks for piping through 4". Submit shield schedule to demonstrate equivalency to
43 preengineered/premanufactured product described above.

44
45 Wood blocks will not be accepted.

46
47 **EXPANSION JOINT AND VALVE INSULATION BLANKETS**

48 Manufacturers: Advance Thermal Corporation, TANI Division B.D. Schiffler or approved equal.

49
50 Jacket shall be 7 ounce per square yard Teflon coated Nomex fabric which is designed for wet and dry
51 steam applications to 550°F. Equal to Advance Thermal Corp. Steamguard-1 cloth. The covers shall be
52 installed to shed water and have a 1-inch rain flap.

53
54 All seams shall be sewn twice with double locked stitching. One seam shall be sewn with 3-ply Nomex and
55 the other with 3-ply stainless steel. Hog rings and staples shall not be used.

56
57 The insulation shall be a 2-inch thick, 6 lb. density ceramic fiber which is held in place with 12 gauge
58 stainless quilt pins which do not puncture the inner surface of the cover.

59
60 Covers shall be designed to allow access to the expansion and ball joints packing cylinder plungers for
61 repacking with removing the covers.

1
2 Adjacent pipe insulation must be installed to allow the piping to expand into expansion joints without
3 damaging the insulation or removable covers.
4
5 **ACCESSORIES**
6 All products shall be compatible with surfaces and materials on which they are applied, and be suitable for
7 use at operating temperatures of the systems to which they are applied.
8
9 Adhesives, sealants, and protective finishes shall be as recommended by insulation manufacturer for
10 applications specified.
11
12 Insulation bands to be 3/4 inch wide, constructed of aluminum or stainless steel. Minimum thickness to be
13 .015 inch for aluminum and .010 inch for stainless steel.
14
15 Tack fasteners to be stainless steel ring grooved shank tacks.
16
17 Staples to be clinch style.
18
19 Insulating cement to be ANSI/ASTM C195, hydraulic setting mineral wool.
20
21 Finishing cement to be ASTM C449.
22
23 Fibrous glass or canvas fabric reinforcing shall have a minimum untreated weight of 6 oz./sq. yd.
24
25 Bedding compounds to be non-shrinking and permanently flexible.
26
27 Vapor barrier coatings to have maximum applied water vapor permeance of .05 perms.
28
29 Fungicidal water base coating (Foster 40-20 or equal) to be compatible with vapor barrier coating.
30

31 **PART 3 - EXECUTION**

32 **EXAMINATION**

33
34 Verify that all piping, equipment, and ductwork are tested and approved prior to installing insulation. Do
35 not insulate systems until testing and inspection procedures are completed.
36
37

38 Verify that all surfaces are clean, dry and without foreign material before applying insulation materials.
39

40 **INSTALLATION**

41 All materials shall be installed by skilled labor regularly engaged in this type of work. All materials shall
42 be installed in strict accordance with manufacturer's recommendations, building codes, and industry
43 standards. Do not install products when the ambient temperature or conditions are not consistent with the
44 manufacturer's recommendations. Surfaces to be insulated must be clean and dry.
45

46 Locate insulation and cover seams in the least visible location. All surface finishes shall be extended in
47 such a manner as to protect all raw edges, ends and surfaces of insulation.
48

49 Install insulation with smooth and even surfaces. Poorly fitted joints or use of filler in voids will not be
50 accepted. Provide neatly beveled and coated terminations at all nameplates, uninsulated fittings, or at other
51 locations where insulation terminates.
52

53 Install fabric reinforcing without wrinkles. Overlap seams a minimum of 2 inches.
54

55 Use full length material (as delivered from manufacturer) wherever possible. Scrap piecing of insulation or
56 pieces cut undersize and stretched to fit will not be accepted.
57

58 All pipe and duct insulation shall be continuous through walls, ceiling or floor openings and through
59 sleeves except where firestop or firesafing materials are required. Vapor barriers shall be maintained
60 continuous through all penetrations.
61

1 Provide a continuous unbroken moisture vapor barrier on insulation applied to systems noted below.
2 Attachments to cold surfaces shall be insulated and vapor sealed to prevent condensation.

3
4 Provide a complete vapor barrier for insulation on the following systems:

- 5 • Chilled Water
- 6 • Insulated Duct
- 7 • Equipment, ductwork or piping with a surface temperature below 65 degrees F

8 9 **PROTECTIVE JACKET INSTALLATION**

10 **PVC FITTING COVERS AND JACKETS (PFJ):**

11 White PVC film, gloss finish one side, semi-gloss other side, FS LP-535D, Composition A, Type II, Grade
12 GU. Ultraviolet inhibited indoor/outdoor grade to be used where exposed to high humidity, ultraviolet
13 radiation, in kitchens or food processing areas or installed outdoors. Jacket thickness to be minimum .02"
14 indoors/.03" outdoors for piping 12" and smaller, .03" indoors/.04" outdoors for piping 15" and larger.

15 16 **SELF-ADHERING JACKETS (SAJ):**

17 Install according to manufacturer's recommendations. Cut allowing minimum 4" overlap on ends and 6"
18 on longitudinal joints. Align parallel to surface. Remove release paper and press flat to surface to avoid
19 wrinkles. Rub entire surface for full adhesion and sealing at joint overlaps. On exterior applications,
20 provide a bead of compatible caulk along exposed edges.

21
22 Piping with self-adhering (SAJ) jackets shall have elbows, fittings, valves and butt joints wrapped with 2
23 layers of vapor retarding tape. Piping with a PVC jacket (PFJ) installed over the self-adhering (SAJ) jacket
24 may be provided with a single, lapped layer of vapor retarding tape for elbows, fittings and valves under
25 the PVC jacket. Vapor retarding tape shall be compatible with the jacket material used.

26 27 **FOIL SCRIM ALL SERVICE JACKETS (FSJ):**

28 Glass fiber reinforced foil kraft laminate, factory applied to insulation. Maximum permeance of .02 perms
29 and minimum beach puncture resistance of 25 units.

30 31 **FABRIC REINFORCED MASTIC JACKETS (FMJ):**

32 Glass fiber reinforcing fabric imbedded in weather barrier mastic as per manufacturer's recommended
33 procedure for 2 coat application.

34 35 **VAPOR RETARDING JACKETS (VRJ):**

36 Piping with vapor retarding (VRJ) jackets shall have elbows, fittings, valves and butt joints wrapped with 2
37 layers of vapor retarding tape. Piping with a PVC jacket (PFJ) installed over the vapor retarding (VRJ)
38 jackets may be provided with a single, lapped layer of vapor retarding tape for elbows, fittings and valves
39 under the PVC jacket. Vapor retarding tape shall be compatible with the jacket material used.

40 41 **PIPING, VALVE, AND FITTING INSULATION**

42 **GENERAL:**

43 Install insulation with butt joints and longitudinal seams closed tightly. Provide minimum 2" lap on jacket
44 seams and 2" tape on butt joints, firmly cemented with lap adhesive unless otherwise noted. Additionally
45 secure with staples along seams and butt joints. Coat staples, longitudinal and transverse seams with vapor
46 barrier mastic on systems requiring vapor barrier.

47
48 Install insulation continuous through pipe hangers and supports with hangers and supports on the exterior
49 of insulation. Where a vapor barrier is not required or where roller hangers are not being used, hangers and
50 supports may be attached directly to piping with insulation completely covering hanger or support and
51 jacket sealed at support rod penetration. Where riser clamps are required to be attached directly to piping
52 requiring vapor barrier, extend insulation and vapor barrier jacketing/coating around riser clamp.

53
54 Where insulated piping is installed on hangers and supports, the insulation shall be installed continuous
55 through the hangers and supports. High density inserts shall be provided as required to prevent the weight
56 of the piping from crushing the insulation. Pipe shields are required at all support locations. The insulation
57 shall not be notched or cut to accommodate the supporting channels.

58
59 Fully insulate all reheat coil piping, fittings and valves (with the exception of unions) up to coil connection
60 to prevent condensation when coil is inactive during cooling season. Provide a vapor proof seal between
61 the pipe insulation and the insulated coil casing.

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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.

MINERAL FIBER:

Secure each 3' section with three stainless steel bands or five 16 gauge stainless steel or annealed copper tie wires evenly spaced and at ends. Twist wire ends, snip off excess and turn ends over into insulation. Stagger joints where more than one layer is used.

ELASTOMERIC AND POLYOLEFIN:

Where practical, slip insulation on piping during pipe installation when pipe ends are open. Miter cut fittings allowing sufficient length to prevent stretching. Completely seal seams and joints for vapor tight installation. For elastomeric insulation, apply full bed of adhesive to both surfaces. For polyolefin, seal factory preglued seams with roller and field seams and joints with full bed of hot melt polyolefin glue to both surfaces. Cover elastomeric insulation on systems operating below 40 degrees F with vapor barrier mastic.

EXTRUDED POLYSTYRENE AND POLYISOCYANURATE:

Fittings, valves, unions, flanges, couplings and specialties shall be insulated with factory molded insulation of the same thickness as adjoining insulation. Secure insulation sections with two wraps of nylon filament tape 9"-12" on center. On single insulation layer systems and on the outer layer of double insulation layer systems, apply a thin coat of elastomeric joint sealant rated for system operating temperatures to all longitudinal and butt insulation joints covering entire face of joint. Allow sealant to fully cure before applying protective covering. For piping service below 0°F, use two layers of insulation with inner and outer butt and longitudinal joints staggered and offset 90 degrees. Where two layers of insulation are used, do not use sealant on the inner layer or adhere the inner layer to the outer layer. Apply vapor stop bead of joint sealant between pipe and insulation on both sides of valves, expansion/contraction joints, flanges, thermometers/gauges, attached vent and drain lines. Insulate attached non-circulated lines, control lines, vents, etc. for a minimum distance of 6" from pipe. Cover insulation with a protective jacket as specified below. Do not penetrate protective covering or insulation with mechanical fasteners.

Provide a protective PVC (PFJ) or Fabric Reinforced Mastic (FMJ) jacket for the following insulated piping:

All piping within mechanical rooms

PIPE INSULATION SCHEDULE:

Provide insulation on new and existing remodeled piping as indicated in the following schedule:

<u>Service</u>	<u>Insulation</u>	<u>Jacket</u>	<u>Insulation Thickness by Pipe Size</u>				
			<u>≤ 1-1/4"</u>	<u>1-1/2"</u>	<u>2" to <4"</u>	<u>4" to 6"</u>	<u>8" and larger</u>
Heating Hot Water	Rigid Fiberglass	ASJ	1.5"	1.5"	2"	2"	2"
Note: On 1" or smaller hot water pipe runouts to terminal unit coils the insulation thickness may be reduced to 1/2" on both the supply and return pipes within 4ft of the coil but not on the distribution system side of the temperature control valve.							
Chilled Water	Polyiso./Polysty.	VRJ or SAJ	1.5"	1.5"	1.5"	1.5"	1.5"
Cooling Coil	Rigid Fiberglass	ASJ	0.5"	0.5"	1"	1"	1"

1 Condensate Drain
2 Cond. Pump Disch. Rigid Fiberglass ASJ 1.5" 1.5" 2" 2" 2"

3
4 The following piping and fittings are not to be insulated:

- 5 • Hot water piping inside radiation, convactor, or cabinet heater enclosures
- 6 • Piping unions for systems not requiring a vapor barrier

7
8 For systems with fluid temperatures 65° F or less, furnish and install removable elastomeric insulation
9 covers, plugs or caps for all mechanical equipment and devices that require access by balancing contractors
10 or service and maintenance personnel. Examples include but are not limited to: flow sensing devices,
11 circuit setters, manual ball valve air vents, drain valves, blowdown valves, pressure/temperature test plugs,
12 grease fittings, pump bearing caps, equipment labels, etc. Covers shall be tight fitting to ensure a complete
13 vapor barrier.

14 **DUCT INSULATION**

15 **GENERAL:**

16 Secure flexible duct insulation on sides and bottom of ductwork over 24" wide and all rigid duct insulation
17 with weld pins. Space fasteners 18" on center or less as required to prevent sagging.

18
19
20 Secure rigid board insulation to ductwork with weld pins. Apply insulation with joints firmly butted as
21 close as possible to the equipment surface. Pins shall be located a maximum of 3" from each edge and
22 spaced no greater than 12" on center.

23
24 Install weld pins without damage to the interior galvanized surface of the duct. Clip pins back to washer
25 and cover penetrations with tape of same material as jacket. Firmly butt seams and joints and cover with 4"
26 tape of same material as jacket. Seal tape with plastic applicator and secure with staples. All joints, seams,
27 edges and penetrations to be fully vapor sealed.

28
29 Stop and point insulation around access doors and damper operators to allow operation without disturbing
30 insulation or jacket material.

31
32 External supply duct insulation is not required where ductwork contains continuous 1" acoustical liner.
33 Provide 4" overlap of external insulation over ends of acoustically lined sections.

34
35 Where insulated ductwork is supported by trapeze hangers, the insulation shall be installed continuous
36 through the hangers. Drop the supporting channels required to facilitate the installation of the insulation.
37 Where rigid board or flexible insulation is specified, install high density inserts to prevent the weight of the
38 ductwork from crushing the insulation.

39
40 Where insulated duct risers are supported by steel channels secured directly to the duct, extend the
41 insulation and vapor barrier jacketing to encapsulate the support channels.

42 **BREECHING:**

43 Fasten insulation over weld pins and secure with washers. Space fasteners not less than 3" from edge or
44 corner and 12" on center longitudinally and 9" on center in the transverse direction. Clip pins back to
45 washer and cover penetrations with tape of same material as jacket. Firmly butt seams and joints and cover
46 with 4" tape of same material as jacket. Seal tape with plastic applicator and secure with staples.

47 **DUCTWORK PROTECTIVE COVERINGS:**

48
49 In addition to the the jackets specified in the duct insulation schedule below the following protective
50 coverings are required:

51
52
53 Provide a protective covering of 2 coats of indoor/outdoor vapor barrier mastic with fibrous glass or canvas
54 fabric covering (FMJ) for the following ductwork:

55
56 Ductwork within 10' of floor, catwalks and mezzanines in mechanical rooms

57 **DUCT INSULATION SCHEDULE:**

58 Provide duct insulation on new and existing remodeled ductwork in the following schedule:
59
60
61

1	Service	Insulation Type	Jacket	Insulation Thickness
2	Outside air ducts	Rigid Fiberglass	FSJ	2"
3	Mixed air ducts	Rigid Fiberglass	FSJ	2"
4	Concealed supply ducts	Flexible Fiberglass	FSJ	1-1/2"
5	Exhaust and relief ducts downstream	Rigid Fiberglass	FSJ	2"
6	of motorized backdraft dampers			

7
8 Proceed with work only when weather conditions comply with Manufacturer recommendations and other
9 current published data and MSDS information. Do not exceed temperature limitations recommended by
10 coating manufacturer.

11
12 Air intake vents, blowers, air conditioning units and evaporative coolers shall be disconnected or otherwise
13 modified to prevent fumes from entering into the building or from contaminating the substrate surface with
14 condensate water.

15
16 Coordinate scheduling with the Owner in order to relocate or protect vehicles, building occupants and
17 building contents from damage during construction operations.

18
19 Existing materials designated to remain, which are damaged or defaced as a result of the work shall be
20 replaced at Contractor's expense to like new condition.

21
22 Reinstall all rooftop mounted equipment in a watertight manner and repair any damage to sheet metal or
23 other components related to connection and protection of the system.

24
25 Prevent materials from entering and clogging roof drains and conductors. Remove roof drain plugs when
26 no work is taking place or when rain is forecast.

27
28 **Protection of surfaces:**

29
30 Take every precaution to prevent water leakage or debris falling into the building interior, or other
31 such occurrences. Contractor is responsible for any damage to the building interior, or contents,
32 during application.

33
34 Provide special protection or avoid heavy traffic on completed work or roof surfaces. Temporary
35 walkways and work platforms shall be provided as necessary.

36
37 Wall surfaces shall be protected with tarpaulins or other suitable cover to prevent damage, staining or
38 discoloration that might result from operations. Windows, doorways, docks, walkways, etc. may
39 require special protection measures.

40
41 Protect building and adjacent area and property within the area from over spray.

42
43 **Caution:** Installation of primers, polyurethane foam or coatings shall not interfere with the proper function
44 of: Manual Volume Dampers, Turning Vanes, Fire Dampers, Smoke Dampers and Combination
45 Fire/Smoke Dampers, Control Dampers, Smoke Detectors, Access Doors, Duct Pressure Relief Doors,
46 Flashings, Duct Flexible Connections, Sound Attenuators, Hoods for Intake and Exhaust, Louvers, Air
47 Blenders and Air Flow Stations.

48
49 **EQUIPMENT INSULATION**

50 **GENERAL:**
51 Do not insulate over equipment access manholes, fittings, nameplates or ASME stamps. Bevel and seal
52 insulation at these locations.

53
54 **SEMI-RIGID FIBERGLASS:**
55 Apply insulation to equipment shells using weld pins, bonding adhesive, banded and wired in place. Fill all
56 joints, seams and depressions with insulating cement to a smooth, even surface. Cover with reinforcing
57 fabric and 2 coats of mastic (FMJ). Use vapor barrier mastic on systems requiring a vapor barrier.

58
59 **ELASTOMERIC/POLYOLEFIN:**
60 Apply full cover coat of adhesive to surface to be insulated, insulation and edge butt joints. Place insulation
61 with edge joints firmly butted pressing to surface for full adhesion. Seal seams and joints vapor tight.

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EQUIPMENT INSULATION SCHEDULE:

Provide equipment insulation as follows:

Equipment	Insulation	Jacket	Thickness Type
Chilled Water Pumps	Elastomeric/Polyolefin	None	1"
Humidifier separator	Rigid Fiberglass	ASJ	2"

CONSTRUCTION VERIFICATION ITEMS

Contractor is responsible for utilizing the construction verification checklists supplied under specification Section 01 91 01 or 01 91 02 in accordance with the procedures defined for construction verification checklists.

END OF SECTION

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SECTION 23 09 23
HVAC CONTROLS AND INSTRUMENTS

PART 1 - GENERAL

CONDITIONS OF THE CONTRACT

The Conditions of the Contract (General, Supplementary, and other Conditions) and the General Requirements (Sections of Division 1) are hereby made a part of this Section.

SCOPE

WORK INCLUDED

This Section is introductory to Sections 23 09 24 and 23 09 25 and includes equipment sequence of operation and BAS Points List.

This specification is intended to cover equipment for the automatic temperature control of the following:

- Air handling units
- Chillers
- Variable volume box
- Equipment interconnects and safety cutouts
- Hydronic pumping control
- Miscellaneous special system controls

DESCRIPTION OF SYSTEMS/SEQUENCE OF OPERATION:

List of each system and sequence of operation shall be as indicated on the drawings.

Common Sensor: Whenever a single sensor controls multiple devices a separate control temperature setpoint shall be allowed for each device.

POINTS LIST

List of each control input and output, the device it is controlling, the location of the device, and the symbol or label of the control point in the software shall be as indicated on point lists included at the end of this section.

SUBMITTALS TO ARCHITECT/ENGINEER

Submit typewritten or printed operating and maintenance instructions per Division 1.

Submit shop drawings with written descriptions of systems sequence of control, annunciator panel layouts, and control diagrams of the system components' relation to each other.

REFERENCE STANDARDS

All wiring to be done in accordance with current National Electric Code.

PART 2 - PRODUCTS

ACCEPTABLE MANUFACTURERS

(See Section 23 09 24 and Section 23 09 25)

PART 3 - EXECUTION

INSTALLATION

1 (See Section 23 09 24 and Section 23 09 25)
2
3
4

END SECTION

DDC INPUT / OUTPUT SUMMARY TABLE

PROJECT:	HARDWARE														SOFTWARE																																	
LOCATION:	OUTPUT							INPUT							ALARMS				ENERGY MANAGEMENT SYSTEM FUNCTIONS																													
SYSTEM: Temporary Air Handling Unit	DIGITAL			ANALOG				DIGITAL			ANALOG				DIGITAL		ANALOG		ENERGY MANAGEMENT SYSTEM FUNCTIONS							Comments																						
POINT DESCRIPTION	Control Relay	Solenoid	Contact	2-Pos Actuator	Electric 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	Flow	Equipment Status	Maintenance	Pressure	High Limit	Low Limit	Run Time		Day/Night Setback	Demand Limiting	Dial-up I/O	Duty Cycling	Optimum Start/Stop	Point History	Scheduled Start/Stop	Totalization	Trend	Lighting Integration	Fire Alarm Integration	Security/Access Integration	Elect PQM Integration	Chiller Integration	HW/OA Reset	CHW Reset	Smoke Control	Fire Alarm Override				
Outside Air Damper					X																																											Coordinate with Temporary Air Handling Unit Manufacturer

1 The Section 23 09 25 System Integrator shall be responsible for the Network Area Controller(s) (NAC),
2 workstations, printers, servers, software and programming of the NAC, graphical user interface software
3 (GUI), development of all graphical screens, setup of schedules, logs and alarms, LonWorks network
4 management, global supervisory control applications, system integration and coordination of the NAC to
5 the local or wide area network.

6
7 **RELATED WORK SPECIFIED ELSEWHERE**

8 Section 23 09 25, System Integration:

- 9
10
 - 11 • Providing Network Area Controllers
 - 12 • LonWorks network management
 - 13 • Integration of LonWorks devices
 - 14 • Graphical user interface software
 - 15 • Global supervisory control sequences
 - 16 • Integration of owner's existing control system (if applicable)

17 Division 26, Electrical:

- 18
19
 - 20 • Providing motor starters and disconnect switches (unless otherwise noted).
 - 21 • Power wiring and conduit (unless otherwise noted).
 - 22 • Provision, installation and wiring of smoke detectors (unless otherwise noted).

23 **AGENCY AND CODE APPROVALS**

24 All products of the FMCS shall be provided with the following agency approvals. Verification that the
25 approvals exist for all submitted products shall be provided with the submittal package. Systems or
26 products not currently offering the following approvals are not acceptable. UL-916; Energy Management
27 Systems, ULC; UL - Canadian Standards Association, FCC, Part 15, Subpart J, Class A Computing
28 Devices.

29
30 **SOFTWARE LICENSE AGREEMENT**

31 The Owner shall sign a copy of the manufacturer's standard software and firmware licensing agreement as a
32 condition of this contract. Such license shall grant use of all programs and application software to Owner
33 as defined by the manufacturer's license agreement, but shall protect manufacturer's rights to disclosure of
34 trade secrets contained within such software.

35
36 **DELIVERY, STORAGE AND HANDLING**

37 Provide factory-shipping cartons for each piece of equipment and control device. Maintain cartons through
38 shipping, storage, and handling as required to prevent equipment damage. Store equipment and materials
39 inside and protected from weather.

40
41 **JOB CONDITIONS**

42 Cooperation with Other Trades: Coordinate the Work of this section with that of other sections to insure
43 that the Work will be carried out in an orderly fashion. It shall be this Contractor's responsibility to check
44 the Contract Documents for possible conflicts between his Work and that of other crafts in equipment
45 location, pipe, duct and conduit runs, electrical outlets and fixtures, air diffusers, and structural and
46 architectural features.

47
48 **QUALITY ASSURANCE**

49 The manufacturer of the digital controllers shall provide documentation supporting compliance with ISO-
50 9001 (Model for Quality Assurance in Design/Development, Production, Installation and Servicing).
51 Product literature provided by the digital controller manufacturer shall contain the ISO-9001 Certification
52 Mark from the applicable registrar.

1 **SUBMITTAL**

2 Eight copies of shop drawings of the entire control system shall be submitted and shall consist of a
3 complete list of equipment and materials, including manufacturers catalog data sheets and installation
4 instructions. Shop drawings shall also contain complete wiring and schematic diagrams, software
5 descriptions, calculations, and any other details required to demonstrate that the system has been
6 coordinated and will properly function as a system. Terminal identification for all control wiring shall be
7 shown on the shop drawings. A complete written Sequence of Operation shall also be included with the
8 submittal package.

9
10 Submittal shall also include a complete point list of all connected points to the DDC system.

11
12 The DDCS Contractor shall provide catalog data sheets, wiring diagrams and point lists to the Section 23
13 09 25 System Integrator for proper coordination of work.

14
15 The DDCS contractor shall work with the Section 23 09 25 Systems integrator prior to programming
16 equipment to insure all necessary points are provided at the time of programming for proper operation.

17
18 Upon completion of the work, provide a complete set of 'as-built' drawings and application software on
19 magnetic floppy disk media or compact disk. Drawings shall be provided as AutoCAD™ or Visio™
20 compatible files. Eight copies of the 'as-built' drawings shall be provided in addition to the documents on
21 magnetic floppy disk media or compact disk.

22
23
24 **PART 2 - MATERIALS**

25
26 **GENERAL**

27 The Direct Digital Control System (DDCS) shall be comprised of a network of interoperable, stand-alone
28 digital controllers and other devices as specified herein.

29
30 It is the intent of this specification for the existing network controller, located on the second floor of the
31 project building, to be utilized for this project. If VAV controllers, other than Alerton are provided that
32 require the installation of an additional network controller; that network controller shall be provided at no
33 additional cost to the owner.

34
35 **OPEN, INTEROPERABLE, INTEGRATED ARCHITECTURES**

36 The intent of this specification is to provide a peer-to-peer networked, distributed control system based on
37 the LonTalk and/or BACnet communication protocols.

38
39 **INTEROPERABLE DIGITAL CONTROLLERS (IDC)**

40 IDC controllers shall be microprocessor based Interoperable LonMark™/LonWorks and/or BACnet
41 controllers. Where possible, all Interoperable Digital Controllers shall bear the applicable LonMark™
42 interoperability logo on each product delivered.

43
44 Provide IDC's and ancillary devices as herein specified, as indicated on the drawings, and as necessary to
45 perform the sequences of operation. The following equipment shall be controlled:

- 46
47
- 48 • Air Terminal Devices (i.e., VAV, Dual Duct, Fan Coil Units, etc.)
 - 49 • Air Handling Units (fans, valve and damper actuators, sensors. etc.)
 - 50 • Pumps
 - 51 • Connectors
 - 52 • Additional equipment outlined herein or on the Mechanical and Electrical Drawings.

1 Provide VAV controllers and all necessary equipment so that the VAV controllers can fully interface with
2 the existing Network Area Controller, including meeting the specified sequence of operation and point list,
3 permitting set point adjustment from the DDC system, sending real time information on monitored points
4 to the DDC system, and passing alarms from the VAV controller to the Network Area Controller.
5

6 Where applicable, control shall be accomplished using LonMark™ based devices where the application has
7 a LonMark profile defined. Where LonMark devices are not available for a particular application, such as
8 some freely programmable controllers, the manufacturer must provide an XIF file for the device to the
9 Section 23 09 25 System Integrator. Publicly available specifications for the Applications Programming
10 Interface (API) must be provided to the Section 23 09 25 System Integrator for each controller defining the
11 programming or setup of each device. The DDCS Contractor shall provide all programming and
12 documentation necessary to set up and configure the supplied devices per the specified sequences of
13 operation.
14

15 The DDCS Contractor shall route the LonWorks and/or BACnet MSTP network trunk to the Network Area
16 Controller (NAC) as indicated on the riser diagram in the bid documents. Coordinate locations of the NAC
17 with the Section 23 09 25 System Integrator to ensure that maximum network wiring distances, as specified
18 by the LonWorks and BACnet wiring guidelines, are not exceeded. A maximum of 70 devices may occupy
19 any one LonWorks and/or BACnet MSTP trunk. LonWorks trunks must be installed using the appropriate
20 trunk termination device. All LonWorks and LonMark devices must be supplied using FTT-10A LonTalk
21 communication transceivers.
22

23 The Network Area Controller (NAC), supplied by the Section 23 09 25 System Integrator, will provide all
24 scheduling, alarming, trending, and network management for the LonMark/LonWorks and/or BACnet-
25 based devices.
26

27 The IDCs shall communicate with the NAC at a baud rate of not less than 32K baud. The IDC shall provide
28 LED indication of communication and controller performance to the technician, without cover removal.
29

30 All IDCs shall be fully application programmable and shall at all times maintain their LONMARK
31 certification, if so certified. Controllers offering application selection only (non-programmable), require a
32 10% spare point capacity to be provided for all applications. All control sequences within or programmed
33 into the IDC shall be stored in non-volatile memory, which is not dependent upon the presence of a battery,
34 to be retained.
35

36 The DDCS Contractor supplying the IDC's shall provide, at a minimum, the following documentation for
37 each device:
38

- 39 • Network Variable Inputs (nvi's); name and type
- 40 • Network Variable Outputs (nvo's); name and type
- 41 • Network configuration parameters (nci, nco); name and type
- 42 • BACnet Object Type, Object Instance and description
43

44 It is the responsibility of the DDCS Contractor to ensure that the proper Network Variable Inputs and
45 Outputs (nvi and nvo) and/or BACnet objects are provided in each IDC and are exposed for connection to
46 them by the Section 23 09 25 System Integrator, as required by the point charts. Refer to the software point
47 charts for the required functionality (read-only, write-only, read-write) for each data point. Use of
48 manufacturer-specific Network Variables and/or BACnet objects shall not be permitted, unless software is
49 provided to allow the use of them by any third-party network management tool.
50

51 All IDC's shall be capable of being managed (upload, download, discovery, reload, bindings, etc.), by any
52 Lon network management tool. IDC's that can be managed only with LNS-based tools or plug-ins built
53 exclusively for LNS, shall not be permitted.
54

1 The DDCS Contractor shall provide two copies of the IDC programming tool and configuration tool, with
2 documentation, to the owner.

- 3
- 4 • This tool shall allow the owner to fully program, configure, diagnose and otherwise manage the
5 controller, without limitations.
- 6 • The tool shall be of the latest revision currently in production release by the manufacturer.
- 7 • The tool shall be licensed to the owner and shall not require annual license renewal fees.
- 8 • The tool shall not be dependent on the LNS network management system in order to properly
9 function and shall be capable of running as a stand-alone application on a Windows XP operating
10 system. Use of LNS-based plug-ins for programming and configuration are not acceptable.

11
12 **CONTROL SYSTEM HARDWARE**
13 **INTEROPERABLE DIGITAL CONTROLLERS**

14
15 **APPLICATION SPECIFIC CONTROLLER (ASC)**

16 Each terminal unit shall have a LONWorks® and/or BACnet-based DDC Application Specific Controller
17 (ASC) designed to provide the specified sequences. The controller shall be LONMark® certified, shall
18 store all specific control sequences and program settings in non-volatile memory.

19
20 All ASC processors shall be Echelon based 3150 Neurons operating at 5 MHz or higher with 8K of RAM
21 and 64K of Flash memory with a minimum 10 year memory retention between program downloads.

22
23 Each ASC shall perform all intended temperature control functions in a ‘standalone’ mode should the unit
24 incur a loss of communications.

25
26 The complete ASC including accessory devices such as relay, transducers, power supplies, etc., shall be
27 factory-mounted, wired and housed in a NEMA 1 enclosure or as required by the location and local code
28 requirements.

29
30 Each ASC shall allow Peer-to-Peer communications over the LON utilizing free-topology transceivers over
31 a single pair 22 AWG twisted, stranded cable, Category 5 or Level IV.

32
33 All ASC’s shall be provided as self sufficient units to maximize reliability and shall include internal ‘soft’
34 clock, operating systems, communication timing and interrupt controls, and shall be suitable for the
35 specified applications.

36
37 In the event of a power outage or controller reset, each ASC shall enter a preprogrammed state on power
38 re-application. Upon application of power to the ASC, all control conditions will start from an ‘off’ /
39 ‘closed’ position or the default state. This state will be maintained for an automatically adjusted amount of
40 time. Once this time delay has passed, the ASC control sequence shall resume according to current values

41
42 Network and controller-to-controller communications must conform to LONTalk® standards.

43
44 All ASC’s shall be provided with a communications port to allow connection of any industry standard
45 laptop PC and custom configuration tools. Program access via this communications port allows direct field
46 modification of the configuration parameters.

47
48 **Digital Inputs:**

- 49
- 50 • All digital inputs shall be over voltage protected.
- 51 • Digital input types supported by the CU:
 - 52 - Normally open contacts (24V and 120V).

- 1 - Normally closed contacts (24V and 120V).
- 2 - Current/no current.
- 3 - Voltage/no voltage.
- 4 - Pulse/Totalizer contacts.

5
6 Digital Outputs:

- 7
- 8 • All digital outputs shall be 24 volt AC, current sinking, 0.5 amp opto-isolated triacs.
- 9 • Digital outputs shall be capable of handling maintained as well as pulsed outputs for momentary
- 10 or magnetic latching circuits. It shall be possible to configure outputs for 3-mode control (fast-
- 11 slow-off) and 2-mode control.
- 12

13 Analog Inputs:

- 14
- 15 • All analog inputs shall be over voltage protected.
- 16 • The analog to digital resolutions shall be a minimum of 10 bit.
- 17 • Analog inputs shall accept the following temperature types: 10K Ohm thermistor, 20K Ohm
- 18 thermistor, or 1K Ohm RTD.
- 19 • Inputs shall be configurable to accept a wide range of inputs including: 4-20mA, 1-5Vdc, 2-
- 20 10Vdc, etc.
- 21

22 Analog Outputs:

- 23
- 24 • The ASC shall accommodate true analog outputs. Voltage (0-10V) and current (4-20 mA) outputs
- 25 shall be accommodated.
- 26 • All analog outputs shall be proportional current or voltage type.
- 27 • The digital to analog resolution shall be a minimum of 10 bit.
- 28 • Outputs shall be configurable so that 0-100% output commands can represent any portion of the
- 29 output voltage/current range.
- 30 • Outputs shall be reversible so that an increasing output command yields a decreasing electrical
- 31 signal.
- 32

33 In addition to local physical or internal I/O, each ASC shall support distributed, or 'bound' I/O. This bound

34 I/O can be used to allow the ASC to provide I/O data to another controller on the LON or to allow another

35 controller to provide data to the controlling ASC.

36
37 The following modes of control shall be incorporated into each ASC:

- 38
- 39 • Occupied shall be a mode designed for normal occupied control of an area during regular business
- 40 hours. This mode shall have unique heating and cooling setpoints associated with it.
- 41 • Unoccupied shall be a mode designed for after hours control of an area. This mode shall have
- 42 unique heating and cooling setpoints associated with it.
- 43 • Override shall be a mode designed to invoke normal occupied control during after hours of an
- 44 area. This mode shall use the occupied heating and cooling setpoints.
- 45 • Economy shall be a mode designed for normal occupied times when energy demand usage is high
- 46 and control setpoints need to be adjusted for lower energy use. This mode shall have unique
- 47 heating and cooling setpoints associated with it.
- 48 • Morning Warm-Up on units with a outdoor air economizer shall be a mode designed for the pre-
- 49 heat/pre-cool time before normal occupancy occurs. This mode shall allow heating or cooling as
- 50 required by the occupied setpoints but it will prevent outdoor air from entering the space. The
- 51 outdoor air will move to its minimum position once the morning warm-up mode is over and the
- 52 occupied mode is activated.

- Morning Warm-Up on VAV units shall be a mode designed for the pre-heat/pre-cool time before normal occupancy occurs. This mode shall allow heating or cooling as required by the occupied setpoints but it will prevent the VAV box from maintaining a minimum air flow until the morning warm-up mode is over and the occupied mode is activated.

VAV box ASC's shall have an integral damper actuator and shall be the manufacturer's standard VAV box controller.

It shall be the responsibility of the SI to verify that VAV box controllers will physically fit into the VAV box controls enclosure, and that the controllers can register the expected minimum and maximum flow rates utilizing the flow probe provided by the VAV box manufacturer.

Acceptable Manufacturers and approved Vendors: TAC/Invensys, Alerton, Seimens Staefa, Distech, Tridium, supplied by: Environmental Systems Inc. W223N603 Saratoga Ave Waukesha WI 262-544-8860, HC Energy Solutions 300 Mandan. Drive Waukesha WI 53188 262-364-8035, Modahl & Associates 721 Christensen Ave. Madison WI 53714 608-843-2954

PROGRAMMABLE CONTROL UNITS (PCU'S)

A LONWorks® based DDC Programmable Control Unit (PCU) shall be provided where required to perform the sequence of operation. The PCU shall be fully configurable by configuration tool. The controller shall be store all specific control sequences and program settings in non-volatile memory.

All PCU processors shall be Echelon based 3150 Neurons operating at 5 MHz or higher with 8K of RAM and 64K of Flash memory with a minimum 10 year memory retention between program downloads.

Each PCU shall perform all intended temperature control functions in a 'standalone' mode should the unit incur a loss of communications.

The complete PCU including accessory devices such as relay, transducers, power supplies, etc., shall be factory-mounted, wired and housed in a NEMA 1 enclosure or as required by the location and local code requirements.

Each PCU shall allow Peer-to-Peer communications over the LON utilizing free-topology transceivers over a single pair 22 AWG twisted, stranded cable.

All PCU's shall be provided as self sufficient units to maximize reliability and shall include internal 'soft' clock, operating systems, communication timing and interrupt controls, and shall be suitable for the specified applications.

In the event of a power outage or controller reset, each PCU shall enter a preprogrammed state on power re-application. Upon application of power to the PCU, all control conditions will start from an 'off' / 'closed' position or the default state. This state will be maintained for an automatically adjusted amount of time. Once this time delay has passed, the PCU control sequence shall resume according to current values

Network and controller-to-controller communications must conform to LONTalk® standards.

All PCU's shall be provided with a communications port to allow connection of any industry standard laptop PC and custom configuration tools. Program access via this communications port allows direct field modification of the configuration parameters.

Digital Inputs:

- All digital inputs shall be over voltage protected.

- 1 • Digital input types supported by the CU:
 - 2 - Normally open contacts (24V and 120V).
 - 3 - Normally closed contacts (24V and 120V).
 - 4 - Current/no current.
 - 5 - Voltage/no voltage.
 - 6 - Pulse/Totalizer contacts.

7
8 Digital Outputs:
9

- 10 • All digital outputs shall be 24 volt AC, current sinking, 0.5 amp opto-isolated triacs.
- 11 • Digital outputs shall be capable of handling maintained as well as pulsed outputs for momentary
12 or magnetic latching circuits. It shall be possible to configure outputs for 3-mode control (fast-
13 slow-off) and 2-mode control.

14
15 Analog Inputs:
16

- 17 • All analog inputs shall be over voltage protected.
- 18 • The analog to digital resolutions shall be a minimum of 10 bit.
- 19 • Analog inputs shall accept the following temperature types: 10K Ohm thermistor, 20K Ohm
20 thermistor, or 1K Ohm RTD.
- 21 • Inputs shall be configurable to accept a wide range of inputs including: 4-20mA, 1-5Vdc, 2-
22 10Vdc, etc.

23
24 Analog Outputs:
25

- 26 • The ASC shall accommodate true analog outputs. Voltage (0-10V) and current (4-20 mA) outputs
27 shall be accommodated.
- 28 • All analog outputs shall be proportional current or voltage type.
- 29 • The digital to analog resolution shall be a minimum of 10 bit.
- 30 • Outputs shall be configurable so that 0-100% output commands can represent any portion of the
31 output voltage/current range.
- 32 • Outputs shall be reversible so that an increasing output command yields a decreasing electrical
33 signal.

34
35 In addition to local physical or internal I/O, each ASC shall support distributed, or 'bound' I/O. This bound
36 I/O can be used to allow the ASC to provide I/O data to another controller on the LON or to allow another
37 controller to provide data to the controlling ASC.

38
39 The following modes of control shall be incorporated into each PCU:
40

41 Occupied shall be a mode designed for normal occupied control of an area during regular business hours.
42 This mode shall have unique heating and cooling setpoints associated with it.
43

44 Unoccupied shall be a mode designed for after hours control of an area. This mode shall have unique
45 heating and cooling setpoints associated with it.
46

47 Override shall be a mode designed to invoke normal occupied control during after hours of an area. This
48 mode shall use the occupied heating and cooling setpoints.
49

50 Economy shall be a mode designed for normal occupied times when energy demand usage is high and
51 control setpoints need to be adjusted for lower energy use. This mode shall have unique heating and
52 cooling setpoints associated with it.
53

1 Morning Warm-Up on units with a outdoor air economizer shall be a mode designed for the pre-heat/pre-
2 cool time before normal occupancy occurs. This mode shall allow heating or cooling as required by the
3 occupied setpoints but it will prevent outdoor air from entering the space. The outdoor air will move to its
4 minimum position once the morning warm-up mode is over and the occupied mode is activated.
5

6 Morning Warm-Up on VAV units shall be a mode designed for the pre-heat/pre-cool time before normal
7 occupancy occurs. This mode shall allow heating or cooling as required by the occupied setpoints but it
8 will prevent the VAV box from maintaining a minimum air-flow until the morning warm-up mode is over
9 and the occupied mode is activated.
10

11 Acceptable Manufacturers and approved Vendors: TAC/Invensys, Alerton, Seimens Staefa, Distech,
12 Tridium, supplied by: Environmental systems Inc W223N603 Saratoga Ave Waukesha WI 262-544-8860,
13 HC Energy Solutions 300 Mandan. Drive Waukesha WI 53188 414-659-5153, Modahl and Associates 721
14 Christensen Ave. Madison WI 53714
15

16 TEMPERATURE SENSORS AND TRANSMITTERS

17 Zone temperature sensors shall allow for temperature set point adjustment at the sensor.
18

19 General Sensor & Transmitter Requirements

- 20
- 21 • Provide sensors and transmitters required as outlined in the input/output summary and sequence of
- 22 operation, and as required to achieve the specified accuracy as specified herein.
- 23 • Temperature transmitters shall be equipped with individual zero and span adjustments. The zero
- 24 and span adjustments shall be non-interactive to permit calibration without iterative operations.
- 25 Provide a loop test signal to aid in sensor calibration.
- 26 • Temperature transmitters shall be sized and constructed to be compatible with the medium to be
- 27 monitored. Transmitters shall be equipped with a linearization circuit to compensate for non-
- 28 linearities of the sensor and bridge and provide a true linear output signal.
- 29 • Temperature sensors shall be of the resistance type and shall be 10K or 20K Ohm Thermistor type.
- 30 - Thermistors are acceptable provided the mathematical relationship of a thermistor with
- 31 respect to resistance and temperature with the thermistor fitting constraints is contained
- 32 with the controllers operating software and the listed accuracy's can be obtained. Submit
- 33 proof of the software mathematical equation and thermistor manufacturer fitting
- 34 constants used in the thermistor mathematical/expressions. Thermistors shall be of the
- 35 Thermistor (NTC) Type with a minimum of 50 ohm/°C. resistance change versus
- 36 temperature to insure good resolution and accuracy. Thermistors shall be certified to be
- 37 stable $\pm 0.13^{\circ}\text{C}$. over 5 years and $\pm 0.2^{\circ}\text{C}$. accurate and free from drift for 5 years.
- 38 • The following accuracy's are required and include errors associated with the sensor, lead wire and
- 39 A to D conversion.

40 - <u>Point Type</u>	<u>Accuracy</u>
41 Outside Air	+/-3%
42 Chilled/Hot Water	+/-1%
43 Room Temperature	+/-1%
44 Steam	+/-5%
45 Duct Temperature	+/-3%
46 - Sensors Used in Energy Water (BTU) or Process Calculations	+/-1%
47 - Sensors used in energy or process calculations shall be accurate to $\pm 0.10^{\circ}\text{C}$ over the	
48 process temperature range. Submit a manufacturer's calibration report indicating that the	
49 calibration certification is traceable to the National Bureau of Standards (NBS)	
50 Calibration Report Nos. 209527/222173.	

51
52 Thermowells:
53

- 1 • When thermowells are required, the sensor and well shall be supplied as a complete assembly
2 including well head and greenfield fitting, except where wells are to be installed under separate
3 contract.
- 4 • Thermowells shall be pressure rated and constructed in accordance with the system working
5 pressure
- 6 • Thermowells and sensors shall be mounted in a threadolet or 1/2" NPT saddle and allow easy
7 access to the sensor for repair or replacement.
- 8 • Thermowells shall be constructed of the following materials:
9 - Chilled and Hot Water; brass.
10 - Steam; 316 stainless steel.
11 - Brine (salt solutions): marine grade stainless steel.

12
13 **Outside Air Sensors:**

- 14
- 15 • Outside air sensors shall be designed to withstand the environmental conditions to which they will
16 be exposed. They shall also be provided with a solar shield.
- 17 • Sensors exposed to wind velocity pressures shall be shielded by a perforated plate surrounding the
18 sensor element.
- 19 • Temperature transmitters shall be of NEMA 3R construction and rated for ambient temperatures.
- 20 • Solar load sensors shall be provided in locations shown. The use of a thermistor combined with a
21 solar compensator is acceptable. Provide calibration charts as part of the O&M Manual.

22
23 **Duct Type Sensors:**

- 24
- 25 • Duct mount sensors shall mount in a hand box through a hole in the duct and be positioned so as
26 to be easily accessible for repair or replacement. A neoprene grommet (sealtite fitting and
27 mounting plate) shall be used on the sensor assembly to prevent air leaks.
- 28 • Duct sensors shall be insertion type and constructed as a complete assembly including lock nut
29 and mounting plate. Duct sensors probe shall be constructed of 304 stainless steel.
- 30 • For outdoor air duct applications, use a weatherproof mounting box with weatherproof cover and
31 gasket.

32
33 **Averaging Duct Type Sensors:**

- 34
- 35 • Where called out on the drawings and points lists, provide averaging type duct sensors.
36 Thermistor sensors are acceptable. The sensor shall be multi-point sensitive through the length of
37 the temperature conducting tubing. The thermistors shall be configured in a series / parallel
38 method which creates an end result of total average resistance equal to the same span as a standard
39 thermistor.
- 40 • Provide capillary supports at the sides of the duct to support the sensing element.

41
42 **Acceptable Manufacturers:** BAPI, Tac/Invensys, Staefa, ACI

43
44 **RELATIVE HUMIDITY SENSORS/TRANSMITTERS**

- 45
- 46 • The sensor shall be a solid state, resistance type relative humidity sensor of the Bulk Polymer
47 Design. The sensor element shall be washable and shall resist surface contaminations.
- 48 • Humidity transmitter shall be equipped with non-interactive span and zero adjustments, a 2 wire
49 isolated loop powered, 4-20ma, 0-10.0 VDC linear proportional output.
- 50 • The humidity transmitter shall meet the following overall accuracy including lead loss and A to D
51 conversion.
52 - Room Type Sensor $\pm 2\%$ RH

- 1 - Duct Type Sensor $\pm 2\%$ RH
- 2 • Outside air relative humidity sensors shall be installed in a rain proof, perforated cover. The
- 3 transmitter shall be installed in a NEMA 3R enclosure with sealtite fittings and stainless steel
- 4 bushings.
- 5 • Provide a single point humidity calibrator, if required, for field calibration. Transmitters shall be
- 6 shipped factory pre-calibrated.
- 7 • Duct type sensing probes shall be constructed of 304 stainless steel and be equipped with a
- 8 neoprene grommet, bushings and a mounting bracket.
- 9 • Acceptable Manufacturers: BAPI, ACI, Mamac, Visaila

10

11 **DIFFERENTIAL PRESSURE TRANSMITTERS AND ACCESSORIES**

12 General Air and Water Pressure Transmitter Requirements:

- 13
- 14 • Pressure transmitters shall be constructed to withstand 100% pressure over-range without damage
- 15 and to hold calibrated accuracy when subject to a momentary 40% over-range input.
- 16 • Pressure transmitters shall provide the option to transmit a 0 to 5V dc, 0 to 10V dc, or 4 to 20 mA
- 17 output signal.
- 18 • Differential pressure transmitters used for flow measurement shall be sized to the flow sensing
- 19 device and shall be supplied with shutoff and bleed valves in the high and low sensing pick-up
- 20 lines (3 valve manifolds).
- 21 • Provide a minimum of a NEMA 1 housing for the transmitter. Locate transmitters in accessible
- 22 local control panels wherever possible.
- 23 • Low air pressure, differential pressure transmitters used for room pressurization control (i.e.
- 24 laboratories, OR's clean rooms, etc.) shall be equipped with a LED display indicating the
- 25 transmitter output signal.
- 26 • Duct sensing pressure applications where the velocity exceeds 1500 fpm shall utilize a static
- 27 pressure traverse probes.

28

29 Low Air Pressure Applications (0 to 125 Pa)

- 30
- 31 • The pressure transmitter shall be capable of transmitting a linear electronic signal proportional to
- 32 the differential of the room and reference static pressure input signals with the following minimum
- 33 performance specifications.
 - 34 - Span: Not greater than two times the design space DP.
 - 35 - Accuracy: Plus or minus 0.5% of F.S.
 - 36 - Dead Band: Less than 0.3% of output.
 - 37 - Repeatability: Within 0.2% of output.
 - 38 - Linearity: Plus or minus 0.2% of span.
 - 39 - Response: Less than one second for full span input.
 - 40 - Temperature Stability: Less than 0.05% output shift per degree C change.
- 41 • The transmitter shall utilize variable capacitance sensor technology and be immune to shock and
- 42 vibration.
- 43 • Acceptable Manufacturers: BAPI, Setra, Veris, Mamac

44

45 Medium to High Air Pressure Applications (125 Pa to 2500 Pa)

- 46
- 47 • The pressure transmitter shall be similar to the Low Air Pressure Transmitter except the
- 48 performance specifications are not as severe. Provide differential pressure transmitters which meet
- 49 the following performance requirements.
 - 50 - Zero & span: (% F.S./Deg. C): .05% including linearity, hysteresis and repeatability
 - 51 - Accuracy: 1% F.S. (best straight line)

- 1 - Static Pressure Effect: 0.5% F.S. (to 700 KPa)
- 2 - Thermal Effects: $\leq \pm 0.05\%$ F.S./Deg. C. over 5°C. to 40°C. (calibrated at 22°C.)
- 3 • Acceptable manufacturers: BAPI, Setra, Veris, Mamac

4

5 **LOW DIFFERENTIAL, WATER PRESSURE APPLICATIONS (0 KPa to 5 KPa)**

6 The differential pressure transmitter shall be of industrial quality and transmit a linear, 4 to 20mA output in
7 response to variation of flow meter differential pressure or water pressure sensing points.

8

9 The differential pressure transmitter shall have non-interactive zero and span adjustments adjustable from
10 the outside cover and meet the following performance specifications.

- 11
- 12 • 0 – 10 KPa input differential pressure range
- 13 • 4 - 20 mA output
- 14 • Maintain accuracy up to 20 to 1 ratio turndown
- 15 • Reference Accuracy: $\pm 0.2\%$ of full span

16

17 Provide a two year warranty for each transmitter. Replace all transmitters found to be defective at no cost to
18 the Owner during the warranty period. Acceptable Manufacturers: Tobar, Foxboro, Omega, Bailey,
19 Modus, Setra

20

21 **MEDIUM TO HIGH DIFFERENTIAL WATER PRESSURE APPLICATIONS (5 KPa to 700 KPa)**

22 The differential pressure transmitter shall meet the low pressure transmitter specifications except the
23 following:

- 24
- 25 • Differential pressure range: 5 KPa to 700 KPa.
- 26 • Reference Accuracy: $\pm 1\%$ of full span (includes non-linearity, hysteresis, and repeatability)
- 27 • Warranty: 1 year.

28

29 Acceptable Manufacturers: BAPI, Veris, Mamac, Setra

30

31 Bypass Valve Assembly: Mount stand-alone pressure transmitters in a bypass valve assembly panel. The
32 panel shall be constructed to NEMA 1 standards. The transmitter shall be installed in the panel with hi and
33 low connections piped and valved. Air bleed units, bypass valves and compression fittings shall be
34 provided

35

36 **ELECTRONIC VALVE AND DAMPER ACTUATORS**

37 General Requirements:

- 38
- 39 • Electronic actuators shall be electric, direct-coupled type capable of being mounted over the shaft
40 of the damper. They shall be UL listed and the manufacturer shall provide a 2 year unconditional
41 warranty from the date of commissioning. Power consumption shall not exceed 8 watts or 15 VA
42 of transformer sizing capacity per high torque actuator nor 2 watts or 4 VA for VAV actuators.
43 Sound level shall not exceed 45 dB for high torque nor 35 dB for VAV actuators.
- 44 • Electronic overload protection shall protect actuator motor from damage. If damper jams actuator
45 shall not burn-out. Internal end switch type actuators are not acceptable. Actuators may be
46 mechanically and electrically paralleled on the same shaft to multiply the available torque. A
47 reversing switch shall be provided to change action from direct to reverse in relation to control
48 signal as operation requires.
- 49 • Warranty must be two years by manufacturer on actuator as a whole and all components.
- 50 • Acceptable manufacturers: Belimo, Siemens, Tac/Invensys

51

52 Control Damper Actuators:

53

- 1 • OA (outside air), RA (return air), and EA (exhaust air) actuators shall be spring return type for
2 safety functions. Individual battery backup or capacitor return is not acceptable.
- 3 • The control circuit shall be fully modulating using 2 - 10 volt or 4 - 20 mA signals. Accuracy and
4 repeatability shall be within $\pm 1/21$ of control signal. A 2 - 10 v or 4 - 20 mA signal shall be
5 produced by the actuator which is directly proportional to the shaft clamp position which can be
6 used to control actuators which are paralleled off a master motor or to provide a feedback signal to
7 the automation system indicating damper position. Accuracy shall be within $\pm 2.5\%$.
- 8 • Face and bypass dampers and other control dampers shall be modulating using the same control
9 circuit detailed above but shall not be spring return.

10
11 **Miscellaneous Damper Actuators:**

- 13 • OA combustion and ventilation air intake and EA damper actuators shall be 2 position spring
14 return closed if any water piping, coils or other equipment in the space which the damper serves
15 needs to be protected from freezing. Otherwise drive open, drive closed type 2 position may be
16 used. The minimum torque for any actuator shall be 5 N-m.
- 17 • Provide auxiliary switches on damper shaft or blade switch to prove damper has opened on all air
18 handling equipment handling 100% outside air and greater than 6 KPa TSP.

19
20 **Air Terminals:** Air terminal actuators shall be minimum 5 N-m torque and use fully modulating floating
21 (drive open, drive closed) 3 wire control or use control circuit as detailed in control dampers depending on
22 the controllers requirements.

23
24 **Inlet Vanes Actuators:** Inlet vane actuators shall provide at least 150% of the minimum torque specified by
25 the manufacturer as necessary to operate vanes properly. Either direct coupled or gear train with linkages
26 are acceptable as required. The control loop for static control of the actuator shall operate slowly enough to
27 avoid hunting and maintain stable control. See automation system specifications for details.

28 **Approved Vendors:** Belimo, Seimens, Invensys

29
30 **VALVE ACTUATORS**

31 **Control Valves Actuators (3 inch and smaller):**

- 33 • Actuators shall have a gear release button on all non-spring return models to allow manual setting.
34 The actuator shall have either an insulating air gap between it and the linkage or a non-conducting
35 thermoplastic linkage. Care shall be taken to maintain the actuator's operating temperatures and
36 humidity within its specifications. Pipes shall be fully insulated and heat shields shall be installed
37 if necessary. Condensation may not form on actuators and shall be prevented by a combination of
38 insulation, air gap, or other thermal break.
- 39 • The control circuit shall be fully modulating using 2 - 10 volt or 4 - 20 mA signals. Accuracy and
40 repeatability shall be within $1/21$ of control signal. A 2 - 10 v or 4 - 20 mA signal shall be
41 produced by the actuator which is directly proportional to the shaft clamp position which can be
42 used to control actuators which are paralleled off a master motor or to provide a feedback signal to
43 the automation system indicating valve position.
- 44 • Valve body and actuators shall be shipped fully assembled and tested at the valve factory prior to
45 shipment.

46
47 **Control Valve Actuators (4 inch and larger):**

- 49 • The valve actuator shall consist of a permanent split capacitor, reversible type electric motor
50 which drives a compound epicycle gear. The electric actuator shall have visual mechanical
51 position indication, readable from a distance of 8 meters, showing output shaft and valve position.

1 Unit shall be mounting directly to the valves without brackets and adapters, or readily adapted to
2 suit all other types quarter-turn valves.

- 3 • The actuator shall have an integral terminal strip, which, through conduit entries, will ensure
4 simple wiring to power supplies. Cable entries shall have UL recommended gland stops within
5 the NPT hole to prevent glands from being screwed in too far and damaging cable.
- 6 • The actuator shall be constructed to withstand high shock and vibrations without operations
7 failure. The actuator cover shall have captive bolts to eliminate loss of bolts when removing the
8 cover from the base. One copy of the wiring diagram shall be provided with the actuator.
- 9 • The actuator shall have a self-locking gear train which is permanently lubricated at the factory.
10 The gearing shall be run on ball and needle bearings. Actuators with 70 N-m or more output
11 torque shall have two adjustable factory calibrated mechanical torque limit switches of the single-
12 pole, double-throw type. The motor shall be fitted with thermal overload protection. Motor rotor
13 shaft shall run in ball bearings at each end of motor.
- 14 • The actuator housing shall be hard anodized aluminum for full environmental protection.
- 15 • The environmental temperature range of the actuator shall be -30°C to +60°C.
- 16 • For intermittent on/off service, the actuator shall be rated at a 20% duty cycle (i.e., 12 minutes
17 extended duty in every hour, or alternatively; one complete cycle every 2 minutes). For more
18 frequent cycling and modulating service, an actuator shall be rated for continuous duty. The
19 actuator rated for continuous duty shall be capable of operating 100% of the time at an ambient
20 temperature of 40°C.
- 21 • The actuator shall have an integral self-locking gear train. Motor brakes shall not be required to
22 maintain desired valve position. Levers or latches shall not be required to engage or disengage the
23 manual override. Mechanical travel stops, adjustable to 15° in each direction of 90° rotation shall
24 be standard, as well as two adjustable travel limit switches with electrically isolated contacts.
25 Additional adjustable switches shall be available as option.
- 26 • Single Phase Motor: The motor shall have Class B insulation capable of withstanding locked-
27 rotor for 25 seconds without overheating. Wiring shall also be Class B insulation. An auto-reset
28 thermal cut-out protector shall be embedded in the motor windings to limit heat rise to 80°C in a
29 40°C ambient. All motors shall be capable of being replaced by simply disconnecting the wires
30 and then removing mounting bolts. Disassembly of gears shall not be required to remove the
31 motor.
- 32 • Materials of Construction: The electric actuator shall have a pressure die-cast, hard anodized
33 aluminum base and cover. The compound gear shall be made of die-cast, hard anodized
34 aluminum or steel. An alloy steel worm gear shall be provided for manual override and torque
35 limiting. Bearings for gears shall be of the ball and needle type; bronze bearings shall be used on
36 the shafting parts.
- 37 • Accessories: Potentiometer for providing continuous feedback of actuator position at the
38 controller (for valves specified position feedback).
- 39 • Acceptable manufacturers: Belimo, Siemens, Tac/Invensys

40 41 **CONTROL VALVES**

42 Control valves shall be 2-way or 3-way pattern as shown constructed for tight shutoff and shall operate
43 satisfactorily against system pressures and differentials. Two-position valves shall be ‘line’ size.
44 Proportional control valves shall be sized for a maximum pressure drop of 5.0 psi at rated flow (except as
45 may be noted on the drawings). Valves with sizes up to and including 2 inches shall be “screwed”
46 configuration and 2-1/2 inch and larger valves shall be “flanged” configuration. Electrically controlled
47 valves shall include spring return type actuators sized for tight shut-off against system pressures and
48 furnished with integral switches for indication of valve position (open-closed). Three-way butterfly valves,
49 when utilized, shall include a separate actuator for each butterfly segment.

50
51 Acceptable manufacturers: Belimo, Siemens, Tac/Invensys

52 53 **SWITCHES**

54 Differential Pressure Switches:

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- All pressure sensing elements shall be corrosion resistant. Pressure sensing elements shall be bourdon tubes, bellows, or diaphragm type. Units shall have tamper-proof adjustable range and differential pressure settings.
- Pressure sensor switch contacts shall be snap action micro-switch type. Sensor assembly shall operate automatically and reset automatically when conditions return to normal. Complete sensor assembly shall be protected against vibration at all critical movement pivots, slides and so forth.
- Differential pressure switches shall be vented to withstand a 50% increase in working pressure without loss of calibration.
- Acceptable Manufacturers: Mercoid, Dwyer, McDonnell Miller

Electric Low Limit Thermostat (Freeze Stat):

- Duct type, fixed 3 degrees Celsius differential, range 0 to 15 degrees Celsius. Sensing element shall be a 7 meter long capillary tube responding to the lowest temperature sensed along any 30 cm of bulb length. Switch shall be SPDT 120/240 volts AC, rated for 10 amps at 120 volts full load. Unit shall be manually reset. Provide one low limit thermostat for each 2 square meter or fraction thereof of coil surface area.
- Provide DPST switches, 1 NO, 1 NC contact.
- Provide manual type low limit thermostat set at 2 degrees Celsius on each air handling unit.
- Provide thermostat override on air handling units for smoke control in area being served.

Water Flow Switches:

- UL listed, suitable for all service application conditions. Body minimum working pressure rating shall equal or exceed service pressure. Switch electrical rating shall be 230 volts AC 3.7 ampere, 115 volts AC 7.4 ampere, and 125 VAC 115-230 VAC AC Pilot duty. Unit shall have two SPDT switches. Actuating flow rated shall be field adjustable for the specified and indicated service. Switch location shall preclude exposure to turbulent or pulsating flow conditions. Flow switch shall not cause pressure drop exceeding 2 psi at maximum system flow rate.
- Acceptable Manufacturer: McDonnell-Miller.

Strap-On Aquastat: UL listed, provided with a suitable removable spring clip for attaching aquastat to pipe and a snap-action SPDT switch. Switch setpoint shall be as indicated. Electrical rating shall be 5 amperes, 120 VAC.

Current Sensitive Switches: Solid state, split core current switch that operates when the current level (sensed by the internal current transformer) exceeds the adjustable trip point. Current switch to include an integral LED for indication of trip condition and a current level below trip set point.

FLOW, PRESSURE AND ELECTRICAL MEASURING APPARATUS

Traverse Probe Air Flow Measuring Stations:

- Traverse probes shall be a dual manifolded, cylindrical, type constructed of 3003 extruded aluminum with an anodized finish to eliminate surface pitting and unnecessary air friction. The multiple total pressure manifold shall have sensors located along the stagnation plane of the approaching air flow and without the physical presence of forward projecting sensors into the airstream. The static pressure manifold shall incorporate dual offset static tips on opposing sides of the averaging manifold so as to be insensitive to flow-angle variations of as much as $\pm 20^\circ$ in the approaching airstream.
- The air flow traverse probe shall not induce a measurable pressure drop, nor shall the sound level within the duct be amplified by its singular or multiple presence in the airstream. Each airflow

1 measuring probe shall contain multiple total and static pressure sensors placed at equal distances
2 along the probe length. The number of sensors on each probe and the quantity of probes utilized
3 at each installation shall comply with the ASHRAE Standards for duct traversing.

- 4 • Traverse probes shall be accurate to $\pm 25\%$ of the measured airflow range down to 60 Pa static
5 pressure.
- 6 • Each flow measuring station shall be complete with its own dedicated microprocessor with a 4-
7 line, 80 character, Alpha Numeric display and full function key pad. The panel shall be fully
8 programmable and display calculated liters per minute directly on a LED monitor on the panel
9 face.
- 10 • Provide 24 volt 1 phase power to each flow measuring station.
- 11 • Acceptable Manufacturers: Air Monitor, Ultratech, Air Sentinel, Ebtron

12
13 **Shielded Static Pressure Sensor:**

- 14
15 • Provide for each zone where required a shielded static pressure sensor suitable for ceiling surface
16 mounting, complete with multiple sensing ports, pressure impulse suppression chamber with
17 minimum volume of 800 cubic centimeters, airflow shielding, and 3/8" compression takeoff
18 fittings, all contained in a welded stainless steel casing, with polish finish on the exposed surfaces.
- 19 • These probes shall be capable of sensing the static pressure in the proximity of the sensor to within
20 1% of the actual pressure value while being subjected to a maximum airflow of 300 meters per
21 minute from a radial source.
- 22 • The shielded static sensing devices shall be used for both reference and space pressure sensing.
- 23 • Pressure sensors used for outside air pressure reference purposes shall be equipped with a conduit
24 seal for pneumatic tubing and bushings for a weather tight installation.

25
26 **Static Pressure Traverse Probe:**

- 27
28 • Provide multipoint traverse probes in the duct at each point where static pressure sensing is
29 required.
- 30 • Each duct static traverse probe shall contain multiple static pressure sensors located along the
31 exterior surface of the cylindrical probe. Pressure sensing points shall not protrude beyond the
32 surface of the probe.
- 33 • The duct static traverse probe shall be of 304 stainless steel construction and (except for 3/4" dia.
34 probes with lengths of 60 cm or less) be complete with threaded end support rod, sealing washer
35 and nut, and mounting plate with gasket and static pressure signal fitting. The static traverse probe
36 shall be capable of producing a steady, non-pulsating signal of standard static pressure without
37 need for correction factors, with an instrument accuracy of 21.
- 38 • Acceptable Manufacturers: Mamac, STAT-Probe/1, Veris, Setra, BAPI

39
40 **Venturi Flowmeter**

- 41
42 • Pressure drop on venturi type flowmeters shall not exceed 60 Pa. Each venturi low and high
43 pressure taps shall be equipped with nipples, valves and quick disconnects.
- 44 • Equip each venturi with a metal identification tag indicating the size, location, Liters Per Minute
45 (LPM) and meter reading for the LPM specified.
- 46 • Provide (1) dial differential pressure meter of the proper range to determine piping system flow
47 rate. The meter shall be the property of the Owner.
- 48 • Venturi meters shall utilize flanged or screwed connections for removal purposes and shall be
49 rated for the system operating pressures.
- 50 • The venturi flowmeter shall be factory calibrated to provide a minimum of flow accuracy between
51 actual and factory flow calibration data.
- 52 • Acceptable Manufacturers: Barco, Gerand, Aeroquip

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RELAYS AND CONTACTORS

Relays other than those associated with digital output cards shall be general purpose, enclosed type and protected by a heat and shock resistant duct cover. Number of contacts and operational function shall be as required.

Solid State Relays (SSR): Input/output isolation shall be greater than $10E^9$ ohms with a breakdown voltage of 1500V root mean square or greater at 60 Hz. The contact life shall be $10 \times 10 E^6$ operations or greater. The ambient temperature range of SSRs shall be -28 to +60°C. Input impedance shall not be less than 500 ohms. Relays shall be rated for the application. Operating and release time shall be for 100 milliseconds or less. Transient suppression shall be provided as an integral part of the relay.

Contactors: Contactors shall be of the single coil, electrically operated, mechanically held type. Positive locking shall be obtained without the use of hooks, latches, or semi-permanent magnets. Contractor shall be double-break-silver-to-silver type protected by arcing contacts. The number of contacts and rating shall be selected for the application. Operating and release times shall be 100 milliseconds or less. Contactors shall be equipped with coil transient suppression devices.

ELECTRIC TO PNEUMATIC TRANSDUCERS

Electric to pressure transducers shall have internal pressure feedback to compare actual commanded pressure value and will compensate for leakage or drift. Provide with manual override. Output of transducer shall bleed to zero PSI on power fail.

High air capacity	500 SCIM at 20 psig
Low air consumption	15 SCIM at 20 psig
Input	4-20 MA / 0-10VDC
Output	0-20 psig
Linearity	1% of span
Hysteresis	1% of span

This contractor shall be responsible for verifying that the input of electric to pneumatic transducers is compatible with the output of the DDC controller provided under 23 09 24 or 23 09 23.

TEMPERATURE CONTROL PANELS

Furnish temperature control panels of code gauge steel with locking doors for mounting all devices as shown. Panels shall conform to NEMA 1 standards, unless otherwise indicated.

Control panels shall meet all requirements of UL508A and shall be so certified.

All external wiring shall be connected to terminal strips mounted within the panel.

Provide engraved phenolic nameplates identifying all devices mounted on the face of control panels and the identification number of the panel.

A complete set of 'as-built' control drawings (relating to the controls within that panel) shall be furnished within each control panel. Danfoss

PART 3 - EXECUTION

INSTALLATION

All work described in this section shall be installed, wired, circuit tested and calibrated by factory certified technicians qualified for this work and in the regular employment of the Direct Digital Control System manufacturer or its exclusive factory authorized installing contracting field office (representative). The

1 installing office shall have a minimum of five years of installation experience with the manufacturer and
2 shall provide documentation in submittal package verifying longevity of the installing company's
3 relationship with the manufacturer. Supervision, calibration and checkout of the system shall be by the
4 employees of the local exclusive factory authorized temperature control contracting field office (branch or
5 representative).

6
7 Install system and materials in accordance with manufacturer's instructions, and as detailed on the project
8 drawing set.

9
10 Drawings of Direct Digital Control Systems are diagrammatic only and any apparatus not shown, such as
11 relays, accessories, etc., but required to make the system operative to the complete satisfaction of the
12 Engineer and Owner shall be furnished and installed without additional cost.

13
14 Line and low voltage electrical connections to control equipment shown specified or shown on the control
15 diagrams shall be furnished and installed by the DDCS Contractor in accordance with these specifications.

16
17 Equipment furnished by the HVAC Contractor that is normally wired before installation shall be furnished
18 completely wired. Control wiring normally performed in the field will be furnished and installed by the
19 DDCS Contractor.

20
21 All control devices mounted on the face of control panels shall be clearly identified as to function and
22 system served with permanently engraved phenolic labels.

23
24 All electrical control wiring and power wiring to the control panels shall be the responsibility of the DDCS
25 Contractor.

26
27 The electrical contractor (Division 26) shall furnish all power wiring to electrical starters and motors.

28
29 All wiring shall be in accordance with the Project Electrical Specifications (Division 26), the National
30 Electrical Code and any applicable local codes. All DDCS wiring shall be installed in the conduit types
31 specified in the Project Electrical Specifications (Division 26) unless otherwise allowed by the National
32 Electrical Code or applicable local codes. Where DDCS plenum rated cable wiring is allowed, it shall be
33 run parallel to or at right angles to the structure, properly supported and installed in a neat and workmanlike
34 manner.

35 **WIRING**

36 **GENERAL REQUIREMENTS**

37 Install low voltage power and LON and LAN communication trunks in conduit in the following locations
38 regardless of local building code allowances otherwise.

- 39
- 40
- 41 • Mechanical rooms.
- 42 • Electrical rooms.
- 43 • Vertical risers (exception: fire rated continuous closet like a telephone closet).
- 44 • Open Areas where the wiring will be exposed to view or tampering.
- 45

46 Splices:

- 47
- 48 • Splices in shielded cables shall consist of terminations and the use of shielded cable couplers
49 which maintain the integrity of the shielding. Terminations shall be in accessible locations.
50 Cables shall be harnessed with cable ties as specified herein. Splices are not permitted in the FMS
51 LAN or LON communication cables.
- 52 • Follow manufacturer suggested procedures for proper splicing.
- 53

1 Conceal conduit within finished shafts, ceilings and wall as required. Install exposed conduit parallel with
2 or at right angles to the building walls
3
4 Tag all equipment, panels, cables, conduits, junction boxes, etc., as called out in the "Identification" section
5 of this specification and as shown on the drawings.
6
7 Perform installation of all devices in the manner specified by each manufacturer. Aside from product
8 submittal requirements, provide manufacturer's installation instructions for verification as requested by the
9 DGS agent.
10
11 Where Class 2 wires are in concealed and accessible locations including ceiling return air plenums,
12 approved cables not in raceway may be used provided that:
13
14 • Circuits meet NEC Class 2 (current-limited) requirements. (Low-voltage power circuits shall be
15 sub-fused when required to meet Class 2 current-limit.)
16 • All cables shall be UL listed for application, i.e., cables used in ceiling plenums shall be UL listed
17 specifically for that purpose.
18
19 Do not install Class 2 wiring in conduit containing Class 1 wiring. Boxes and panels containing high
20 voltage may not be used for low voltage wiring except for the purpose of interfacing the two (e.g., relays
21 and transformers).
22
23 Where Class 2 wiring is run exposed, wiring to be run parallel along a surface or perpendicular to it, and
24 NEATLY tied at 3m intervals.
25
26 All wire-to-device connections shall be made at a terminal blocks or terminal strip. All wire-to-wire
27 connections shall be at a terminal block, or with a crimped connector. All wiring within enclosures shall be
28 neatly bundled and anchored to permit access and prevent restriction to devices and terminals.
29
30 Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values.
31 If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
32
33 **ETHERNET NETWORK REQUIREMENTS**
34 Wired network communication shall be via channels consisting of Category 5E or Category 6 network
35 cable installed in a 3/4" EMT.
36
37 Communication conduits shall not be installed closer than 2m from high power transformers or run parallel
38 within six feet of electrical high power cables. Care shall be taken to route the cable as far from
39 interference generating devices as possible.
40
41 Ethernet network wiring shall be installed as shown on riser diagram.
42
43 There shall be no power wiring, in excess of 30 VAC rms, run in conduit with communications wiring.
44
45 Recommended CAT 5E and CAT 6 Ethernet wiring guidelines shall be followed and in no case shall the
46 distance between any Ethernet switch, NAC or other Ethernet LAN device exceed 100 meters.
47
48 Ethernet wiring shall installed and rated for communications at 100mb.
49
50 **LON NETWORK REQUIREMENTS**
51 Wired network communication shall utilize approved Lon cable as indicated on the drawings. No
52 substitutions will be allowed.
53

1 Communication conduits shall not be installed closer than 2m from high power transformers or run parallel
2 within six feet of electrical high power cables. Care shall be taken to route the cable as far from
3 interference generating devices as possible.

4
5 Lon network wiring shall be installed as shown on riser diagram.

6
7 There shall be no power wiring, in excess of 30 VAC rms, run in conduit with communications wiring.

8
9 Recommended Lon wiring guidelines shall be followed for double-terminated bus topology, with repeaters
10 provided as required, based on wiring distance and device quantity configuration. In no case shall the total
11 network wiring distance from any NAC to the last Lon device on the network exceed 1,400 meters, with a
12 maximum stub length of 3 meters.

13 INPUT / OUTPUT AND ANCILLARY HARDWARE WIRING

14 Input/Output Control Wiring:

- 15 • Thermistor wiring shall be two conductor, twisted, shielded, minimum 22 gauge.
- 16 • Other analog inputs shall be a minimum of number 22 gauge, twisted, shielded.
- 17 • Binary control function wiring shall be a minimum of number 18 gauge.
- 18 • Analog output control functions shall be a minimum of number 22 gauge, twisted, shielded cable,
19 number of conductors as required.
- 20 • Binary input wiring shall be a minimum of number 22 gauge, twisted, shielded.
- 21 • 120V control wiring shall be #14 THHN in 1/2" conduit.

22
23 Provide interlock wiring between supply and return fans and electrical wiring for relays (including power
24 feed) for temperature and pressure indication. Provide interlock wiring between refrigeration machines,
25 pumps and condensing equipment as required for the specified sequence of operation and the refrigeration
26 system integral controller(s). Do not provide interlock wiring if a dedicated digital output has been
27 specified for the equipment or the sequence of operation requires independent start/stop.

28
29 Provide power wiring, conduit and connections for low temperature thermostats, high temperature
30 thermostats, alarms, flow switches, actuating and sensing devices for temperature, humidity, pressure and
31 flow indication, point resets and user disconnect switches for electric heating appliances controlled by this
32 Section.

33 CONDUIT AND FITTINGS

34 Conduit for Control Wiring, Control Cable and Transmission Cable: Electrical metallic tubing (EMT) with
35 compression fittings, cold rolled steel, zinc coated or zinc-coated rigid steel with threaded connections.

36
37 Outlet Boxes (Dry Location): Sheradized or galvanized drawn steel suited to each application, in general,
38 four inches square or octagon with suitable raised cover.

39
40 Outlet Boxes (Exposed to Weather): Threaded hub cast aluminum or iron boxes with gasket device plate.

41
42 Pull and Junction Boxes: Size according to number, size, and position of entering raceway as required by
43 National Electrical Codes. Enclosure type shall be suited to location.

44
45 Plug or cap all unused conduit openings and stub-ups. Do not use caulking compound.

46
47 Route all conduit to clear beams, plates, footings and structure members. Do not route conduit through
48 column footings or grade beams.

49
50 Set conduits as follows:

- 1 • Expanding silicone firestop material where conduit is run between floors and through walls of
2 fireproof shaft.
3 • Oakum and lead, sealed watertight penetration through outside foundation walls.
4

5 Cap open ends of conduits until conductors are installed.
6

7 Where conduit is attached to vibrating or rotating equipment, flexible metal conduit with a minimum length
8 of 18 inches and maximum length of 36 inches shall be installed and anchored in such a manner that
9 vibration and equipment noise will not be transmitted to the rigid conduit.
10

11 Where exposed to the elements or in damp or wet locations, waterproof flexible conduit shall be installed.
12 Installation shall be as specified for flexible metal conduit.
13

14 Provide floor, wall, and ceiling plates for all conduits passing through walls, floors or ceilings. Use prime
15 coated cast iron, split-ring type plates, except with polished chrome-plated finish in exposed finished
16 spaces.
17

18 IDENTIFICATION

19 Wire Tags:
20

- 21 • All multi-conductor cables, including those for all I/O devices, in all pull boxes and terminal strip
22 cabinets shall be uniquely tagged at both ends. Keep a catalog of wire identification for submittal
23 to the City of Chicago at the project's completion.
24 • Provide wire Tags as per Division 16.
25

26 Conduit Tags: Provide tagging or labeling of conduit so that it is always readily observable which conduit
27 was installed or used in implementation of this Work.
28

29 Miscellaneous Equipment Identification:
30

- 31 • Screwed-on, engraved black lamacoid sheet with white lettering on all control panels and remote
32 processing panels. Lettering sizes subject to approval.
33 • Inscription, subject to review and acceptance, indicating equipment, system numbers, functions
34 and switches. For panel interior wiring, input/output modules, local control panel device
35 identification.
36

37 Automatic Control Valve Tags:
38

- 39 • For valves, etc., use metal tags with a 2 inch minimum diameter, fabricated of brass, stainless steel
40 or aluminum. Attach tags with chain of same materials. For lubrication instructions, use linen or
41 heavy duty shipping tag.
42 • Tag valves with identifying number and system. Number valves by floor level, column location
43 and system served.
44 • Prepare lists of all tagged valves showing location, floor level, tag number, use. Prepare separate
45 lists for each system. Include copies in each maintenance manual.
46

47 WARRANTY

48 Equipment, materials and workmanship incorporated into the work shall be warranted for a period of one
49 year from the time of system acceptance.
50

1 Within this period, upon notice by the Owner, any defects in the work provided under this section due to
2 faulty materials, methods of installation or workmanship shall be promptly (within 48 hours after receipt of
3 notice) repaired or replaced by the DDCS Contractor at no expense to the Owner.

4 5 **START-UP AND TESTING**

6 It is the responsibility of the DDCS contractor to ensure the proper installation and performance of the Lon
7 networks and to coordinate the start-up and testing of the networks with the Section 23 09 25 System
8 Integrator to ensure the networks and attached devices are functioning properly. Once all devices are
9 installed, programmed, configured and powered, the DDCS contractor shall notify the Section 23 09 25
10 System Integrator to schedule a start-up schedule. During the start-up, all IDC's supplied by the DDCS
11 contractor shall be checked for proper communication, network bindings, and network traffic to ensure
12 proper performance. The DDCS contractor shall correct any devices or performance found to be defective

13
14 The DDCS contractor, along with the Section 23 09 25 System Integrator shall reconfigure nodes as
15 necessary to maintain traffic to no more than 50% of channel bandwidth capacity.

16 17 **WARRANTY ACCESS**

18 The Owner shall grant to the DDCS Contractor, reasonable access to the DDCS during the warranty period.

19 20 **ACCEPTANCE TESTING**

21 The DDCS Contractor shall verify that all IDC's are ready for operation. This inspection shall verify that
22 the following items have been properly installed.

- 23
- 24 • Network connection.
- 25 • Power connection.
- 26 • Proper power supply voltage and type.
- 27 • Electrical installation conforms to local code authorities.
- 28 • Valves (normally open or closed).
- 29 • Fail safe devices are equipped with spring return operators.
- 30 • Device or control unit in a standalone mode accomplishes the following:
 - 31 - Operate smoothly throughout entire control range without binding or cogging.
 - 32 - Sensors have been calibrated to specifications.
 - 33 - Differential pressure transmitters have been zero and span adjusted.
- 34 • With application code loaded, execute specific control loops effectively without hunting or
- 35 hysteresis.
- 36 • Point to point check of all digital I/O for continuity and correct execution of the functional
- 37 operation.
- 38

39 Submit an Inspection Log, which enumerates the above in a check list form for all IDC's. Indicate
40 corrective action for non-conforming or defective products and/or product installations.

41
42 The DDCS Contractor shall perform all necessary calibration, testing and de-bugging and perform all
43 required operational checks to insure that the system is functioning in full accordance with these
44 specifications. The Division 23 and Section 23 09 25 contractors are to coordinate the checkout of the
45 system such that each Section has a representative present during system checkout.

46
47 The DDCS Contractor shall perform tests to verify proper performance of components, sequences of
48 operation, and points. Repeat tests until proper performance results. This testing shall include a point-by-
49 point log to validate 100% of the input and output points of the DDC system operation. The Section 23 09
50 25 System Integrator shall have a representative present during system checkout by the DDCS Contractor.

51
52 Upon completion of the performance tests described above, repeat these tests, point by point as described in
53 the validation log above in presence of Owner's Representative, as required. Properly schedule these tests

1 so testing is complete at a time directed by the Owner's Representative. Do not delay tests so as to prevent
2 delay of occupancy permits or building occupancy.

3
4 **System Acceptance:** Satisfactory completion is when the Temperature Control sub-contractor has
5 performed successfully all the required testing to show performance compliance with the requirements of
6 the Contract Documents to the satisfaction of the Owner's Representative. System acceptance shall be
7 contingent upon completion and review of all corrected deficiencies.

8
9 In conjunction with the work of other trades, thoroughly test all equipment and systems in a dynamic mode
10 simulating all operating sequences including safety shutdown and emergency fire mode.

11
12 **TESTING, ADJUSTING AND BALANCING REQUIREMENTS**

13 **SUMMARY:**

14 This contractor shall work with the Section 23 05 93 test and balance contractor to secure the proper
15 operation of all control systems and devices.

16
17
18 **PART 4 - SEQUENCES OF OPERATION**

19
20 **SUMMARY**

21 For each system listed, provide the sequence of operation as stated in Section 23 09 23 and as shown on
22 drawings.

23
24 **CONTROL DIAGRAMS AND SCHEDULE**

25 Refer to Drawings for information, which indicates the components and intended control functions and
26 devices.

27
28 SI Contractor shall be responsible for all control wiring connections, auxiliary devices and control wiring
29 diagrams to complete the control system and attain the described sequence of operation.

30
31 All set points of sensors, controllers and the like, that are not factory preset, shall be preset by the SI
32 Contractor before system startup.

33
34 **SEQUENCES OF OPERATION**

35 Program each ASC, CU, etc, to perform the sequences of operation printed on the control drawings.
36 Provide all necessary hardware on each piece of equipment in order for the equipment to perform the
37 specified sequence and to meet the requirements of the points lists. (Points on the points list may be for
38 monitoring and alarm purposes. They may not be required to perform the sequence. DDCS Contractor is
39 responsible for providing these as well.)

40
41 SI Contractor shall be responsible for all control wiring connections, auxiliary devices and control wiring
42 diagrams to complete the control system and attain the described sequence of operation.

43
44 **OPERATOR INSTRUCTION, TRAINING**

45 The Section 23 09 24 contractor shall provide a minimum of 4 hours of instruction to the owner's
46 designated personnel six months after substantial completion.

47
48
49 **END OF SECTION**

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SECTION 23 09 25
INTEGRATED AUTOMATION SYSTEM (IAS)

PART 1 - GENERAL

SUMMARY

This section describes the Systems Integration scope of work for the project. This section also coordinates the responsibilities of the Mechanical and Electrical trade contractors pertaining to control products or systems, furnished by each trade that will be integrated by this Section.

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.

SYSTEM DESCRIPTION

The Integrated Automation System (IAS) shall be comprised of Network Area Controller or Controllers (NAC) within each facility. The NAC shall connect to the owner's local or wide area network, depending on configuration. Access to the system, either locally in each building, or remotely from a central site or sites, shall be accomplished through standard Web browsers, via the Internet and/or local area network. Each NAC shall communicate to LonTalk (IDC) controllers provided under Section 23 09 24.

SYSTEM INTEGRATION CONTRACTOR QUALIFICATIONS

General:

The System Integrator shall have a successful history in the design and installation of open control systems with browser based wide area network connectivity and shall provide evidence of this history as a condition of acceptance of bid.

The System Integrator shall have an office that is staffed with LONWORKS® and Internet Protocol (IP) trained engineers and technicians fully capable of providing instruction and routine emergency maintenance service on all system components within 24 hours of notification.

Contractor Service:

- System Integrator shall have a local service facility within a 90-mile radius of the job site, staffed with qualified service personnel, fully capable of providing instructions and routine or emergency maintenance service.
- Qualified Bidder: Environmental Systems, Inc., Waukesha WI 262-544-8860
- (This system will tie in to an established integrated automation system presently being developed throughout Dane County.)

SUBMITTAL

Eight copies of shop drawings of the IAS system shall be submitted and shall consist of a complete list of equipment and materials, including manufacturers catalog data sheets and installation instructions. Shop drawings shall also contain complete wiring and schematic diagrams, software descriptions, calculations, and any other details required to demonstrate that the system has been coordinated and will properly function as a system. Terminal identification for all control wiring shall be shown on the shop drawings. A complete written Sequence of Operation shall also be included with the submittal package.

Submittal shall include a network cable schematic diagram depicting operator workstations, control panel locations and a description of the communication type, media and protocol.

1 Upon completion of the work, provide a complete set of 'as-built' drawings and application software on
2 compact disk and on the Network Supervisor (NS) hard drive. Drawings shall be provided as AutoCAD™
3 or Visio™ compatible files. Eight copies of the 'as-built' drawings shall be provided in addition to the
4 documents on magnetic floppy disk media or compact disk. Section 23 09 24 and Division 26 contractors
5 shall provide as-builts for their portions of work. Section 23 09 25 contractor shall be responsible for as-
6 built-ups pertaining to overall IAS architecture and network diagrams.

8 **SPECIFICATION NOMENCLATURE**

9 Acronyms used in this specification are as follows:

11 IAS	Integrated Automation System
12 DDCS	Direct Digital Control System
13 NAC	Network Area Controller
14 NS	Network Supervisor
15 IDC	Interoperable Digital Controller
16 ASC	Application Specific Controller
17 PCU	Programmable Control Unit
18 IBC	Interoperable BACnet Controller
19 GUI	Graphical User Interface
20 WBI	Web Browser Interface
21 POT	Portable Operator's Terminal
22 PMI	Power Measurement Interface
23 DDC	Direct Digital Controls
24 LAN	Local Area Network
25 WAN	Wide Area Network
26 OOT	Object Oriented Technology
27 PICS	Product Interoperability Compliance Statement

29 **DIVISION OF WORK**

30 The DDCS Contractor shall be responsible for all controllers (IDC), control devices, control panels,
31 controller programming, controller programming software, controller input/output wiring, power wiring,
32 interlock and safety wiring, controller network wiring, and Ethernet LAN wiring, if applicable.

34 The System Integrator (SI) shall be responsible for the Network Area Controller(s) (NAC), workstations,
35 printers, servers, software and programming of the NAC, graphical user interface software (GUI),
36 development of all graphical screens, setup of schedules, logs and alarms, LonWorks network management,
37 global supervisory control applications, system integration and coordination of the NAC to the local or
38 wide area network.

40 The point of demarcation for the products to be provided by the System Integrator shall be up to and
41 including the Network Area Controller (NAC).

43 **WORK INCLUDED**

44 Furnish and install the following application software as outlined in this section.

- 46 • User Interface software
- 47 • HVAC application software

49 The following will be developed:

- 51 • Provide custom set-up and development of the software to provide the functional and performance
52 requirements specified. Develop system graphics for all specified mechanical and electrical
53 systems, using animated objects to display all system variables and process valves, according to
54 Owner standards.

- 1 • Provide supervisory control strategies for mechanical and electrical systems to permit the global
2 sequence of operations specified herein.

3
4 **RELATED WORK SPECIFIED ELSEWHERE**

5 Section 23 09 24, Mechanical: Providing control devices and systems including but not limited to:

- 6
- 7 • Interoperable Digital Controllers and programming
- 8 • Control panels, devices and wiring
- 9 • Control device networks

10
11 Division 26, Electrical:

- 12
- 13 • Providing motor starters and disconnect switches (unless otherwise noted).
- 14 • Power wiring and conduit (unless otherwise noted).
- 15 • Provision, installation and wiring of smoke detectors (unless otherwise noted).

16
17 **AGENCY AND CODE APPROVALS**

18 All products of the IAS shall be provided with the following agency approvals. Verification that the
19 approvals exist for all submitted products shall be provided with the submittal package. Systems or
20 products not currently offering the following approvals are not acceptable: UL-916; Energy Management
21 Systems, ULC; UL - Canadian Standards Association, FCC, Part 15, Subpart J, Class A Computing
22 Devices.

23
24 **SOFTWARE LICENSE AGREEMENT**

25 The Owner shall sign a copy of the manufacturer's standard software and firmware licensing agreement as a
26 condition of this contract. Such license shall grant use of all programs and application software to Owner
27 as defined by the manufacturer's license agreement, but shall protect manufacturer's rights to disclosure of
28 trade secrets contained within such software.

29
30 **DELIVERY, STORAGE AND HANDLING**

31 Provide factory-shipping cartons for each piece of equipment and control device. Maintain cartons through
32 shipping, storage, and handling as required to prevent equipment damage. Store equipment and materials
33 inside and protected from weather.

34
35 **JOB CONDITIONS**

36 Cooperation with Other Trades: Coordinate the Work of this section with that of other sections to insure
37 that the Work will be carried out in an orderly fashion. It shall be this Contractor's responsibility to check
38 the Contract Documents for possible conflicts between his Work and that of other crafts in equipment
39 location, pipe, duct and conduit runs, electrical outlets and fixtures, air diffusers, and structural and
40 architectural features.

41
42
43 **PART 2 - MATERIALS**

44
45 **GENERAL**

46 The Integrated Automation System (IAS) shall be comprised of a network of interoperable, stand-alone
47 Network Area Controllers, servers, operator workstations, graphical user interface software, printers,
48 network devices and other devices as specified herein.

49
50 The installed system shall provide secure password access to all features, functions and data contained in
51 the overall IAS.

52
53 **OPEN, INTEROPERABLE, INTEGRATED ARCHITECTURES**

1 The intent of this specification is to provide a peer-to-peer networked, stand-alone, distributed control
2 system with the capability to integrate both the ANSI/ASHRAE Standard 135-1995 BACnet and
3 LonWorks technology communication protocols in one open, interoperable system.

4
5 The supplied computer software shall employ object-oriented technology (OOT) for representation of all
6 data and control devices within the system. In addition, adherence to industry standards including ANSI /
7 ASHRAE™ Standard 135-1995, BACnet and LonMark to assure interoperability between all system
8 components is required. For each LonWorks device that does not have LonMark certification, the device
9 supplier must provide an XIF file for the device. For each BACnet device, the device supplier must
10 provide a PICS document showing the installed device's compliance level. Minimum compliance is Level
11 3; with the ability to support data read and write functionality. Physical connection of BACnet devices
12 shall be via Ethernet or MSTP.

13
14 All components and controllers supplied under this contract shall be true "peer-to-peer" communicating
15 devices. Components or controllers requiring "polling" by a host to pass data shall not be acceptable.

16
17 The supplied system must incorporate the ability to access all data using standard Web browsers without
18 requiring proprietary operator interface and configuration programs. An Open DataBase Connectivity
19 (ODBC) or Structured Query Language (SQL) compliant server database is required for all system
20 database parameter storage. This data shall reside on a supplier-installed server for all database access.
21 Systems requiring proprietary database and user interface programs shall not be acceptable.

22
23 A hierarchical topology is required to assure reasonable system response times and to manage the flow and
24 sharing of data without unduly burdening the customer's internal Intranet network. Systems employing a
25 "flat" single tiered architecture shall not be acceptable.

- 26
27
- Maximum acceptable response time from any alarm occurrence (at the point of origin) to the point
28 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
29 of annunciation shall not exceed 60 seconds for remote or dial-up connected user interfaces.
- 30
31

32 NETWORKS

33 The Local Area Network (LAN) shall be a 100 Megabits/sec Ethernet network supporting BACnet, Java,
34 XML, and HTTP for maximum flexibility for integration of building data with enterprise information
35 systems and providing support for multiple Network Area Controllers (NACs), user workstations and, if
36 specified, a local server.

37
38 Local area network minimum physical and media access requirements:

- 39
- Ethernet; IEEE standard 802.3
 - Cable; 10 Base-T, UTP-8 wire, category 5E or 6
 - Minimum throughput; 10 Mbps, with ability to increase to 100 Mbps
- 40
41
42
43

44 NETWORK ACCESS

45 Remote Access: For Local Area Network installations, provide access to the LAN from a remote location,
46 via the Internet. The owner shall provide a connection to the Internet to enable this access via high-speed
47 cable modem, asynchronous digital subscriber line (ADSL) modem, ISDN line, T1 Line or via the
48 customer's Intranet to a corporate server providing access to an Internet Service Provider (ISP). Customer
49 agrees to pay monthly access charges for connection and ISP.

50 NETWORK AREA CONTROLLER (NAC)

51 The Section 23 09 25 contractor shall utilize the available, existing network controller, located on the
52 second floor of the project building.

1 The Network Area Controller (NAC) shall provide the interface between the LAN or WAN and the field
2 control devices, and provide global supervisory control functions over the control devices connected to the
3 NAC. It shall be capable of executing application control programs to provide:

- 4
- 5 • Calendar functions
- 6 • Scheduling
- 7 • Trending
- 8 • Alarm monitoring and routing
- 9 • Time synchronization
- 10 • Integration of LonWorks controller data and BACnet controller data
- 11 • Network Management functions for all LonWorks based devices
- 12

13 The Network Area Controller must provide the following hardware features as a minimum:

- 14
- 15 • One Ethernet Port – 10/100 Mbps
- 16 • One RS-232 port
- 17 • One LonWorks Interface Port – 78KB FTT-10A
- 18 • Battery Backup
- 19 • Flash memory for long term data backup (If battery backup or flash memory is not supplied, the
20 controller must contain a hard disk with at least 1 gigabyte storage capacity)
- 21 • The NAC must be capable of operation over a temperature range of 0 to 55°C
- 22 • The NAC must be capable of withstanding storage temperatures of between 0 and 70°C
- 23 • The NAC must be capable of operation over a humidity range of 5 to 95% RH, non-condensing
- 24

25 The NAC shall support standard Web browser access via the Intranet/Internet. It shall support a minimum
26 of 26 simultaneous users.

27

28 Event Alarm Notification and Actions:

- 29
- 30 • The NAC shall provide alarm recognition, storage; routing, management, and analysis to
31 supplement distributed capabilities of equipment or application specific controllers.
- 32 • The NAC shall be able to route any alarm condition to any defined user location whether
33 connected to a local network or remote via dial-up telephone connection, or wide-area network.
- 34 • Alarm generation shall be selectable for annunciation type and acknowledgement requirements
35 including but limited to: To alarm, Return to normal, To fault.
- 36 • Provide for the creation of a minimum of eight of alarm classes for the purpose of routing types
37 and or classes of alarms, i.e.: security, HVAC, Fire, etc.
- 38 • Provide timed (schedule) routing of alarms by class, object, group, or node.
- 39 • Provide alarm generation from binary object “runtime” and /or event counts for equipment
40 maintenance. The user shall be able to reset runtime or event count values with appropriate
41 password control.
- 42

43 Control equipment and network failures shall be treated as alarms and annunciated.

44

45 Alarms shall be annunciated in any of the following manners as defined by the user:

- 46
- 47 • Screen message text
- 48

49 **DATA COLLECTION AND STORAGE**

50 The NAC shall have the ability to collect data for any object and store this data for future use.

51

1 The data collection shall be performed by log objects, resident in the NAC that shall have, at a minimum,
2 the following configurable properties:

- 3
- 4 • Designating the log as interval or deviation.
- 5 • For interval logs, the object shall be configured for time of day, day of week and the sample
6 collection interval.
- 7 • For deviation logs, the object shall be configured for the deviation of a variable to a fixed value.
8 This value, when reached, will initiate logging of the object.
- 9 • For all logs, provide the ability to set the maximum number of data stores for the log and to set
10 whether the log will stop collecting when full, or rollover the data on a first-in, first-out basis.
- 11 • Each log shall have the ability to have its data cleared on a time-based event or by a user-defined
12 event or action.
- 13

14 All log data shall be stored in a relational database and the data shall be accessed from a standard Web
15 Browser.

16
17 All log data, when accessed from the Network Supervisor (NS), shall be capable of being manipulated
18 using standard SQL statements.

19
20 All log data shall be available to the user in the following data formats:

- 21
- 22 • HTML
- 23 • XML
- 24 • Plain Text
- 25 • Comma or tab separated values
- 26

27 Systems that do not provide log data in HTML and XML formats at a minimum shall not be acceptable.

28
29 The NAC shall have the ability to archive it's log data to a Network Supervisor on the network. Provide
30 the ability to configure the following archiving properties, at a minimum:

- 31
- 32 • Archive on time of day
- 33 • Archive on user-defined number of data stores in the log (buffer size)
- 34 • Archive when log has reached it's user-defined capacity of data stores
- 35 • Provide ability to clear logs once archived
- 36

37 **AUDIT LOG**

38 Provide and maintain an Audit Log that tracks all activities performed on the NAC. Provide the ability to
39 specify a buffer size for the log and the ability to archive the log based on time to the Network Supervisor.

40 For each log entry, provide the following data:

- 41
- 42 • Time and date
- 43 • User ID
- 44 • Change or activity: i.e., Change setpoint, add or delete objects, commands, etc.
- 45

46 **DATABASE BACKUP AND STORAGE**

47 The NAC shall have the ability to automatically backup its database. The database shall be backed up
48 based on a user-defined time interval.

49
50 Copies of the current database and, at the most recently saved database shall be stored on the Network
51 Supervisor. The age of the most recently saved database is dependent on the user-defined database save
52 interval.

1
2 The NAC database shall be stored, at a minimum, in XML format to allow for user viewing and editing, if
3 desired. Other formats are acceptable as well, as long as XML format is supported.
4

5 **WEB BROWSER CLIENTS**

6 The operator interface shall be an extension of the existing operator interface. Provide all additional
7 graphics for new equipment and systems.
8

9 **SYSTEM PROGRAMMING**

10 The extension of the existing Graphical User Interface software (GUI) shall provide the ability to perform
11 system programming and graphic display engineering as part of a complete software package. Access to
12 the programming functions and features of the GUI shall be through password access as assigned by the
13 system administrator.
14

15 A library of control, application, and graphic objects shall be provided to enable the creation of all
16 applications and user interface screens. Applications are to be created by selecting the desired control
17 objects from the library, dragging or pasting them on the screen, and linking them together using a built in
18 graphical connection tool. Completed applications may be stored in the library for future use. Graphical
19 User Interface screens shall be created in the same fashion. Data for the user displays is obtained by
20 graphically linking the user display objects to the application objects to provide “real-time” data updates.
21 Any real-time data value or object property may be connected to display its current value on a user display.
22 Systems requiring separate software tools or processes to create applications and user interface displays
23 shall not be acceptable.
24

25 **Programming Methods:**

- 26
- 27 • Provide the capability to copy objects from the supplied libraries, or from a user-defined library to
28 the user’s application. Objects shall be linked by a graphical linking scheme by dragging a link
29 from one object to another. Object links will support one-to-one, many-to-one, or one-to-many
30 relationships. Linked objects shall maintain their connections to other objects regardless of where
31 they are positioned on the page and shall show link identification for links to objects on other
32 pages for easy identification. Links will vary in color depending on the type of link; i.e., internal,
33 external, hardware, etc.
- 34 • Configuration of each object will be done through the object’s property sheet using fill-in the
35 blank fields, list boxes, and selection buttons. Use of custom programming, scripting language, or
36 a manufacturer-specific procedural language for configuration will not be accepted.
- 37 • The software shall provide the ability to view the logic in a monitor mode. When on-line, the
38 monitor mode shall provide the ability to view the logic in real time for easy diagnosis of the logic
39 execution. When off-line (debug), the monitor mode shall allow the user to set values to inputs
40 and monitor the logic for diagnosing execution before it is applied to the system.
- 41 • All programming shall be done in real-time. Systems requiring the uploading, editing, and
42 downloading of database objects shall not be allowed.
- 43 • The system shall support object duplication within a customer’s database. An application, once
44 configured, can be copied and pasted for easy re-use and duplication. All links, other than to the
45 hardware, shall be maintained during duplication.
46

47 **LONWORKS NETWORK MANAGEMENT**

48 The Graphical User Interface software (GUI) shall provide a complete set of integrated LonWorks network
49 management tools for working with LonWorks networks. These tools shall manage a database for all
50 LonWorks devices by type and revision, and shall provide a software mechanism for identifying each
51 device on the network. These tools shall also be capable of defining network data connections between
52 LonWorks devices, known as “binding”. Systems requiring the use of third party LonWorks network
53 management tools shall not be accepted.

1
2 Network management shall include the following services: device identification, device installation, device
3 configuration, device diagnostics, device maintenance and network variable binding.
4

5 The Network configuration tool shall also provide diagnostics to identify devices on the network, to reset
6 devices, and to view health and status counters within devices.
7

8 These tools shall provide the ability to “learn” an existing LonWorks network, regardless of what network
9 management tool(s) were used to install the existing network, so that existing LonWorks devices and newly
10 added devices are part of a single network management database.
11

12 The network management database shall be resident in the Network Area Controller (NAC), ensuring that
13 anyone with proper authorization has access to the network management database at all times. Systems
14 employing network management databases that are not resident, at all times, within the control system,
15 shall not be accepted.
16

17 **OBJECT LIBRARIES**

18 A standard library of objects shall be included for development and setup of application logic, user
19 interface displays, system services, and communication networks.
20

21 The objects in this library shall be capable of being copied and pasted into the user’s database and shall be
22 organized according to their function. In addition, the user shall have the capability to group objects
23 created in their application and store the new instances of these objects in a user-defined library.
24

25 In addition to the standard libraries specified here, the supplier of the system shall maintain an on-line
26 accessible (over the Internet) library, available to all registered users to provide new or updated objects and
27 applications as they are developed.
28

29 All control objects shall conform to the control objects specified in the BACnet specification.
30

31 The library shall include applications or objects for the following functions, at a minimum:
32

- 33 • Scheduling Object. The schedule must conform to the schedule object as defined in the BACnet
34 specification, providing 7-day plus holiday & temporary scheduling features and a minimum of 10
35 on/off events per day. Data entry to be by graphical sliders to speed creation and selection of on-
36 off events.
- 37 • Calendar Object. . The calendar must conform to the calendar object as defined in the BACnet
38 specification, providing 12-month calendar features to allow for holiday or special event data
39 entry. Data entry to be by graphical “point-and-click” selection. This object must be “linkable” to
40 any or all scheduling objects for effective event control.
- 41 • Duty Cycling Object. Provide a universal duty cycle object to allow repetitive on/off time control
42 of equipment as an energy conserving measure. Any number of these objects may be created to
43 control equipment at varying intervals
- 44 • Temperature Override Object. Provide a temperature override object that is capable of overriding
45 equipment turned off by other energy saving programs (scheduling, duty cycling etc.) to maintain
46 occupant comfort or for equipment freeze protection.
- 47 • Start-Stop Time Optimization Object. Provide a start-stop time optimization object to provide the
48 capability of starting equipment just early enough to bring space conditions to desired conditions
49 by the scheduled occupancy time. Also, allow equipment to be stopped before the scheduled un-
50 occupancy time just far enough ahead to take advantage of the building’s “flywheel” effect for
51 energy savings. Provide automatic tuning of all start / stop time object properties based on the
52 previous day’s performance.
- 53 • Demand Limiting Object. Provide a comprehensive demand-limiting object that is capable of
54 controlling demand for any selected energy utility (electric, oil, and gas). The object shall provide

1 the capability of monitoring a demand value and predicting (by use of a sliding window prediction
2 algorithm) the demand at the end of the user defined interval period (1-60 minutes). This object
3 shall also accommodate a utility meter time sync pulse for fixed interval demand control. Upon a
4 prediction that will exceed the user defined demand limit (supply a minimum of 6 per day), the
5 demand limiting object shall issue shed commands to either turn off user specified loads or modify
6 equipment set points to effect the desired energy reduction. If the list of sheddable equipment is
7 not enough to reduce the demand to below the set point, a message shall be displayed on the users
8 screen (as an alarm) instructing the user to take manual actions to maintain the desired demand.
9 The shed lists are specified by the user and shall be selectable to be shed in either a fixed or
10 rotating order to control which equipment is shed the most often. Upon suitable reductions in
11 demand, the demand-limiting object shall restore the equipment that was shed in the reverse order
12 in which it was shed. Each sheddable object shall have a minimum and maximum shed time
13 property to effect both equipment protection and occupant comfort.
14

15 The library shall include control objects for the following functions. All control objects shall conform to the
16 objects as specified in the BACnet specification.
17

- 18 • Analog Input Object - Minimum requirement is to comply with the BACnet standard for data
19 sharing. Allow high, low and failure limits to be assigned for alarming. Also, provide a time
20 delay filter property to prevent nuisance alarms caused by temporary excursions above or below
21 the user defined alarm limits.
- 22 • Analog Output Object - Minimum requirement is to comply with the BACnet standard for data
23 sharing.
- 24 • Binary Input Object - Minimum requirement is to comply with the BACnet standard for data
25 sharing. The user must be able to specify either input condition for alarming. This object must
26 also include the capability to record equipment run-time by counting the amount of time the
27 hardware input is in an “on” condition. The user must be able to specify either input condition as
28 the “on” condition.
- 29 • Binary Output Object - Minimum requirement is to comply with the BACnet standard for data
30 sharing. Properties to enable minimum on and off times for equipment protection as well as
31 interstart delay must be provided. The BACnet Command Prioritization priority scheme shall be
32 incorporated to allow multiple control applications to execute commands on this object with the
33 highest priority command being invoked. Provide sixteen levels of priority as a minimum.
34 Systems not employing the BACnet method of contention resolution shall not be acceptable.
- 35 • PID Control Loop Object - Minimum requirement is to comply with the BACnet standard for data
36 sharing. Each individual property must be adjustable as well as to be disabled to allow
37 proportional control only, or proportional with integral control, as well as proportional, integral
38 and derivative control.
- 39 • Comparison Object - Allow a minimum of two analog objects to be compared to select either the
40 highest, lowest, or equality between the two linked inputs. Also, allow limits to be applied to the
41 output value for alarm generation.
- 42 • Math Object - Allow a minimum of four analog objects to be tested for the minimum or
43 maximum, or the sum, difference, or average of linked objects. Also, allow limits to be applied to
44 the output value for alarm generation.
- 45 • Custom Programming Objects - Provide a blank object template for the creation of new custom
46 objects to meet specific user application requirements. This object must provide a simple BASIC-
47 like programming language that is used to define object behavior. Provide a library of functions
48 including math and logic functions, string manipulation, and e-mail as a minimum. Also, provide a
49 comprehensive on-line debug tool to allow complete testing of the new object. Allow new objects
50 to be stored in the library for re-use.
- 51 • Interlock Object - Provide an interlock object that provides a means of coordination of objects
52 within a piece of equipment such as an Air Handler or other similar types of equipment. An

1 example is to link the return fan to the supply fan such that when the supply fan is started, the
2 return fan object is also started automatically without the user having to issue separate commands
3 or to link each object to a schedule object. In addition, the control loops, damper objects, and
4 alarm monitoring (such as return air, supply air, and mixed air temperature objects) will be
5 inhibited from alarming during a user-defined period after startup to allow for stabilization. When
6 the air handler is stopped, the interlocked return fan is also stopped, the outside air damper is
7 closed, and other related objects within the air handler unit are inhibited from alarming thereby
8 eliminating nuisance alarms during the off period.

- 9 • Temperature Override Object - Provide an object whose purpose is to provide the capability of
10 overriding a binary output to an "On" state in the event a user specified high or low limit value is
11 exceeded. This object is to be linked to the desired binary output object as well as to an analog
12 object for temperature monitoring, to cause the override to be enabled. This object will execute a
13 Start command at the Temperature Override level of start/stop command priority unless changed
14 by the user.
- 15 • Composite Object - Provide a container object that allows a collection of objects representing an
16 application to be encapsulated to protect the application from tampering, or to more easily
17 represent large applications. This object must have the ability to allow the user to select the
18 appropriate parameters of the "contained" application that are represented on the graphical shell of
19 this container.

20
21 The object library shall include objects to support the integration of devices connected to the Network Area
22 Controller (NAC). At a minimum, provide the following as part of the standard library included with the
23 programming software:
24

- 25 • LonMark/LonWorks devices. These devices shall include, but not be limited to, devices for
26 control of HVAC, lighting, access, and metering. Provide LonMark manufacturer-specific objects
27 to facilitate simple integration of these devices. All network variables defined in the LonMark
28 profile shall be supported. Information (type and function) regarding network variables not
29 defined in the LonMark profile shall be provided by the device manufacturer.
- 30 • For devices not conforming to the LonMark standard, provide a dynamic object that can be
31 assigned to the device based on network variable information provided by the device
32 manufacturer. Device manufacturer shall provide an XIF file and documentation for the device to
33 facilitate device integration.
- 34 • For BACnet devices, provide the following objects at a minimum: BACnet AI, BACnet AO,
35 BACnet BI, BACnet BO, BACnet Device.
- 36 • For each BACnet object, provide the ability to assign the object a BACnet device and object
37 instance number.

38 39 40 **PART 3 - EXECUTION**

41 **INSTALLATION**

42 All work described in this section shall be performed by a system integrator that have a successful history
43 in the design and installation of integrated control systems. The installing office shall have a minimum of
44 five years of integration experience and shall provide documentation in the submittal package verifying the
45 company's experience.
46

47
48 Install system and materials in accordance with manufacturer's instructions, and as detailed on the project
49 drawing set.
50

51 Drawings of IAS network are diagrammatic only and any apparatus not shown, but required to make the
52 system operative to the complete satisfaction of the Architect shall be furnished and installed without
53 additional cost.
54

1 Line and low voltage electrical connections to control equipment shown specified or shown on the control
2 diagrams shall be furnished and installed by the Temperature Control sub-contractor in accordance with the
3 specifications in Section 23 09 24 and Division 26.

4
5 **WIRING**

6 All electrical control wiring and power wiring to the NAC, computers and network components (routers,
7 hubs, switches, etc.) shall be the responsibility of the Section 23 09 24, DDCS Contractor.

8
9 All wiring shall be in accordance with the Project Electrical Specifications (Division 26), the National
10 Electrical Code and any applicable local codes. All IAS wiring shall be installed in the conduit types
11 specified in the Project Electrical Specifications (Division 26) unless otherwise allowed by the National
12 Electrical Code or applicable local codes. Where IAS plenum rated cable wiring is allowed it shall be run
13 parallel to or at right angles to the structure, properly supported and installed in a neat and workmanlike
14 manner.

15
16 **WARRANTY**

17 Equipment, materials and workmanship incorporated into the work shall be warranted for a period of one
18 year from the time of "substantial completion".

19
20 Within this period, upon notice by the Owner, any defects in the work provided under this section due to
21 faulty materials, methods of installation or workmanship shall be promptly (within 48 hours after receipt of
22 notice) repaired or replaced by the Section 23 09 25 contractor at no expense to the Owner.

23
24 **WARRANTY ACCESS**

25 The Owner shall grant to the Section 23 09 25 contractor, reasonable access to the IAS during the warranty
26 period. The owner shall allow the contractor to access the IAS from a remote location for the purpose of
27 diagnostics and troubleshooting, via the Internet, during the warranty period.

28
29 **ACCEPTANCE TESTING**

30 Upon completion of the installation, the Section 23 09 25 contractor shall load all system software and
31 start-up the system. The Section 23 09 24 contractor shall perform all necessary calibration, testing and de-
32 bugging and perform all required operational checks to insure that the system is functioning in full
33 accordance with these specifications. The Section 23 09 24 and Section 23 09 25 contractors are to
34 coordinate the checkout of the system such that each Section has a representative present during system
35 checkout.

36
37 The Section 23 09 24 contractor shall perform tests to verify proper performance of components, routines,
38 and points. Repeat tests until proper performance results. This testing shall include a point-by-point log to
39 validate 100% of the input and output points of the DDC system operation. The Section 23 09 25
40 contractor shall have a representative present during system checkout by the Section 23 09 24 contractor.

41
42 Upon completion of the performance tests described above, repeat these tests, point by point as described in
43 the validation log above in presence of Owner's Representative, as required. Properly schedule these tests
44 so testing is complete at a time directed by the Owner's Representative. Do not delay tests so as to prevent
45 delay of occupancy permits or building occupancy.

46
47 System Acceptance: Satisfactory completion is when the Section 23 09 24, Division 26, and Section 23 09
48 25 contractors have performed successfully all the required testing to show performance compliance with
49 the requirements of the Contract Documents to the satisfaction of the Owner's Representative. System
50 acceptance shall be contingent upon completion and review of all corrected deficiencies.

51
52 **OPERATOR INSTRUCTION, TRAINING**

53 During system commissioning and at such time acceptable performance of the IAS hardware and software
54 has been established the Temperature Control sub-contractor shall provide on-site operator instruction to

1 the owner's operating personnel. Operator instruction shall be done during normal working hours and shall
2 be performed by a competent representative familiar with the system hardware, software and accessories.
3

4 The Section 23 09 25 contractor shall provide a minimum of 8 hours of instruction to the owner's
5 designated personnel on the operation of the IAS and describe its intended use with respect to the
6 programmed functions specified. Operator orientation of the IAS shall include, but not be limited to; the
7 overall operation program, equipment functions (both individually and as part of the total integrated
8 system), commands, systems generation, advisories, and appropriate operator intervention required in
9 responding to the System's operation. The Section 23 09 25 contractor shall provide a minimum of 4 hours
10 of instruction six months after the initial training session.
11

12 **PART 4 - SEQUENCES OF OPERATION**

13 **SUMMARY**

14
15 The Section 23 09 25 contractor shall refer to this Item under Section 23 09 24 to determine what level of
16 control functionality the Network Area Controller, must provide, which is the responsibility of this Section.
17 It is the responsibility of the Section 23 09 25 contractor to coordinate control functions, such as scheduling
18 and supervisory-level global control with the Section 23 09 24 contractor.
19
20

21 **PART 5 - POINT LISTS**

22 **SUMMARY**

23
24 The Section 23 09 25 contractor shall refer to this Item under Section 23 09 24 to determine what data in
25 the local controllers must be integrated into the Network Area Controller, which is the responsibility of this
26 Section. It is the responsibility of the Section 23 09 25 contractor to coordinate control functions, such as
27 scheduling and supervisory-level global control with the Section 23 09 24 contractor.
28
29

30 **END OF SECTION**
31

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**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
- Chilled Water
- Cooling Coil Condensate
- Unions and Flanges
- Gaskets

PART 3 - EXECUTION

- Preparation
- Erection
- Welded Pipe Joints
- Threaded Pipe Joints
- Copper Pipe Joints
- Water Systems
- Cooling Coil Condensate
- Unions and Flanges
- Gaskets
- Piping System Leak Tests
- Hydronic Piping System Flushing
- Construction Verification Items
- Piping System Test Report

RELATED WORK

- 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

REFERENCE

Applicable provisions of Division 1 govern work under this section.

REFERENCE STANDARDS

- 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 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 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

1 Refer to division 1, General Conditions, Submittals.

2
3 Contractor shall submit schedule indicating the ASTM specification number of the pipe being proposed
4 along with its type and grade and sufficient information to indicate the type and rating of fittings for each
5 service.

6
7 **TYPE F STEEL PIPE:**

8 Statement from manufacturer on his letterhead that the pipe furnished meets the ASTM specification
9 contained in this section.

10
11 **TYPE E OR S STEEL PIPE:**

12 Mill certification papers, also known as material test reports, for the pipe furnished for this project, in
13 English. Heat numbers on these papers to match the heat numbers stenciled on the pipe. Chemical
14 analysis indicated on the mill certification papers to meet or exceed the requirements of the referenced
15 ASTM specification.

16
17 **COPPER TUBE:**

18 Statement from manufacturer on his letterhead that the pipe furnished meets the ASTM specification
19 contained in this section.

20
21 **QUALITY ASSURANCE**

22 Order all Type E and Type S steel pipe with heat numbers rolled, stamped, or stenciled to each length or
23 each bundle, depending on the size of the pipe, and in accordance with the appropriate ASTM
24 specification.

25
26 Any installed material not meeting the specification requirements must be replaced with material that meets
27 these specifications without additional cost to the Owner.

28
29 **DELIVERY, STORAGE, AND HANDLING**

30 Promptly inspect shipments to insure that the material is undamaged and complies with specifications.

31
32 Cover pipe to eliminate rust and corrosion while allowing sufficient ventilation to avoid condensation. Do
33 not store materials directly on grade. Protect pipe, tube, and fitting ends so they are not damaged. Where
34 end caps are provided or specified, take precautions so the caps remain in place. Protect fittings, flanges,
35 and unions by storage inside or by durable, waterproof, above ground packaging.

36
37 Offsite storage agreements will not relieve the contractor from using proper storage techniques.

38
39 Storage and protection methods must allow inspection to verify products.

40
41 **DESIGN CRITERIA**

42 Use only new material, free of defects, rust and scale, and meeting the latest revision of ASTM
43 specifications as listed in this specification.

44
45 Construct all piping for the highest pressures and temperatures in the respective system in accordance with
46 ANSI B31, but not less than 125 psig unless specifically indicated otherwise.

47
48 Where weld fittings or mechanical grooved fittings are used, use only long radius elbows having a
49 centerline radius of 1.5 pipe diameters.

50
51 Where ASTM A53 type F pipe is specified, ASTM A53 grade A type E or S, or ASTM A53 grade B type
52 E or S may be substituted at Contractor's option. Where ASTM A53 grade A pipe is specified, ASTM A53
53 grade B pipe may be substituted at Contractor's option. Where the grade or type is not specified,
54 Contractor may choose from those commercially available.

55
56 Where ASTM B88, type L hard temper copper tubing is specified, ASTM B88, type K hard temper copper
57 tubing may be substituted at Contractor's option.

58
59 **WELDER QUALIFICATIONS**

60 Before any metallic welding is performed, the Contractor shall submit his Standard Welding Procedure
61 Specifications, Procedure Qualification Records and Qualification Test Records for each Welder along
62 with associated continuity records to demonstrate compliance with ASME Section IX, paragraph QW-322.

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The Contractor shall maintain a complete set of welder qualification documents at the jobsite, including Test Records and Continuity Records for each welder.

The A/E or owner reserves the right to test the work of any welder employed on the project, at the Contractor's expense. Testing will include a visual examination of the pipe and weld and may include radiography of any suspect welds. If the work of the welder is found to be unsatisfactory, the welder shall be prevented from doing further welding on the project. Any welds deemed unacceptable will be repaired at the contractor's expense.

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.

2-1/2" and Larger: ASTM A53, standard weight (schedule 40) black steel pipe with ASTM A234 grade WPB/ANSI B16.9 standard weight, seamless, carbon steel weld 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.

CHILLED 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.

2-1/2" and Larger: ASTM A53, standard weight (schedule 40) black steel pipe with ASTM A234 grade WPB/ANSI B16.9 standard weight, seamless, carbon steel weld 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.

COOLING COIL CONDENSATE

ASTM B88, type L hard temper copper tubing with ASTM B145/ANSI B16.23 cast red bronze or ASTM B75/ANSI B16.29 wrought solder-type drainage fittings.

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.

2-1/2" and Larger: ASTM A181 or A105, grade 1 hot forged steel flanges of threaded, welding and of a pressure class compatible with that specified for valves, piping specialties and fittings of the respective piping service. Flanges smaller than 2-1/2" may be used as needed for connecting to equipment and piping specialties. Use raised face flanges ANSI B16.5 for mating with other raised face flanges on equipment with flat ring or full face gaskets. Use ANSI B16.1 flat face flanges with full face gaskets for mating with other flat face flanges on equipment.

GASKETS

Water and Glycol Systems: Branded, compressed, non-asbestos sheet gaskets. Klingersil C4401, Garlock 3000, JM Clipper 978 or approved equal.

PART 3 - EXECUTION

ERECTION

1 Carefully inspect all pipe, fittings, valves, equipment and accessories before installation. Any items that
2 are unsuitable, cracked or otherwise defective shall be rejected and removed from the job site immediately.
3 Excluding minor surface rust, piping that exhibits significant oxidation or corrosion will be rejected.
4

5 Exercise care at every stage of storage, handling, laying and erecting to prevent entry of foreign matter into
6 piping, fittings, valves, equipment and accessories. Do not erect or install any item that is not clean.
7

8 Remove all loose dirt, scale, oil, chips, burrs and other foreign material from the internal and external
9 surfaces of all pipe and piping components prior to assembly, including debris associated with cutting,
10 threading and welding.
11

12 During fabrication and assembly, remove slag and weld spatter from internal pipe surfaces at all joints by
13 peening, chipping and wire brushing.
14

15 During construction, until system is fully operational, keep all openings in piping and equipment closed
16 except when actual work is being performed on that item of the system. Use plugs, caps, blind flanges or
17 other items designed for this purpose.
18

19 Furnish and install all flanges, caps, bypasses, drains, valves, etc. required to facilitate flushing and
20 draining all heating and cooling system piping.
21

22 Install all piping parallel to building walls and ceilings and at heights which do not obstruct any portion of
23 a window, doorway, stairway, or passageway. Where interferences develop in the field, offset or reroute
24 piping as required to clear such interferences. In all cases, consult drawings for exact location of pipe
25 spaces, ceiling heights, door and window openings, or other architectural details before installing piping.
26

27 Provide anchors, expansion joints, swing joints and/or expansion loops so that piping may expand and
28 contract without damage to itself, equipment, or building.
29

30 Mitered ells, notched tees, and orange peel reducers are not acceptable. On threaded piping, bushings are
31 not acceptable.
32

33 "Weldolets" and "Threadolets" may be used for branch takeoffs up to one-half (1/2) the diameter of the
34 main.
35

36 Install drains throughout the systems to permit complete drainage.
37

38 Do not route piping through transformer vaults or above transformers, panelboards, or switchboards,
39 including the required service space for this equipment, unless the piping is serving this equipment
40

41 Install all valves, control valves, and piping specialties, including items furnished by others, as specified
42 and/or detailed. Make connections to all equipment installed by others where that equipment requires the
43 piping services indicated in this section.
44

45 **WELDED PIPE JOINTS**

46 Make all welded joints by fusion welding in accordance with ASME Codes, ANSI B31, and State Codes
47 where applicable.
48

49 All pipe welding shall be completed by Qualified Welders in accordance with the Contractor's Procedure
50 Specifications.
51

52 Contractor will ensure that these steps are followed where pipe sections will be joined by welding:

- 53 1. Cleaning – Welding surfaces will be clean and free of defects.
- 54 2. Alignment – Inside diameter of piping components will be aligned as accurately as possible.
55 Internal misalignment shall not exceed 1/16".
- 56 3. Spacing – Pipe sections will be spaced to allow deposition of weld filler material through the
57 entire weld joint thickness.
- 58 4. Girth Butt Welds:

- 1 a. Girth butt welds shall be complete penetration welds.
- 2 b. Concavity will not exceed 1/32"
- 3 c. Under cuts will not exceed 1/32"
- 4 d. As welded surfaces are permitted however surfaces will be free from coarse ripples,
- 5 grooves, abrupt ridges and valleys.
- 6

7 Electrodes shall be Lincoln, or approved equal, with coating and diameter as recommended by the
8 manufacturer for the type and thickness of work being done.

9
10 **THREADED PIPE JOINTS**

11 Use a Teflon based thread lubricant or Teflon tape when making joints; no hard setting pipe thread cement
12 or caulking will be allowed.

13
14 **COPPER PIPE JOINTS**

15 Remove all slivers and burrs remaining from the cutting operation by reaming and filing both pipe
16 surfaces. Clean fitting and tube with emery cloth or sandpaper. Remove residue from the cleaning
17 operation, apply flux, and assemble joint. Use 95-5 solder or brazing to secure joint as specified for the
18 specific piping service.

19
20 Where mechanically formed tee fittings are allowed, form mechanically extracted collars in a continuous
21 operation, consisting of drilling a pilot hole and drawing out the tube surface to form a collar having a
22 height of not less than three times the thickness of the tube wall. Use an adjustable collaring device.
23 Notch and dimple the branch tube. Braze the joint, applying heat properly so that pipe and tee do not
24 distort; remove distorted connections.

25
26 **WATER SYSTEM**

27 Run water mains level or pitch horizontal mains up 1 inch in 40 feet in the direction of flow. Install
28 manual air vents at all high points where air may collect. If vent is not in an accessible location, extend air
29 vent piping to the nearest code acceptable drain location with vent valve located at the drain.

30
31 Main branches and runouts to terminal equipment may be made at the top, top 45 degree, side, and/or
32 bottom 45 degree of the main provided that there are drain valves suitably located for complete system
33 drainage and manual air vents are located at all top and top 45 degree connections. Bottom connections are
34 not acceptable unless approved by the owner's Mechanical Inspector.

35
36 Use top or top 45 degree connection to main for upfeed risers and bottom 45 degree connection to main for
37 downfeed risers. Bottom connections are not acceptable unless approved by the owner's Mechanical
38 Inspector.

39
40 Use a minimum of two elbows in each pipe line to a piece of terminal equipment to provide flexibility for
41 expansion and contraction of the piping systems. Offset pipe connections at equipment to allow for
42 service, such as removal of the terminal device.

43
44 Use eccentric fittings for changes in horizontal pipe sizes with the fittings installed for proper air venting.
45 Concentric fittings may be used for changes in vertical pipe sizes.

46
47 **COOLING COIL CONDENSATE**

48 Trap each cooling coil drain pan connection with a trap seal of sufficient depth to prevent conditioned air
49 from moving through the piping. Extend drain piping to nearest code approved drain location. Construct
50 trap with plugged tee for cleanout purposes as detailed.

51
52 **UNIONS AND FLANGES**

53 Install a union or flange, as required, at each automatic control valve and at each piping specialty or piece
54 of equipment which may require removal for maintenance, repair, or replacement. Where a valve is
55 located at a piece of equipment, locate the flange or union connection on the equipment side of the valve.
56 Concealed unions or flanges are not acceptable.

57
58 **GASKETS**

59 Store horizontally in cool, dry location and protect from sunlight, water and chemicals. Inspect flange
60 surfaces for warping, radial scoring or heavy tool marks. Inspect fasteners, nuts and washers for burrs or
61 cracks. Replace defective materials.

62

1 Align flanges parallel and perpendicular with bolt holes centered without using excessive force. Center
2 gasket in opening. Lubricate fastener threads, nuts and washers with lubricant formulated for application.
3

4 Draw flanges together evenly to avoid pinching gasket. Tighten fasteners in cross pattern sequence (12 – 6
5 o'clock, 3 – 9 o'clock, etc.), one pass by hand and four passes by torque wrench at 30% full torque, 60%
6 full torque and two passes at full torque per ASME B16.5.
7

8 **PIPING SYSTEM LEAK TESTS**

9 Verify that the piping system being tested is fully connected to all components and that all equipment is
10 properly installed, wired, and ready for operation. If required for the additional pressure load under test,
11 provide temporary restraints at expansion joints or isolate them during the test. Verify that hangers can
12 withstand any additional weight load that may be imposed by the test.
13

14 Provide all piping, fittings, blind flanges, and equipment to perform the testing.
15

16 Conduct pressure test with test medium of air or water unless specifically indicated. Minimum test time is
17 indicated in the table below; additional time may be necessary to conduct an examination for leakage.
18 Each test must be witnessed by the owner's representative. If leaks are found, repair the area with new
19 materials and repeat the test; caulking will not be acceptable.
20

21 Do not insulate pipe until it has been successfully tested.
22

23 For hydrostatic tests, use clean water and remove all air from the piping being tested by means of air vents
24 or loosening of flanges/unions. Measure and record test pressure at the high point in the system.
25

26 For air tests, gradually increase the pressure to not more than one half of the test pressure; then increase the
27 pressure in steps of approximately one-tenth of the test pressure until the required test pressure is reached.
28 Examine all joints and connections with a soap bubble solution or equivalent method. The piping system
29 exclusive of possible localized instances at pump or valve packing shall show no evidence of leaking.
30 After testing is complete, slowly release the pressure in a safe manner.
31

<u>System</u>	<u>Pressure</u>	<u>Medium</u>	<u>Duration</u>
Heating hot water	100 psig	Water	8 hr
Chilled water	100 psig	Water	8 hr

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33
34
35
36 All pressure tests are to be documented on a Division of State Facilities form included in this specification.
37

38 On piping that can not be tested because of connection to an active line, provide temporary blind flanges
39 and hydrostatically test new section of piping. After completion of test, remove temporary flanges and
40 make final connections to piping. Die penetrate test pass weld or x-ray the piping that was not
41 hydrostatically tested up to the active system.
42

43 **HYDRONIC PIPING SYSTEM FLUSHING**

44 All new chilled water and heating hot water system piping shall be flushed thoroughly before the systems
45 are put in to operation. Prior to adding scale and corrosion inhibitors, flush all piping and components with
46 a clean source of water until the discharge from the system is clean. Discharge shall be from drains
47 provided at all low points in the piping, ends of headers and as otherwise necessary to flush and drain the
48 entire system.
49

50 Project specific procedures shall be established prior to flushing. Before beginning flushing operations,
51 submit proposed flushing procedures to the A/E and owner for review and approval. Provide sufficient
52 notice to the A/E and/or owner to allow the flushing operations to be observed.
53

54 A clean water source shall be tapped into the system downstream of the main circulation pump(s). Provide
55 minimum 2" connection between water source and hot water/chilled water systems including taps with ball
56 valves (or line size tap and ball valve for piping systems smaller than 2"). Provide minimum 2" taps (or
57 line size if mains are smaller than 2") at the ends of headers, the low pint of each of the mains on each floor
58 and as otherwise necessary to flush and drain the entire system. Provide minimum 2" bypass with shut off
59 valve (or line size if mains are smaller than 2") between the supply and return mains on each floor as where

1 directed by the A/E and owner or where shown on the drawings. Contractor shall identify proposed clean
2 water source along with the method/location of drain discharge and review with the A/E and owner prior to
3 installing flushing connections to water source and drain outlets. Provide code required temporary
4 backflow prevention for the clean water source if needed. Provide all temporary taps, valves, piping,
5 bypasses and hoses as needed to accomplish flushing procedures. The owner's district chilled water
6 system shall NOT be used as a source of water for flushing any piping.
7

8 Flush piping systems using the following procedure:
9

10 Flushing sequence for hot water and chilled water systems is as follows:

- 11 1. Close isolation valves at all coils and wall fin.
- 12 2. Open the temporary bypasses that connect the ends of supply and return mains.
- 13 3. Flush mains by turning on flushing water source and sequentially opening drains on mains on
14 each floor until the discharge is clean. This will flush the mains without forcing water/debris into
15 the branches and run out pipes.
- 16 4. Close isolation valves located downstream of coils/wall fin.
- 17 5. Open isolation valves located upstream of coils/wall fin.
- 18 6. Open individual drain valves upstream of coils/wall fin until the discharge is clean. This will
19 flush the supply branch and run out lines between the mains and the coils/wall fin without running
20 water/debris through the TCV or coils/wall fin.
- 21 7. Close the individual drain valves upstream of coils/wall fin.
- 22 8. Open drain valves at low points in the return piping mains.
- 23 9. Open the individual isolation valves located downstream of the coils/wall fin. This will flush the
24 return branch and run out lines located between the coils/wall fin and the mains back into the
25 mains and out the drains on the return mains. The water going through the coil/wall fin should be
26 already be clean since this section was flushed previously.
- 27 10. Repeat steps 1-3 to clean debris from the mains.
28

29 Isolate all coils while flushing risers and mains. Flush the mains on each floor individually, starting at the
30 top of the building and working down towards the basement level. After risers and mains have been
31 flushed clean, individually open the drain valves in each branch circuit to discharge any debris that may
32 have accumulated in the branch piping.
33

34 As directed by the owner, the Contractor will be required to open drain valves at selected locations in the
35 system to verify the effectiveness of flushing procedures. If sediment or debris is identified in the system,
36 it will be flushed again and reinspected at no expense to the State.
37

38 After flushing operations are complete, drain and/or blow out any residual water, clean and replace all
39 strainers, and add scale and corrosion inhibitors as specified in Section 23 25 00. Leave flushing
40 connections/valves in place and cap.

41 All flushing procedures shall be documented by completing and submitting the report form included at the
42 end of this Section.
43

44 INITIAL FILL AND VENT

45 Fill hydronic systems with appropriate working fluids as specified. All system fluids shall be chemically
46 treated as specified in Section 23 25 00 – HVAC WATER TREATMENT.
47

48 For closed piping systems, all air trapped at high points shall be relieved through the manual air vents prior
49 to notifying OWNER that the systems are ready to be tested and balanced.
50

1 **CONSTRUCTION VERIFICATION ITEMS**
2 Contractor is responsible for utilizing the construction verification checklists supplied under specification
3 Section 01 91 01 or 01 91 02 in accordance with the procedures defined for construction verification
4 checklists.

5
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7

END OF SECTION

PIPING SYSTEM LEAKAGE TEST REPORT

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: _____

PIPING SYSTEM FLUSHING REPORT

Submitted: _____

Project Name: _____

Location: _____ Project No: _____

Contractor: _____

System Identification (check one):

- Chilled Water Process Chilled Water Heat Reclaim
 Heating Hot Water Other _____

Describe procedure: _____

Flush Date: _____ Start Time: _____ Stop Time: _____

Pressure of Water Source: _____ PSIG Describe water source and method of connection to source :

Flushed By: _____ Witnessed By: _____

Title: _____ Title: _____

Company: _____ Agency: _____

Signed: _____ Signed: _____

Date: _____ Date: _____

Describe results: _____

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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 Centrifugal Pumps
- Glycol Fill Pump

PART 3 - EXECUTION

- Installation
- Glycol Fill Pump
- Construction Verification Items
- Functional Performance Testing
- Owner Training

RELATED WORK

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.

1 Where a pump is specified for parallel operation, the scheduled conditions are for that pump with both
2 pumps operating; i.e., total system flow rate is twice that scheduled for a single pump. When only one of
3 the parallel pumps is operating, the operating point of that pump must fall within the manufacturer's
4 recommended operating range.

5
6 Provide pump with a motor sized for non-overloading over the entire pump curve. Motors to be 1750 rpm
7 unless specified otherwise.

8
9 Furnish each pump and motor with a nameplate giving the manufacturer's name, serial number of pump,
10 capacity in GPM and head in feet at design condition, horsepower, voltage, frequency, speed and full load
11 current.

12
13 Test all pumps, clean and paint before shipment. The manufacturer shall certify all pump ratings.

14
15 All pumps to operate without excessive noise or vibration.

16
17 After completion of balancing, provide replacement of impellers, or trim impellers to provide specified
18 flow at actual pumping head, as installed.

19
20 Furnish one spare seal and casing gasket for each pump to owner.

21 22 **PART 2 - PRODUCTS**

23 **IN-LINE CENTRIFUGAL PUMPS**

24 **MANUFACTURERS:**

25 Bell and Gossett, Armstrong, Thrush, Taco, Grundfos, Aurora, or approved equal.

26 **TYPE:**

27 Single stage, direct connected, resiliently mounted motor for in-line mounting, oil lubricated, 175 psig
28 maximum working pressure at operating temperature of 225 ° F. continuous, 250 ° F. intermittent.

29 **CASING:**

30 Cast iron or stainless steel; flanged suction and discharge connection; with plugged taps for vent, drain,
31 suction and discharge gauges.

32 **IMPELLER:**

33 Brass or bronze, keyed to the shaft, single suction enclosed type, hydraulically and dynamically balanced.

34 **BEARINGS:**

35 Two, oil lubricated bronze sleeves or ball bearings capable of being greased.

36 **SHAFT:**

37 Stainless steel or carbon steel with stainless steel or bronze sleeve, integral thrust collar.

38 **SEAL:**

39 Mechanical type, carbon rotating against a stationary ceramic seat, 225°F maximum continuous operating
40 temperature.

41 **DRIVE:**

42 close coupled.

43 **GLYCOL FILL PUMP**

44 Provide one portable mixing tank and electric fill pump assembly. The mixing tank shall be constructed of
45 corrosion resistant material, with 25 gallon capacity. Pump shall have a capacity of 3 to 5 gpm at 20 psig
46 fill pressure. Provide threaded hose adapter for pump discharge, and electrical cord for standard 120 volt
47 outlet.

48 49 **PART 3 - EXECUTION**

1 **INSTALLATION**
2 Install all pumps in strict accordance with manufacturer's instructions. Access/service space around pumps
3 shall not be less than minimum space recommended by pump manufacturer.
4
5 Support piping adjacent to pump such that no weight is carried on pump casings.
6
7 Decrease from line size at pump connections with suction diffusers where specified, long radius reducing
8 elbows or concentric reducers/increasers in the vertical piping, and eccentric reducers/increasers for
9 horizontal piping. Install eccentric reducers/increasers with the top of the pipe level
10
11 All valves and piping specialties must be full line size as indicated on the drawings
12
13 Lubricate pumps before startup.
14
15 Install a full line size spring loaded check valve and balancing valve in the pump discharge piping. At
16 contractor's option, combination shut-off, check, balancing valve may be substituted instead of separate
17 valves. Reference section 23 05 23.
18
19 **INLINE PUMPS**
20 Align all flexible coupled base-mounted pumps in accordance with the manufacturer's instructions.
21
22 provide supports for elbows on pump suction and discharge piping 4" and over.
23
24 Provide air vent and drain valve on horizontal pump casings.
25
26 Provide drains for bases and seals, piped to and discharging into floor drains.
27
28 **GLYCOL FILL PUMP**
29 After initial system fill, turn pump over to owner
30
31 **CONSTRUCTION VERIFICATION ITEMS**
32 Contractor is responsible for utilizing the construction verification checklists supplied under specification
33 Section 01 91 01 or 01 91 02 in accordance with the procedures defined for construction verification
34 checklists.
35
36 **FUNCTIONAL PERFORMANCE TESTING**
37 Contractor is responsible for utilizing the functional performance test procedures supplied under
38 specification Section 01 91 01 or 01 91 02 in accordance with the procedures defined for functional
39 performance test procedures.
40
41 **OWNER TRAINING**
42 All training provided for owner shall comply with the format, general content requirements and submission
43 guidelines specified under Section 01 91 01 or 01 91 02.
44
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46

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, steam, and condensate 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
- Algaecides
- Glycol
- Closed Water System Treatment
- Treatment Equipment

PART 3 - EXECUTION

- Preparation
- Cleaning Sequence
- Glycol Water Systems
- Closed Water Systems

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

1 Recommend a periodic test procedure and chemical treatment program for each system.

2
3 Treat the following systems:

- 4 • Chilled water
- 5 • Hot water
- 6 • Glycol water
- 7 • Condenser water

8
9
10 Provide the initial chemical treatment for all systems based on a complete system fluid analysis prior to the
11 equipment installation. The initial chemical treatment supply of chemicals for each system shall be
12 adequate for the start-up and testing period, for the time the systems are being operated by the Contractor
13 for temporary heating and cooling, and for one year after start-up of the system.

14
15 The chemicals used in the condenser water treatment system shall use only liquid chemicals and shall
16 contain no phosphates or chromates.

17
18 Provide electrical devices, motors, wiring and conduit in accordance with the applicable sections of the
19 Electrical Specifications.

20 **MAINTENANCE SERVICE**

21 Furnish service and maintenance of treatment systems for one year from date of substantial completion.

22
23 Provide laboratory and technical assistance services for the warranty period.

24
25 Include two hours training course for operating personnel, instructing them on installation, care,
26 maintenance, testing, and operation of the treatment systems. Arrange course at startup of systems.

27
28 Provide site inspection of equipment during scheduled shutdown to evaluate success of the treatment
29 program. Make recommendations in writing based on these inspections.

30 31 32 **PART 2 - PRODUCTS**

33 **MANUFACTURERS**

34 Betz Entac, Dearborn Div. - W. R. Grace & Co., Fremont Industries, Mitco Water Labs, Mogul
35 Corporation, Nalco Chemical Co., Western Water Management, or approved equal.

36 **SYSTEM CLEANER**

37 Blend of organic alkaline penetrants, emulsifiers, surfactants and corrosion inhibitors that remove grease
38 and petroleum products from the interior of piping systems. Cleaners that contain trisodium phosphate are
39 specifically not acceptable.

40 **SYSTEM INHIBITOR**

41 Scale and corrosion inhibitor consisting of boron nitrite, benzol thiazol, benzotriazole, mercapto-benzo-
42 thiazole, and tolyltrizole silicates.

43 **ALGAECIDES**

44 Chlorine release agents such as sodium hypochlorite or calcium hypochlorite, or microbiocides such as
45 quaternary ammonia compounds, tributyl tin oxide, methylene bis (thiocyanate), or isothiazolones, all in a
46 liquid format.

47 **GLYCOL PROPYLENE**

48 Glycol based material specifically designed for use in closed heat transfer systems.

49 **CLOSED WATER SYSTEM TREATMENT**

50 Sequestering agent to reduce deposits and adjust pH: polyphosphate.

51 Corrosion inhibitors: boron-nitrite, sodium nitrite and borax, sodium tolyltriazole, low molecular weight
52 polymers, phosphonates, sodium molybdate, or sulphites.

1 Conductivity enhancers: phosphates or phosphonates.
2
3 **TREATMENT EQUIPMENT**
4 **SOLUTION METERING PUMP:**
5 Positive displacement, diaphragm pump with adjustable flow rate, thermoplastic construction, continuous-
6 duty fully enclosed electric motor and drive, and relief valve.
7
8 **SOLUTION TANKS:**
9 50 gallon capacity, polyethylene, self-supporting, 5 gallon graduated markings; molded fiberglass cover
10 with recess for mounting pump, agitator, and liquid level switch.
11
12 **AGITATOR:**
13 Totally enclosed electric motor; stainless steel clamp, motor mount, and propeller.
14
15 **LIQUID LEVEL SWITCH:**
16 Polypropylene housing with integrally mounted polyvinylchloride air trap, receptacles for connection to
17 metering pump, and low level alarm contact.
18
19 **WATER METER:**
20 Displacement type cold water meter with sealed, tamper-proof magnetic drive, bronze housing, 125 psig
21 minimum working pressure, impulse contact register when required by the sequence, single pole double
22 throw dry contact switch. Meters must be capable of being used with remote readout heads and capable of
23 being sealed to prevent tampering.
24
25 **SOLENOID VALVES:**
26 Forged brass body, globe pattern, normally open or closed as required, general purpose solenoid enclosure
27 unless another type is recommended for the specific application, and continuous duty coil with voltage
28 compatible with the remainder of the system components. Use stainless steel body and trim in lieu of brass
29 if brass is not compatible with valves installed in the lines handling the chemical treatment.
30
31 **TIMERS:**
32 Electronic timers, infinitely adjustable over full range of 150 seconds to five minutes, mounted together in
33 cabinet with hand-off-automatic switches and status lights.
34
35

36 **PART 3 - EXECUTION**

37
38 **PREPARATION**
39 Prior to cleaning, verify that systems are operational, filled, started, and vented. Use water meter to record
40 capacity in each system.
41
42 Place terminal control valves in the full-open position
43
44 **CLEANING SEQUENCE**
45 **GENERAL:**
46 Systems are to be cleaned before they are used for any purpose except conduct pressure test before
47 cleaning. Add cleaner to closed systems at concentrations as recommended by the manufacturer. Remove
48 water filter elements from the system before starting circulation.
49
50 Use neutralizer agents on recommendation of the system cleaner supplier and approval of the
51 Architect/Engineer.
52
53 Flush open systems with clean water for one hour minimum. Drain completely and refill.
54
55 Remove, clean, and replace strainer screens.
56
57 Inspect, remove sludge, and flush low points with clean water after cleaning process is completed. Include
58 disassembly of components as required.
59
60 Use attached form to document system cleaning, flushing, and proper startup.
61

1 **CHILLED WATER SYSTEMS:**

2 Add cleaner to the system water until the M alkalinity value is 250 above that of the initial fill water.
3 Verify the M alkalinity level before and after the addition of the cleaner by means of chemical tests that are
4 observed by the Owner's construction representative; include results of all tests in the Operating and
5 Maintenance manuals. Circulate for 48 hours, then drain system as quickly as possible. Refill with clean
6 water, circulate for 24 hours, then drain. Refill with clean water and repeat until system cleaner is removed
7 and the M alkalinity level returns to normal. Remove and clean all strainers. Re-vent the system and
8 install clean filter elements in water filters. Treat with scale and corrosion inhibitors before using the
9 system for building heating or cooling.

10
11 **GLYCOL WATER SYSTEMS:**

12 Clean and flush as indicated above for hot water heating systems. Verify complete drainage by measuring
13 amount of water used for the initial fill versus the amount actually drained to assure complete removal of
14 the cleaning solution. Remove all traces of chloride from the system; test to verify this removal and submit
15 test results.

16
17 **GLYCOL WATER SYSTEMS**

18 The heat recovery chiller condenser water system is a glycol water system.

19
20 Propylene glycol shall be used as a safety measure since fluid is utilized in a heat exchanger on a
21 domestic water system.

22
23 Completely flush all traces of cleaning chemicals before adding the glycol water mixture to the system.
24 Verify this by chemical test.

25
26 Premix the glycol water solution to a concentration of 30% by volume. Use water type recommended
27 by the glycol manufacturer to make the solution. Fill system from the mixing tank. Circulate fluid for
28 several hours, vent all high points where air may collect, add more solution to the system if needed,
29 and test the system for proper concentration of glycol; include copy of test report in the Operating and
30 Maintenance manuals.

31
32 **CLOSED WATER SYSTEMS**

33 Install a separate bypass type feeder at the pumps for each closed hot water heating and chilled water
34 cooling system. Provide a separate set of supply and return lines from each pump in the system and install
35 ball valves in each of these lines. Locate the system connection that supplies the feeder upstream of the
36 discharge shutoff valve for the pump. Locate the system connection that returns treatment back to the
37 system at a convenient point downstream of the pump discharge shutoff valve. Provide a drain valve at the
38 bottom of the feeder.

39
40 Install a water meter upstream of the pressure reducing valve in the makeup line to each closed system.
41 Locate the meter on the domestic water side of the pressure reducing valve and in such a manner that the
42 meter can be easily read.

PIPE CLEANING AND TREATMENT REPORT

Project Number: _____
Date Submitted: _____

Project Name: _____
Location: _____
Contractor: _____

System Tested: Hot Water ___ Glycol Water ___ Chilled Water ___ Fuel Oil ___
Condensor Water ___ Steam ___ Condensate ___

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: _____

Traps: _____

Branch

Lines: _____

TerminalUnits: _____

Boilers: _____

Chillers: _____

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
- High Pressure Ductwork (Pressure class 3 inch and over)
- Low Pressure Ductwork (Maximum 2 inch pressure class)
- Duct Sealant
- Gaskets

PART 3 - EXECUTION

- Installation
- High Pressure Ductwork (Pressure class 3 inch and over)
- Low Pressure Duct (Maximum 2 inch pressure class)
- Cleaning
- Leakage Test
- Construction Verification Items

APPENDIX

- Duct Leakage Test Report

RELATED WORK

- 23 33 00 – Air Duct Accessories
- 23 01 30.51 – HVAC Air Duct Cleaning
- 23 05 93 - Testing, Adjusting, and Balancing for HVAC

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

1	ASTM E 84	Test Method for Surface Burning Characteristics of Building Materials
2	ASTM C 1338	Test Method for Determining Fungal Resistance of Insulation Materials
3		and Facings
4	ASTM G 21	Standard Practice for Determining Resistance of Synthetic Polymeric Materials
5	to	
6		Fungi
7	ASTM C 916	Standard Specification for Adhesives for Duct Thermal Insulation
8		NFPA 90A
9	UL 181	Standard for the Installation of Air Conditioning and Ventilating Systems
10	NAIMA	Standard for Safety for Factory Made Air Ducts and Air Connectors.
11		Fibrous Glass Duct Liner Standard

12 **QUALITY ASSURANCE**

13 Refer to division 1, General Conditions, Equals and Substitutions.

14 **SHOP DRAWINGS**

15 Refer to division 1, General Conditions, Submittals.

16 Include manufacturer's data and/or Contractor data for the following:

- 17 • Fabrication and installation drawings.
- 18 • Schedule of duct systems including material of construction, gauge, pressure class,
- 19 • system class, method of reinforcement, joint construction, fitting construction, and
- 20 • support methods, all with details as appropriate.
- 21 • Duct sealant and gasket material.
- 22 • Duct liner including data on thermal conductivity, air friction correction factor, and
- 23 • limitation on temperature and velocity.

24 **DESIGN CRITERIA**

25 Construct all ductwork to be free from vibration, chatter, objectionable pulsations and leakage under

26 specified operating conditions.

27 Use material, weight, thickness, gauge, construction and installation methods as outlined in the following

- 28 • HVAC Duct Construction Standards, Metal and Flexible, 2nd Edition, 1995
- 29 • HVAC Air Duct Leakage Test Manual, 1st Edition, 1985
- 30 • HVAC Systems - Duct Design, 3rd Edition, 1990
- 31 • Rectangular Industrial Duct Construction Standard, 1st Edition, 1980
- 32 • Round Industrial Duct Construction Standards, 2nd Edition, 1999
- 33 • Thermoplastic Duct (PVC) Construction Manual, 2nd Edition, 1995
- 34 • Round Industrial Duct Construction Standards, 2nd Edition, 1999
- 35 • Rectangular Industrial Duct Construction Standards, 1st Edition, 1980

36 Use products which conform to NFPA 90A, possessing a flame spread rating of not over 25 and a smoke

37 developed rating no higher than 50.

38 **DELIVERY, STORAGE AND HANDLING**

39 Promptly inspect shipments to ensure that Ductwork is undamaged and complies with the specification.

40 Protect Ductwork against damage.

41 Protect Ductwork by storing inside or by durable, waterproof, above ground packaging. Do not store

42 material on grade. Protect Ductwork from dirt, dust, construction debris and foreign material. Where end

43 caps/packaging are provided, take precautions so caps/packaging remain in place and free from damage.

44 Offsite storage agreements do not relieve the contractor from using proper storage techniques.

45 Storage and protection methods must allow inspection to verify products.

1
2
3 **PART 2 - PRODUCTS**
4

5 **GENERAL**

6 All sheet metal used for construction of duct shall be 24 gauge or heavier except for round and spiral
7 ductwork and spiral duct take-offs 12" and below may be 26 gauge where allowed in SMACNA HVAC
8 Duct Construction Standards, Metal and Flexible, 2nd Edition, 1995.
9

10 Duct sizes indicated on plans are net inside dimensions; where duct liner is specified, dimensions are net,
11 inside of liner.
12

13 **DUCTWORK PRESSURE CLASS**

14 Minimum acceptable duct pressure class, for all ductwork except transfer ductwork, is 2 inch W.G.
15 positive or negative, depending on the application. Transfer ductwork minimum acceptable duct pressure
16 class is 1 inch W.G. positive or negative, depending on the application. Duct system pressure classes not
17 indicated on the drawings to be as follows:
18

19	Supply duct upstream of VAV boxes	_____ 4 in W.G.	_____ High Pressure
20	Supply duct downstream of VAV terminals	_____ 2 in W.G.	_____ Low Pressure
21	Exhaust ducts	_____ 2 in W.G.	_____ Low Pressure
22	Return ducts	_____ 2 in W.G.	_____ Low Pressure

23

24 **MATERIALS**

25 **GALVANIZED STEEL SHEET:**

26 Use ASTM A 653 galvanized steel sheet of lock forming quality. Galvanized coating to be 1.25 ounces
27 per square foot, both sides of sheet, G90 in accordance with ASTM A90. Provide "Paint Grip" finish for
28 ductwork that will be painted.
29

30 **ALUMINUM SHEET:**

31 Use ANSI/ASTM B209 aluminum sheet, alloy 3003H-14, capable of double seaming without fracture.
32

33 **STAINLESS STEEL SHEET:**

34 Use ASTM A167, Type 304 or 316 stainless steel sheet as specified, 316L if welded ductwork, with No.
35 2B finish for concealed work and No. 3 finish for exposed work.
36

37 Where any duct surface is scratched, marred, or otherwise damaged, paint with PVC aerosol spray.
38

39 All couplings shall be slip-joint construction with a minimum 2 inches insertion length. Seal all couplings
40 with sealants as specified.
41

42 **HIGH PRESSURE DUCTWORK (Pressure class 3 inch and over)**

43 Manufacturers: Ajax, Semco, United Sheet Metal, Sheet Metal Connectors or approved equal.
44

45 Machine formed round and/or flat oval spiral lock seam duct constructed of galvanized steel.
46

47 Rectangular high pressure duct using a transverse joint system as manufactured by Ductmate, Nexus,
48 TDC, TDF, or approved equal, may be used at contractor's option. Duct to be flanged, gasketed and
49 sealed.
50

51 Contractor fabricated ductwork meeting specified construction standards is acceptable with prior approval
52 of Architect/Engineer. Submit construction details, a description of materials to be used, type of service,
53 reinforcing methods, and sealing procedures.
54

55 Use cemented slip joints with 2 inch minimum overlap, flanged connections, or welded/brazed
56 connections, unless noted otherwise for special applications. Prime coat welded joints.
57

58 Provide standard 90 degree conical tee takeoffs except for exhaust at velocities over 2000 feet per minute,
59 use 45° lateral connections; straight taps or bullhead tees are not acceptable.
60

1 Internal bracing will not be accepted on ductwork below 48 inches.

2
3 Use turning vanes as specified in Section 23 33 12.

4
5 Provide bellmouth fittings or expanded fittings at each duct connection to air plenums.

6
7 Provide pressure relief fittings as indicated on the plans and/or details.

8
9 Transform duct sizes gradually, not exceeding 15 degrees divergence and 30 degrees convergence.

10
11 **LOW PRESSURE DUCTWORK (Maximum 2 inch pressure class)**

12 Fabricate and install ductwork in sizes indicated on the drawings and in accordance with SMACNA
13 recommendations, except as modified below.

14
15 Construct so that all interior surfaces are smooth. Use slip and drive or flanged and bolted construction
16 when fabricating rectangular ductwork. Use spiral lock seam construction when fabricating round spiral
17 ductwork. Sheet metal screws may be used on duct hangers, transverse joints and other SMACNA
18 approved locations if the screw does not extend more than 1/2 inch into the duct.

19
20 Use elbows and tees with a center line radius to width or diameter ratio of 1.5 wherever space permits.
21 When a shorter radius must be used due to limited space, install single wall sheet metal splitter vanes in
22 accordance with SMACNA publications, Type RE 3. Where space will not allow and the C value of the
23 radius elbow, as given in SMACNA publications, exceeds 0.31, use rectangular elbows with turning vanes
24 as specified in Section 23 33 00. Square throat-radius heel elbows will not be acceptable. Straight taps or
25 bullhead tees are not acceptable.

26
27 Where rectangular elbows are used, provide turning vanes in accordance with Section 23 33 00.

28
29 Provide expanded take-offs or 45 degree entry fittings for branch duct connections with branch ductwork
30 airflow velocities greater than 700 fpm. Square edge 90-degree take-off fittings or straight taps will not be
31 accepted.

32
33 Button punch snaplock construction will not be accepted on aluminum ductwork.

34
35 Round ducts may be substituted for rectangular ducts with radius elbows if sized in accordance with
36 ASHRAE table of equivalent rectangular and round ducts. No variation of duct configuration or sizes
37 permitted except by written permission of the Architect/Engineer.

38
39 Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible. Divergence
40 upstream of equipment shall not exceed 30 degrees; convergence downstream shall not exceed 45 degrees.

41
42 **DUCT SEALANT**

43 Manufacturer: 3M 800, 3M 900, H.B. Fuller/Foster, Hardcast, Hardcast Peal & Seal, Lockformer cold
44 sealant, Mon-Eco Industries, United Sheet Metal, or approved equal. Silicone sealants are not allowed in
45 any type of ductwork installation.

46
47 Install sealants in strict accordance with manufacturer's recommendations, paying special attention to
48 temperature limitations. Allow sealant to fully cure before pressure testing of ductwork, or before startup
49 of air handling systems.

50
51 **GASKETS**

52 **2 INCH PRESSURE CLASS AND LOWER:**

53 Soft neoprene or butyl gaskets in combination with duct sealant for flanged joints.

54
55 **3 INCH PRESSURE CLASS AND HIGHER:**

56 Butyl gaskets.

57
58 **FUME HOOD EXHAUST;**

59 Butyl gaskets.

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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 2-7, 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 2-8, 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 4-4, 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 fastener rated for 50% of actual load, will be allowed on round ductwork under 12 inches if installed as detailed, with cable double looped on duct and at point of support.

HIGH PRESSURE DUCT (Pressure class 3 inch and over)

1 Seal all duct in accordance with SMACNA seal class "A"; all seams, joints, and penetrations shall be
2 sealed.

3
4 Single wall high pressure ductwork shall be installed.

5
6 **LOW PRESSURE DUCT (Maximum 2 inch pressure class)**

7 Seal all duct, with the exception of transfer ducts, in accordance with SMACNA seal class "A"; all seams,
8 joints, and penetrations shall be sealed.

9
10 Install a manual balancing damper in each branch duct and for each diffuser or grille. The use of splitter
11 dampers, extractors, or grille face dampers will not be accepted for balancing dampers.

12
13 Hangers must be wrapped around bottom edge of duct and securely fastened to duct with sheetmetal
14 screws or pop rivets. Trapeze hangers may be used at contractor's option.

15
16 **CLEANING**

17 Remove all dirt and foreign matter from the entire duct system and clean diffusers, registers, grilles and the
18 inside of air-handling units before operating fans.

19
20 Clean duct systems with high power vacuum machines where systems have been used for temporary heat,
21 air-conditioning, or ventilation purposes during construction. Protect equipment that may be harmed by
22 excessive dirt with filters, or bypass during cleaning.

23
24 **LEAKAGE TEST**

25 Test all ductwork in accordance with test methods described in Section 5 of SMACNA HVAC Air Duct
26 Leakage Test Manual. Do not insulate ductwork until it has been successfully tested. Test pressure shall
27 be equal to the duct pressure class.

28
29 If excessive air leakage is found locate leaks, repair the duct in the area of the leak, seal the duct, and
30 retest.

31
32 Leakage rate shall not exceed more than 5% of the system air quantity for low pressure ductwork,
33 determined in accordance with Appendix C of the SMACNA HVAC Air Duct Leakage Test Manual.

34
35 Leakage rate shall not exceed more than 1% of the system air quantity for high pressure ductwork,
36 determined in accordance with Appendix C of the SMACNA HVAC Air Duct Leakage Test Manual.

37
38 Leakage test for ductwork downstream of air terminal devices may be omitted but will not relieve the
39 contractor from duct sealing requirements.

40
41 Submit a signed report to the Division's Construction Representative, indicating test apparatus used, results
42 of the leakage test, and any remedial work required to bring duct systems into compliance with specified
43 leakage rates.

44
45 **CONSTRUCTION VERIFICATION ITEMS**

46 Contractor is responsible for utilizing the construction verification checklists supplied under specification
47 Section 01 91 01 or 01 91 02 in accordance with the procedures defined for construction verification
48 checklists.

49
50
51
END OF SECTION

DUCT LEAKAGE TEST REPORT

Project Number: _____
Date Submitted: _____

Project	Name: _____		
	Location: _____		
	Contractor: _____		
System	Fan No: _____	Leakage Class (C _L): _____	
Data	Fan Design CFM: _____	Duct Pressure Class (P _C): _____	
		Test Pressure (P _T): _____	
Test			
Equipm ent	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													
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SECTION 23 33 00
AIR DUCT ACCESSORIES

PART 1 - GENERAL

SCOPE

This section 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
- Control Dampers
- Smoke Detectors
- Access Doors
- Flexible Duct
- Flashings
- Duct Flexible Connections
- Hoods for Intake and Exhaust
- Louvers
- Air Flow Stations

PART 3 - EXECUTION

- Manual Volume Dampers
- Turning Vanes
- Control Dampers
- Smoke Detectors
- Access Doors
- Flexible Duct
- Flashings
- Duct Flexible Connections
- Hoods for Intake and Exhaust
- Louvers
- Air Flow Stations

RELATED WORK

- 23 05 29 – Hanger and Supports for HVAC Piping and Equipment
- 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 (6th edition) Standard for Fire Dampers and Ceiling Dampers
- UL 555S (4th 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.

1
2 Submit for all accessories and include dimensions, capacities, ratings, installation instructions, and
3 appropriate identification.

4
5 Include certified test data on dynamic insertion loss, self-noise power levels, and aerodynamic performance
6 of sound attenuators.

7
8 Submit manufacturer's color charts where finish color is specified to be selected by the Architect/Engineer.
9

10 **OPERATION AND MAINTENANCE DATA**

11 All operations and maintenance data shall comply with the submission and content requirements specified
12 under section GENERAL REQUIREMENTS.
13

14 **PART 2 - PRODUCTS**

15 **MANUAL VOLUME DAMPERS**

16
17 Manufacturers: Ruskin, Vent Products, Air Balance, or approved equal.
18

19
20 Dampers must be constructed in accordance with SMACNA Fig. 2-12, Fig. 2-13, and notes relating to
21 these figures, except as modified below.
22

23 Reinforce all blades to prevent vibration, flutter, or other noise. Construct dampers in multiple sections
24 with mullions where width is over 48 inches. Use rivets or tack welds to secure individual components;
25 sheet metal screws will not be accepted. Provide operators with locking devices and damper position
26 indicators for each damper; use an elevated platform on insulated ducts. Provide end bearings or bushings
27 for all volume damper rods penetrating ductwork constructed to a 3" w.c. pressure class or above.
28

29 **TURNING VANES**

30 Manufacturers: Aero Dyne, Anemostat, Barber-Colman, Hart & Cooley, or approved equal.
31

32 Construct turning vanes and runners for square elbows in accordance with SMACNA Fig. 2-3 and Fig. 2-4
33 except use only airfoil type vanes. Construct turning vanes for short radius elbows and elbows where one
34 dimension changes in the turn in accordance with SMACNA Fig. 2-5 and Fig. 2-6.
35

36 **CONTROL DAMPERS**

37 Control dampers are specified in section 23 09 14.
38

39 **SMOKE DETECTORS**

40 Smoke detectors are furnished and installed by the Electrical Contractor.
41

42 **ACCESS DOORS**

43 Access door to be designed and constructed for the pressure class of the duct in which the door is to be
44 installed. Doors in exposed areas shall be hinged type with cam sash lock. Hinges shall be steel full length
45 continuous piano type. Doors in concealed spaces may be secured in place with cam sash latches. For
46 both hinged and non hinged doors provide sufficient number of camp sash latches to provide air tight seal
47 when door is closed. Do not use hinged doors in concealed spaces if this will restrict access. Use minimum
48 1" deep 24 gauge galvanized steel double wall access doors with minimum 24 gauge galvanized steel
49 frames. For non-galvanized ductwork, use minimum 1" deep double wall access door with frame that shall
50 use materials of construction identical to adjacent ductwork. Provide double neoprene gasket that shall
51 provide seals from the frame to the door and frame to the duct. When access doors are installed in
52 insulated ductwork or equipment provide insulated doors with insulation equivalent to what is provided for
53 adjacent ductwork or equipment. Access doors constructed with sheet metal screw fasteners will not be
54 accepted.
55

56 Use insulated, 1-1/2 hour UL 1978 listed and labeled access doors in kitchen exhaust ducts.
57

58 **FLEXIBLE DUCT**

59 Manufacturers: Anco Products, Clevaflex, Thermaflex, Flexmaster or approved equal.
60

1 Factory fabricated , UL 181 listed as a class 1 duct, and having a flame spread of 25 or less and a smoke
2 developed rating of 50 or under in accordance with NFPA 90A.

3
4 Suitable for pressures and temperatures involved but not less than a 180°F service temperature and ±2 inch
5 pressure class, depending on the application.

6
7 Duct to be composed of polyester film, aluminum laminate or woven and coated fiberglass fabric bonded
8 permanently to corrosion resistant coated steel wire helix. Two-ply, laminated, and corrugated aluminum
9 construction may also be used.

10
11 Where duct is specified to be insulated, provide a minimum 1 inch fiberglass insulation blanket with
12 maximum thermal conductance of 0.23 K (75 degrees F.) and vapor barrier jacket of polyethylene or
13 metalized reinforced film laminate. Maximum perm rating of vapor barrier jacket to be 0.1 perm.

14 **FLASHINGS**

15 Provide flashing to completely weatherproof connection of ductwork to louvers. Flashing to be
16 constructed of material similar to louver material.

17
18 Flashing and counterflashing for roof curbs will be provided by others.

19
20
21 Flashing and curbs for duct and pipe penetrations of roof assemblies to be in accordance with details.

22 **DUCT FLEXIBLE CONNECTIONS**

23 Material to be fire retardant, be UL 214 listed, and meet the requirements of NFPA 90A.

24
25
26 Connections to be a minimum of 3 inches wide, crimped into metal edging strip, and air tight. Connections
27 to have adequate flexibility and width to allow for thermal expansion/contraction, vibration of connected
28 equipment, and other movement.

29
30 Use coated glass fiber fabric for all applications. Material for inside applications other than corrosive
31 environments, fume exhaust, or kitchen exhaust to be double coated with neoprene, air and water tight,
32 suitable for temperatures between -10°F and 200°F, and have a nominal weight of 30 ounces per square
33 yard. Material used for outdoor applications other than corrosive environments, fume exhaust, or kitchen
34 exhaust to be double coated with Hypalon air and water tight, suitable for temperatures between -10°F and
35 250°F, and have a nominal weight of 26 ounces per square yard.

36 **HOODS FOR INTAKE AND EXHAUST**

37 Manufacturers: Acme, Ammerman, Carnes, Cook, Greenheck, Louvers and Dampers, Penn, or approved
38 equal.

39
40 Use louvered penthouse type hoods with drainable blade louvers.

41
42 Construct hoods of galvanized steel with a baked enamel finish; color to be selected by the Architect
43 during the submittal stage.

44
45 Provide bird screen and motor operated damper for each hood.

46 **LOUVERS**

47 Louvers are specified in the architectural section of these specifications.

48
49 Manufacturers: Airolite K6776, Industrial Louvers 658, American Warming and Ventilating LE-31, or
50 Construction Specialties 6177, or approved equal.

51
52 Similar to Airolite Type K6776, extruded aluminum alloy not less than 12 gauge (.081" thick), 6063 series
53 frame and blades, all-welded assembly, 35 degree or 45 degree blades with water baffle, 6 inches thick.
54 Provide with bird screen of ½" x ½" mesh aluminum in 12 gauge aluminum frame and an aluminum sill.
55 [Locate the bird screen on the outside of the louver where indicated on the drawings.] Locate the bird
56 screen inside of the louver unless noted otherwise.

57
58 Louver to bear the AMCA certified ratings seal for both air performance and water penetration, having a
59 free area not less than 50% based on a 48" x 48" section, a water penetration less than 0.1 oz/square foot
60
61

1 under AMCA test at 1000 feet per minute, and an intake pressure drop less than 0.20 inches of water at
2 1000 feet per minute.

3
4 Finish to be anodized or Kynar 500 in a custom color to be selected by the Architect. Furnish sufficient
5 paint in the same color as the louver to paint the outer surface of panels over unused portions of louvers
6 and to paint the interior portion of ductwork visible through the louvers.

7
8 **AIR FLOW STATIONS**

9 Air flow stations are specified in section 23 09 24.

10
11 **PART 3 - EXECUTION**

12
13
14 **MANUAL VOLUME DAMPERS**

15 Install manual volume dampers in each branch duct and for each grille, register, or diffuser as far away
16 from the outlet as possible while still maintaining accessibility to the damper. Install so there is no flutter
17 or vibration of the damper blade(s).

18
19 **TURNING VANES**

20 Install turning vanes in all rectangular, mitered elbows in accordance with SMACNA standards and/or
21 manufacturer's recommendations.

22
23 Install double wall, airfoil, 2 inch radius vanes in ducts with vane runner length 18" or greater and air
24 velocity less than 2000 fpm. Install double wall, airfoil, 4-1/2 inch radius vanes in ducts with vane runner
25 length 18" or greater and air velocity 2000 fpm or greater.

26
27 If duct size changes in a mitered elbow, use single wall type vanes with a trailing edge extension. If duct
28 size changes in a radius elbow or if short radius elbows must be used, install sheetmetal turning vanes in
29 accordance with SMACNA Figure 2-5 and Figure 2-6.

30
31 **CONTROL DAMPERS**

32 Install dampers in locations indicated on the drawings, as detailed, and according to the manufacturer's
33 instructions. Install blank-off plates or transitions where required for proper mixing of airstreams in
34 mixing plenums. Provide adequate operating clearance and access to the operator. Install an access door
35 adjacent to each control damper for inspection and maintenance.

36
37 **SMOKE DETECTORS**

38 Installation and wiring of detectors will be by the Electrical Contractor. Install an access door at each
39 detector location.

40
41 **ACCESS DOORS**

42 Install access doors where specified, indicated on the drawings, and in locations where maintenance,
43 service, cleaning or inspection is required. Examples include, but are not limited to motorized dampers,
44 fire and smoke dampers, smoke detectors, fan bearings, heating and cooling coils, filters, valves, and
45 control devices needing periodic maintenance.

46
47 Size and numbers of duct access doors to be sufficient to perform the intended service. Minimum access
48 door size shall be 8 x 8 inch size for hand access, 18 x 18 inch size for shoulder access, or other size as
49 indicated. Install access doors on both inlet and outlet sides of reheat coils as well as other duct mounted
50 coils.

51
52 **FLEXIBLE DUCT**

53 Flexible duct may only be used for final connections of air inlets and outlets at diffuser, register, and grille
54 locations. Where flexible duct is used, it shall be the minimum length required to make the final
55 connections, but no greater than 5 feet in length, and have no more than one (1) 90 degree bend.

56
57 Secure inner jacket of flexible duct in place with stainless steel metal band clamp. Secure insulation vapor
58 barrier jacket in place with steel or nylon draw band. Sheetmetal screws and/or duct tape will not be
59 accepted.

60
61 Flexible duct used to compensate for misalignment of main duct or branch duct will not be accepted.

1
2 Individual sections of flexible ductwork shall be of one piece construction. Splicing of short sections will
3 not be accepted.

4
5 Flexible ductwork used as transfer duct shall be sized for a maximum velocity of 300 fpm.

6
7 Penetration of any partition, wall, or floor with flexible duct will not be accepted.

8
9 **FLASHINGS**

10 Flashing for roof curbs, equipment supports or rails located on roof, will be installed by others.

11
12 **DUCT FLEXIBLE CONNECTIONS**

13 Install at all duct connections to rotating or vibrating equipment, including air handling units (unless unit is
14 internally isolated), fans, or other motorized equipment in accordance with SMACNA Figure 2-19. Install
15 thrust restraints to prevent excess strain on duct flexible connections at fan inlets and outlets; see Related
16 Work.

17
18 For applications in corrosive environments or fume exhaust systems, use a double layer of the Teflon,
19 coated fabric when making the connector.

20
21 **HOODS FOR INTAKE AND EXHAUST**

22 Install in locations indicated on the drawings, coordinating the roof opening location with the General
23 Contractor. Curbs are covered in Section 23 05 29.

24
25 **LOUVERS**

26 Furnish louvers to the General Contractor for mounting in exterior walls. Connect outside air intake duct
27 to the louver, sealing all connections air and water tight.

28
29 Provide bird screen on inside of active louver area where none is provided with louvers. Where louvers
30 are equipped with inside birdscreen, remove screen at all locations where duct connections are not made.

31
32 Install insulated metal panel on unused portion of louver. Panels must be sealed weathertight to louver
33 assembly with flashing as required for proper drainage to outside of building. Paint outside surface of
34 panel to match louver prior to installation. Where ductwork is visible through louver when viewed from
35 outside the building, paint inside of duct to match louver color.

36
37 **AIR FLOW STATIONS**

38 Install where indicated on the drawings and/or as scheduled and in accordance with manufacturer's
39 recommendations.

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END OF SECTION

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SECTION 23 36 00
AIR TERMINAL UNITS

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
- Shop Drawings
- Operation and Maintenance Data
- Design Criteria

PART 2 - PRODUCTS

- Supply Air Terminal Boxes
- Insulation

PART 3 - EXECUTION

- Installation
- Adjusting
- Construction Verification Items
- Functional Performance Testing
- Owner Training

RELATED WORK

- 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
- ASTM E84 – 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.

SHOP DRAWINGS

Refer to division 1, General Conditions, Submittals.

Contractor shall submit air terminal unit data including materials of construction, dimensions, scheduled flow rates, pressure drops, radiated and discharge sound power levels, reset volume controller data, actuator spring range and torque data.

OPERATION AND MAINTENANCE DATA

1 All operations and maintenance data shall comply with the submission and content requirements specified
2 under section GENERAL REQUIREMENTS.

3
4 **DESIGN CRITERIA**

5 Select sizes, capacities, configuration, and operating characteristics as shown on the plans and/or as
6 scheduled.

7
8
9 **PART 2 - PRODUCTS**

10
11 **SUPPLY AIR TERMINAL BOXES**

12 Units shall be single duct and pressure independent.

13
14 **MANUFACTURERS:**

15 Carnes, Envirotec, Metal-Aire, Titus, Trane, Price or equal.

16
17 **CONSTRUCTION:**

18 Unit casing shall be minimum 22 gauge steel and internally insulated with 13/16" rigid fiberglass
19 insulation with a foil scrim face or 3/4" thick polyolefin closed cell insulation. Construction to meet UL 181
20 and NFPA 90A. Casing shall be sealed to limit leakage to a maximum of 15 cfm at 6.0 inches of static
21 pressure. Casing outlet shall have slip and drive joint for connection to discharge ductwork.

22
23 Metal damper blade shall be mounted to shaft having self-lubricated bearings. Shaft end shall be marked
24 to indicate damper position and shall have a built-in stop to prevent overstroking. Damper blade shall
25 close off against gasket to limit leakage to 10 cfm at 6.0 inches of differential static pressure. Damper
26 linkage shall be sized to accept at least 40 inch-pounds of torque to the damper shaft. Damper shaft shall
27 be provided with a marking indicating damper position.

28
29 Round inlet collar shall be equipped with a multi-point flow sensor that shall amplify the measured velocity
30 pressure. Pneumatic tubing from flow sensor to differential pressure transducer shall be UL listed, fire
31 retardant (FR) type.

32
33 **HOT WATER REHEAT COIL:**

34 Reference section 23 82 00 for hot water reheat coil specifications.

35
36 **INSULATION**

37 Materials or accessories containing asbestos will not be accepted.

38
39 Use composite insulation systems (insulation, jackets, sealants, and adhesives) that have a flame spread
40 rating of 25 or less and smoke developed rating of 50 or less.

41
42 The following two internal insulation options may be utilized.

43
44 **RIGID FIBERGLASS INSULATION:**

45 Minimum nominal density of 3 lbs. per cu. ft., and thermal conductivity of not more than 0.23 at 75
46 degrees F, minimum compressive strength of 25 PSF at 10% deformation, rated for service to 450 degrees
47 F.

48
49 Foil-scrim-kraft vapor barrier jacket, factory applied to insulation, maximum permeance of .02 perms. All
50 exposed insulation edges shall be covered with metal nosing.

51
52 **POLYOLEFIN INSULATION:**

53 Flexible closed cell, minimum nominal density of 1.5 lbs. per cu. ft., thermal conductivity of not more than
54 0.24 at 75 degrees F, minimum compressive strength of 5 psi at 25% deformation, maximum water vapor
55 permeability of 0.0 perm inch, maximum water absorption of 0% by weight and volume, rated for service
56 range of -165 degrees F to 210 degrees F.

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PART 3 - EXECUTION

INSTALLATION

Install air terminal units as indicated on project drawings and in accordance with the manufacturer's installation instructions.

Mount air terminal boxes with a minimum 3 feet of straight ductwork upstream of inlet flow sensor for sizes 12" diameter and below. Provide a minimum of 3X the inlet diameter of straight duct upstream of the inlet flow sensor for inlet sizes above 12" diameter.

Where hot water reheat coils are provided with air terminal boxes the following two options may be used.

Field mount coil separate from box with a 12-18" section of duct between the air terminal box and reheat coil. The reheat coil and 12-18" section of duct shall be wrapped with external insulation as indicated in specification section 23 07 00 – HVAC Insulation.

Factory mount coil in extended supply air terminal unit. The supply air terminal unit shall be extended at the factory 12-18" and internally insulated to match the insulation used for the supply air terminal unit

Provide at least 24" of clearance on controller side of the air terminal unit. The clearance area shall extend the full length of the supply air terminal unit and the full length (including the access door) of the exhaust/return air terminal unit

Support air terminal units from building structure using sheet metal straps or trapeze hanger with rods. Do not mount air terminal units off of adjacent ductwork or piping.

INSULATION

RIGID FIBERGLASS INSULATION:

All rigid duct insulation edges shall be covered with metal nosing. Foil scrim face must completely separate the rigid fiberglass duct material from the air stream.

POLYOLEFIN INSULATION:

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.

For supply air terminal units, provide five feet of 1" thick lining immediately downstream from air terminal unit discharge. Where hot water reheat coils are field or factory installed, provide five feet of 1" thick lining in ductwork immediately downstream of reheat coil. Refer to specification section 23 33 00 – Air Duct Accessories for liner specification.

ADJUSTING

Coordinate adjustment of air terminal units with section 23 05 93 - Testing, Adjusting and Balancing.

CONSTRUCTION VERIFICATION ITEMS

Contractor is responsible for utilizing the construction verification checklists supplied under specification Section 01 91 01 or 01 91 02 in accordance with the procedures defined for construction verification checklists.

FUNCTIONAL PERFORMANCE TESTING

Contractor is responsible for utilizing the functional performance test procedures supplied under specification Section 01 91 01 or 01 91 02 in accordance with the procedures defined for functional performance test procedures.

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OWNER TRAINING

All training provided for owner shall comply with the format, general content requirements and submission guidelines specified under Section 01 91 01 or 01 91 02.

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
- Side-Wall Registers and Grilles
- Eggcrate Grille
- Construction Verification Items

PART 3 - EXECUTION

- Installation

RELATED WORK

- Section 23 31 00 - HVAC Ducts and Casings
- Section 23 33 00 - Air Duct Accessories
- Section 23 05 93 - Testing, Adjusting and Balancing for HVAC

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

1 Color selection charts where applicable
2 Manufacturer's installation instructions
3 All other appropriate data
4

5 **DESIGN CRITERIA**

6 All performance data shall be based on tests conducted in accordance with Air Diffusion Council (ADC) Test
7 Code 1062 GRD 84.
8
9

10 **PART 2 - PRODUCTS**

11 **MANUFACTURERS**

12 Manufacturers: Carnes, Krueger, Titus, Metal-Aire, and E.H. Price, and United Sheet Metal.
13
14

15 Acceptable manufacturers for specific products are listed under each item.
16

17 **PERFORATED CEILING DIFFUSERS**

18 Titus model PSS, Carnes series SP or SL, EH Price series PDS, and Metal Aire series 7600
19

20 Aluminum (Steel) unless otherwise indicated, and furnished with frame type appropriate to installation.
21

22 Field adjustable pattern controllers accessible through removable or hinged face plate. Pattern controller
23 mounted directly under the neck of the diffuser and fully adjustable for either side blow or corner blow pattern.
24

25 Provide round or square neck duct adapters for each unit for top connection or side connection as appropriate to
26 the space.
27

28 Unless otherwise indicated, baked enamel finish with color selected by Architect. Flat black diffuser vanes and
29 frame interior.
30

31 **SQUARE CEILING DIFFUSERS**

32 Titus model TDC, Carnes series SK or SE, EH Price model AMD, Metal Aire series 5000 or 5500, and
33 Krueger series S.
34

35 Aluminum (Steel) unless otherwise indicated, louvered face furnished with frame type appropriate to
36 installation.
37

38 Directional blow pattern as shown on the drawings and/or as scheduled.
39

40 One-piece construction louver cones with no corner joints.
41

42 Unless otherwise indicated, baked enamel finish with color selected by Architect.
43

44 **SIDE-WALL REGISTERS AND GRILLES**

45 Titus series 300 (supply) and series 350 (return/exhaust), Carnes model R series, EH Price model NM22S/T
46 or C22S/3, Metal Aire series V4000 or H4000, Krueger series 880.
47

48 Aluminum (Steel) unless otherwise indicated, with frame type appropriate to installation.
49

50 Double deflection type blade supply registers and supply grilles allow deflection adjustment in all direction.
51

52 Opposed blade volume control damper supply registers, operable from face.
53

- 1 Fixed blade (0 degree, 45 degree) core return and exhaust registers and grilles.
2
3 Opposed blade volume control damper return registers, operable from face.
4
5 Register and grille sizes as shown on drawings and/or as scheduled. Unless noted otherwise, baked enamel
6 finish with color selected by Architect.
7
8 Screw holes on surface counter sunk to accept recessed type screws.
9

10 **EGGCRATE GRILLE**

11 Titus model 50, Carnes model RAE or RAT, EH Price model C80, Metal Aire model CC, Krueger model
12 EGC.

13
14 Aluminum construction with frame type appropriate to installation.

15
16 Grille face 1/2" x 1/2" or 1" x 1" grid pattern 1" deep with a minimum of 85% free area.

17
18 Grille sizes and finishes as shown on drawings and/or as scheduled. Unless noted otherwise, baked enamel
19 finish with color selected by Architect.

20
21 Screw holes on surface counter sunk to accept recessed type screws.
22

23
24 **PART 3 - EXECUTION**

25
26 **INSTALLATION**

27 Install grilles, registers and diffusers as shown on drawings and according to manufacturer's instructions.
28

29 Furnish diffusers with equalizing grids where it is not possible to maintain minimum 2 duct diameter straight
30 duct into diffuser. Equalizing grids shall consist of individually adjustable vanes designed for equalizing
31 airflow into diffuser neck and providing directional control of airflow.
32

33 Unless otherwise indicated, size ductwork drops to diffusers or grilles to match unit collar size.
34

35 Seal connections between ductwork drops and diffusers/grilles airtight.
36

37 Where diffusers, registers and grilles cannot be installed to avoid seeing inside duct, paint inside of duct with
38 flat black paint to reduce visibility.
39

40 **CONSTRUCTION VERIFICATION ITEMS**

41 Contractor is responsible for utilizing the construction verification checklists supplied under specification
42 Section 01 91 01 or 01 91 02 in accordance with the procedures defined for construction verification checklists.
43

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45

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SECTION 23 41 00
PARTICULATE AIR FILTRATION

PART 1 - GENERAL

SCOPE

This section includes specifications for air system filters. 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

- Manufacturers
- Panel Filters
- MERV 7 Filters
- Activated Carbon Filters
- Housings for MERV 7 Filters
- Side Access Filter Housings
- Filter Holding Frames
- Filter Gauges

PART 3 - EXECUTION

- Installation
- Filter Gauges
- Construction Verification Items
- Owner Training

RELATED WORK

Section 23 07 00 - HVAC Insulation

REFERENCE

Applicable provisions of Division 1 govern work under this section.

REFERENCE STANDARDS

- ASHRAE Standard 52
- UL 181 – Standard for Factory-Made Air Ducts and Air Connectors
- UL 586 – Standard for High Efficiency Particulate Air Filter Units
- UL 900 – Standard for Air Filter Units

QUALITY ASSURANCE

Refer to division 1, General Conditions, Equals and Substitutions.

SHOP DRAWINGS

Refer to division 1, General Conditions, Submittals.

Include data concerning dimensions, materials, efficiencies, installation instructions and appropriate identification.

OPERATION AND MAINTENANCE DATA

All operations and maintenance data shall comply with the submission and content requirements specified under section GENERAL REQUIREMENTS.

DESIGN CRITERIA

Use UL Class 1 or Class 2 filters unless noted otherwise.(Reference applicable UL standard referenced)

1 Efficiencies indicated in this section are based on ASHRAE Standard 52.

2
3 Fan motors have been selected to operate against the resistance of dirty filters as specified in this section.

4
5
6 **PART 2 - PRODUCTS**

7
8 **MANUFACTURERS**

9 American Air Filter, Barnebey-Cheney, Cambridge, Continental, Flanders, Camil-Farr, Mine Safety
10 Appliances, Research Products, or approved equal.

11
12 **MERV 7 FILTERS**

13 Use 2" thick, pleated panels, 100% synthetic, self supported media fully bonded and sealed in cardboard
14 frame.

15
16 Media nominal rating to be 500 FPM face velocity, 0.20 inch WG initial resistance, 1.0 inches WG
17 recommended final resistance, Average arrestance of filter media shall be 90-92%

18 Furnish a side access housing or holding frame as scheduled.

19 Filter tracks shall be constructed to provide a minimum clearance of 2 inches between the pre-filter and
20 final-filter media to facilitate the installation of static pressure tips.

21
22 **ACTIVATED CARBON FILTERS**

23 Use an assembly consisting of carbon steel, stainless steel, or aluminum casing, pleated bed assembly, and
24 trays; filter servicing trays arranged in a deep V for [upstream] [downstream] [side] servicing; and
25 disposable panel prefilter.

26
27 Media to be activated carbon, 34 lb/cu ft density, pelletized or granular, with minimum carbon
28 tetrachloride activity of 60 percent. Assemble media in thin bed trays or pleated bed cartridges with a
29 minimum of 1.42 cu ft of carbon per 1000 CFM nominal air flow capacity.

30
31 Media rating at above conditions to be 500 FPM face velocity, 0.45 inch WG initial resistance, and 99.99%
32 efficiency by means of a freon leak test.

33
34 **HOUSINGS FOR PANEL FILTERS**

35 Manufactured by air handling unit manufacturer, filter media manufacturer, or contractor fabricated.
36 Casing and tracks constructed of galvanized or enameled steel or aluminum. Provide access to the media
37 tracks from outside the casing so media and be readily changed.

38
39 **HOUSINGS FOR MERV 7 FILTERS**

40 Housing or holding frame to be of the same manufacturer as filter media or provided by the air handling
41 unit manufacturer. Contractor fabricated housings or filter racks will not be accepted. Casing and tracks
42 constructed of galvanized or enameled steel or aluminum. Provide access to the media tracks from outside
43 the casing so media and be readily changed. Filter tracks shall be constructed to provide a minimum
44 clearance of 2 inches between the pre-filter and final-filter media to facilitate the installation of static
45 pressure tips.

46
47 **SIDE ACCESS FILTER HOUSINGS**

48 Galvanized steel housing with aluminum or galvanized steel filter mounting tracks. Mounting tracks and
49 access doors to have gaskets to minimize air bypass around the filters. Housing assembly is to be suitable
50 for use in duct systems with 4 inches of water static pressure.

51
52 Standard filter sections provided by air handling unit manufacturers may be used for MERV 11 and MERV
53 14 filters but will not be accepted for HEPA filters or activated carbon filters.

54
55 Insulate housings where adjacent duct or air handling apparatus is insulated. Insulation to be contained
56 within a 2" thick, double wall steel panel and meet the requirements specified for adjacent duct or
57 apparatus.

- 1 Furnish a door on each end of the housing to facilitate filter changing. Doors to be hinged and provided
 2 with lever handle latches to secure the door. Doors shall not be secured with nuts, bolts, wing nuts, or
 3 sheet metal screws.
 4
 5 Furnish housings for MERV 11, MERV 14, , HEPA filters, or activated carbon filters with a lever action
 6 sealing mechanism to secure media in tracks.
 7
 8 Filter bypass shall be less than 1% of design cfm.
 9
 10 Include an integral prefilter track for installation of MERV 7 prefilters. Filter tracks shall be constructed to
 11 provide a minimum clearance of 2 inches between the pre-filter and final-filter media to facilitate the
 12 installation of static pressure tips.
 13

14 **FRONT ACCESS FILTER HOLDING FRAMES**

15 Construct frames of aluminum or corrosion resistant coated steel with provisions for assembly in a bank.

16
 17 Frames for MERV 11 filters, MERV 14 filters, , HEPA filters, and activated carbon filters to have
 18 provisions for installation of MERV 7 prefilters upstream of high efficiency media. Secure prefilters by
 19 means of spring clips or a spring loaded mechanism. Spring clips or latches shall be on the upstream side
 20 of the prefilter. Provide leakproof gaskets between prefilter media and holding frame. Prefilters shall be
 21 removable without removal of final filters.
 22

23 **FILTER GAUGES**

24 Manufacturers: Dwyer, or approved equal.

25
 26 Direct reading, 3-1/2 inch dial type, diaphragm actuated, in a metal case. Lettering shall be black figures
 27 on white background. Provide front recalibration adjustment.
 28

29 Provide gauges with the following ranges:

30	Filter Type	Scale Range (inch W.G.)
31		
32		
33	Panel filters	0.0 to 0.5
34	MERV 7	0.0 to 1.0
35	Activated carbon filters	0.0 to 2.0
36		

37 Provide one gauge for each filter bank, suitable for flush or surface mounting. Include an air filter gauge
 38 accessory package consisting of mounting bracket, aluminum tubing, two static pressure tips, and vent
 39 valves for each gauge
 40

41
 42 **PART 3 - EXECUTION**
 43

44 **INSTALLATION**

45 Where air handling equipment is to be used for temporary heating or ventilation of a facility, do not
 46 operate the equipment until specified filter media has been installed. Contractor shall be responsible for
 47 maintaining the cleanliness of air handling apparatus and air distribution systems during construction
 48 through regular inspection and changing of filter media throughout the construction period.
 49

50 Where air handling apparatus is used during the construction period, install new filter media prior to start
 51 of air balancing. Additionally, deliver one new set of media to the owner prior to substantial completion.
 52

53 Install units as shown on drawings and details according to manufacturer's instructions.

54 Reinforce filter holding frames per manufacturer's instructions.

55 Maintain necessary clearance for changing filters.
 56

57
 58 **ULPA FILTER MEDIA**

59 The filter assembly shall be leak tested and factory certified per referenced ASME and IES standards.
 60

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FILTER GAUGES

Install filter gauge static pressure tips upstream and downstream of filters. Mount gauge on outside of filter housing or filter plenum in accessible position outside of the unit housing, (*The intent is to have the gauge viewable without opening an access door*); install tubing and gauge valves between gauge and sensor tips. Adjust and level each gauge.

CONSTRUCTION VERIFICATION ITEMS

Contractor is responsible for utilizing the construction verification checklists supplied under specification Section 01 91 01 or 01 91 02 in accordance with the procedures defined for construction verification checklists.

OWNER TRAINING

All training provided for owner shall comply with the format, general content requirements and submission guidelines specified under Section 01 91 01 or 01 91 02.

END OF SECTION

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**SECTION 23 57 00
HEAT EXCHANGERS FOR HVAC**

PART 1 - GENERAL

SCOPE

This section includes specifications for shell and tube heat exchangers and plate heat exchangers. Included are the following topics:

PART 1 - GENERAL

Scope
Related Work
Reference
Reference Standards
Quality Assurance
Submittals
Operation and Maintenance Data

PART 2 - PRODUCTS

Plate Heat Exchangers

PART 3 - EXECUTION

Installation
Plate Heat Exchangers

RELATED WORK

Section 23 21 13 - Hydronic Piping

REFERENCE

Applicable provisions of Division 1 govern work under this section.

REFERENCE STANDARDS

ASME Boiler and Pressure Vessel Code VIII - Rules for Construction of Pressure Vessels-Latest Edition.

QUALITY ASSURANCE

Refer to division 1, General Conditions, Equals and Substitutions

SUBMITTALS

Refer to division 1, General Conditions, Submittals.

Include data concerning dimensions, capacities, and material of construction.

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

PLATE HEAT EXCHANGERS

Manufactures: Alfa Laval, Bell & Gossett, Graham, ITT Standard, Taco or approved equal.

Plate and frame type with gasketed heat transfer channel plates mounted on carrying bars and held between a stationary frame plate and a moveable pressure plate. Design pressure of 150 psig at 230 degrees F in each circuit with no pressure in the other circuit. Heat exchangers shall be constructed and stamped in accordance with the latest ASME Pressure Vessel Code Section VIII.

304 or 316 stainless steel corrugated channel plates with one piece Nitrile or EPDM gaskets (whichever material suitable for the fluids used). Gaskets may be glued or non-glued type. Provide relieving grooves on gaskets to prevent cross contamination between fluids. Provide OSHA compliant aluminum splashguard over channel plate rack.

- 1 Carbon steel pressure plates with enamel paint or epoxy coating. Plates shall not require additional stiffeners
2 for support. Carbon steel carrying bars with zinc yellow chromate finish or epoxy coated finish.
3
4 Studded port type pipe connections to accept ANSI flanges for 3” and larger. Carbon steel NPT tapings or
5 stainless steel NPT nozzles for connections 2” and smaller. Factory seal all connections prior to shipment to
6 prevent entrance of foreign material.
7
8 Provide heat exchangers with capacities and operating characteristics indicated on drawings.
9
10 Circuits utilized for domestic water to be double-walled.
11
12

13 **PART 3 - EXECUTION**
14

15 **INSTALLATION**

16 Install units as shown on plans, as detailed, and according to manufacturer's installation instructions. Provide
17 clearance around units as shown on the drawings and as recommended by the manufacturer for service access.
18 Provide elbows, flanges and unions on piping to allow for servicing heat exchangers.
19

20 **PLATE HEAT EXCHANGERS**

21 Bolt to concrete pad. Apply grease to the threaded surfaces of the compression bolts and cover with plastic
22 sleeving.
23
24

25 **END OF SECTION**

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SECTION 23 64 15
DEDICATED HEAT RECOVERY CHILLER

PART 1 - GENERAL

SCOPE

This section includes water-cooled water chillers, specifically designed for high (140° F) condenser water temperature. Included are the following topics:

PART 1 - GENERAL

- Scope
- Related Work
- Reference
- Reference Standards
- Quality Assurance
- Performance Requirements
- Operating Sound Pressure Level
- Submittals
- Operation and Maintenance Data
- Delivery, Storage and Handling
- Warranty

PART 2 - PRODUCTS

- Manufacturers
- Manufactured Units
- Compressors
- Evaporator
- Condenser
- Insulation
- Pumpout and Storage System
- Purge System
- Controls
- Starter
- Vibration Isolation
- Factory Performance Test
- Refrigerant Monitors

PART 3 - EXECUTION

- Installation
- Startup
- Construction Verification Items
- Functional Performance Testing
- Agency Training

RELATED WORK

- Division 1– Commissioning Process
- Section 23 05 00 - Common Work Results for HVAC
- Section 23 05 13 – Common Motor Requirements for HVAC Equipment
- Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment
- Section 23 21 13 – Hydronic Piping
- Section 23 09 23 – Direct Digital Control for HVAC
- Section 23 09 93 - Sequence of Operations for HVAC Controls

REFERENCE

Applicable provisions of Division 1 shall govern work under this section.

REFERENCE STANDARDS

ARI 550/590-2003	Scroll Water-Chilling Packages
ARI 575	Method of Measuring Machinery Sound Within an Equipment Space
ASHRAE 15	Safety Code for Mechanical Refrigeration
ASHRAE 90.1	Energy Standard for Building except Low Rise Residential Buildings
ASME SEC 8	Boiler and Pressure Vessel Code
NEMA MG1	Motors and Generators

1 UL 1995 Central Cooling Air Conditioners
2 COMM 45 Wisconsin Department of Commerce Mechanical Refrigeration Code

3
4 **QUALITY ASSURANCE**

5 Refer to division 1, General Conditions, Equals and Substitutions.

6
7 Construct, test and rate chiller performance in accordance with ARI 550 with exceptions as noted in this
8 specification.

9
10 Construct, install and operate chillers in accordance with ANSI/ASHRAE 15- Safety Code for Mechanical
11 Refrigeration and COMM 45 Wisconsin Mechanical Refrigeration Code.

12
13 Construct and test chillers in accordance with ASME SEC 8.

14
15 Construct and label chillers in accordance with UL 1995.

16
17 **PERFORMANCE REQUIREMENTS**

18 Refer to schedule for performance requirements.

19
20 **OPERATING SOUND PRESSURE LEVEL**

21 The unit shall operate at full load and all part load conditions without exceeding (*71-dBA*) sound pressure
22 level in the equipment room at 3 feet. If units do not meet the (*71-dBA*) requirements, as measured in
23 accordance with latest version ARI Standard 575, furnish all attenuation devices necessary to meet this
24 requirement. The sound pressure levels in all octave bands must be met as scheduled for full load and part
25 load conditions.

26
27 **SUBMITTALS**

28 Refer to division 1, General Conditions, Submittals

29
30 Submit chiller system shop drawings including the following information: specific manufacturer and model
31 numbers, dimensional and weight data, required clearances, materials of construction, capacities and
32 ratings, minimum load achievable without hot gas bypass, pressure ratings, refrigerant charge, pumpout
33 refrigerant storage capacity, component information, assembly information, size and location of piping
34 connections, electrical connections, wiring diagrams, motor information (ref. 23 05 13), surfaces requiring
35 insulation, SqFt of surface insulation, sound pressure levels in all octave bands at 100% load, information
36 for all specialties and accessories.

37
38 Indicate ASME construction and stamping of pressure vessels or unit physical characteristics and ASME
39 code section and paragraph references that allow non-compliance with this construction and stamping
40 requirement.

41
42 At substantial completion, submit warranty certificate and copy of start-up report.

43
44 **OPERATION AND MAINTENANCE DATA**

45 All operations and maintenance data shall comply with the submission and content requirements specified
46 under section GENERAL REQUIREMENTS.

47
48 **DELIVERY, STORAGE AND HANDLING**

49 Comply with manufacturer's installation instructions for rigging, unloading, and transporting units.

50
51 Protect units from physical damage. Leave factory-shipping covers in place until installation.

52
53 Shipping of the chillers to the project and unloading shall be the responsibility of the chiller manufacturer.

54
55 **WARRANTY**

56 Provide a one year all-inclusive warranty to begin upon acceptance of project by owner.

57
58 Provide an additional four (4) year material and labor warranty extension for compressor motor,
59 compressor assembly and unit controls.

60
61
62 **PART 2 - PRODUCTS**

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MANUFACTURERS

Multistack, Clima-Cool, Climate Master

MANUFACTURED UNITS

Provide factory assembled and tested, packaged, water-cooled, liquid chiller consisting of one module that incorporates two rotary scroll type compressors in individual refrigeration circuits. Each circuit shall consist of an individual compressor, condenser, evaporator, thermal expansion valve and controls, control panel, gages and indicating lights, auxiliary components and accessories, solid state motor starter. The multi-circuit chiller must be able to produce chilled water or hot water even in the event of a failure of one or more refrigerant circuits.

Acceptable refrigerant is R-410A; provide full operating charge of refrigerant and oil.

Refrigerant Circuit: Provide refrigerant charging port on the suction side of the circuit.

Firmly attach metal nameplates to major components indicating the name of the manufacturer, unit model number, compressor/condenser/cooler type, refrigerant used, pounds of refrigerant needed for normal operation, operating pressures, and unit serial number.

COMPRESSORS

Unit shall contain multiple hermetic scroll compressors independently circuited with internal spring isolation and mounted with rubber-in-shear isolators to the module frame.

EVAPORATOR AND CONDENSERS

Each heat exchanger must be constructed of 316L stainless steel and designed, tested and stamped in accordance with ASME code for 440 psig (650 psig for R-410A) working pressure on the evaporator and 440 psig (650 psig for R-410A) working pressure on the condenser. Both of the heat exchangers must be mounted to eliminate the effect of migration of refrigerant to the cold evaporator with consequent liquid slugging on start-up.

INSULATION

3/4" thick, flexible closed cell elastomeric foam insulation; minimum nominal density of 5.5 lbs. per cu. ft., thermal conductivity of not more than 0.27 at 75 °F, minimum compressive strength of 4.5 psi at 25% deformation, maximum water vapor transmission of 0.17 perm inch, maximum water absorption of 6% by weight, rated for service range of -20°F to 180°F.

Factory insulate the following:

- Evaporator
- Suction elbow
- All lines and surfaces 65°F or colder

CONTROLS

Provide a BACnet chiller control interface that is compatible with the building standard DDC control system. All available chiller software points shall be integrated into the building automation system.

Scheduling of the various compressors shall be performed by the module microprocessor base controller (Master Controller). The lead compressor shall not rotate. A load limit control shall be available to limit the number of compressors that can be energized at one time (3). Master controller to operate chiller module isolation valves as shown on the plans.

The Master Controller shall monitor and report the following for each refrigeration circuit in each module:

- Discharge pressure fault
- Suction pressure fault
- Compressor winding high temperature fault
- Low evaporator leaving chilled water temperature fault

The Master Controller shall monitor and report the following system parameters for the chiller system:

- 1 Chilled water entering and leaving temperature
- 2 Condenser water entering and leaving temperature
- 3 Evaporator and condenser water flow availability
- 4

5 An out of tolerance indication from individual module controls or sensors shall cause a “fault” indication at
6 the Master Controller and shutdown of that compressor circuit with the transfer of load requirements to the
7 next available compressor circuit. In the case of a System “fault” the entire chiller will be shut down.
8 When any fault occurs, the Master Controller shall record conditions at the time of the fault, and store the
9 data for recall. This information shall be capable of recall through the keypad of the Master Controller and
10 displayed on the 2 line by 40 character back-lit LCD. A history of faults shall be maintained including date
11 and time for each fault (up to the last 20 occurrences). Internal leaving chilled water reset control will
12 insure that the parallel evaporators are operated above the freeze point for part load operation.

13
14 Heat recovery mode control shall be incorporated in the Master Controller through special algorithms that
15 are supplied by the chiller manufacturer.

16
17 The condenser water pump shall be interlocked with the Master Controller on the chiller, and the chiller
18 shall be locked out until the condenser pump is verified on. The chilled water pump must indicate a chilled
19 water load before the chiller will be enabled.

20
21 **Chiller Input/Output**

- 22 Chiller enable (remote stop/start)
- 23 Condenser pump interlock relay
- 24 Chiller failure output relay (enacted when a preset number of compressors fail)
- 25 Condenser water flow switch
- 26 Chilled water flow switch
- 27 Condenser and evaporator entering and leaving water temperature
- 28
- 29

30 **SAFETIES, CONTROLS AND OPERATION**

31 Minimum chiller safety controls provided with unit:

- 32
- 33 Low evaporator refrigerant pressure
- 34 Loss of flow through the evaporator
- 35 High condenser refrigerant pressure
- 36 Loss of flow through the condenser
- 37 High compressor motor temperature
- 38 Low leaving evaporator water temperature
- 39 Electrical phase failure
- 40

41 Failure of chiller to start or shut down due to any of the above safety cutouts shall be enunciated by display
42 of the appropriate diagnostic description at the unit control panel. This annunciation shall be in plain
43 English. No codes are acceptable.

44
45 The chillers shall be furnished with a Master Controller as an integral part of the chiller circuitry to provide
46 the following functions:

- 47
- 48 Provide automatic chiller shutdown during periods when the load decreases below the normal
49 operating requirements of the building. Upon an increase in load, the chiller shall automatically
50 restart. In between, the chiller shall stop and start compressors to track the load.
- 51 Provide connection to enable the chiller from a remote energy management system.
- 52 Provide information on the control panel in alphanumeric format, showing all system parameters
53 in the English language with numeric date in English units.
- 54

55 **WIRING AND PIPING**

56 Before construction is to begin, a total system wiring diagram that shows the power and control wiring
57 between the pump/HX/controller, the DHRC™ and any building management system (if utilized), shall be
58 provided. Also provide a pumping and piping diagram for integrating the building heating system and the
59 DHRC™. These diagrams must be approved by the DHRC™ factory and the consulting engineer/owner
60 and clearly show field and factory wiring and piping responsibilities.

61 **STARTER**

1 Motor starter shall be a 480 volt across the line or solid-state type.
2
3 Isolating switch and contactor assemblies, including current limiting fuses, shall be of the component-to-
4 component design without any interconnecting cables or flexible shunts, removable from the front of the
5 enclosure. Line and load cable terminations shall be completely accessible from the front.
6
7 The isolating switch shall be an externally operated manual three pole draw-out, such that in the open
8 position it completely grounds and isolates the starter from the line connectors. Integral mechanical
9 interlocks shall prevent entry while the starter is energized and shall prevent accidental opening or closing
10 of the isolating switch when the door is open or contactor is closed. The isolating switch handle shall have
11 provision for three (3) padlocks.
12
13 Current limiting power fuses shall be of the self-protecting type with visible fuse condition indicators, and
14 with special time/current characteristics for motor service allowing proper coordination with the contactor
15 and overload protection for each phase for maximum motor protection. The power fuses shall be vertically
16 mounted permitting easy inspection and replacement without starter disassembly.
17
18 Isolate the low voltage starter control from the high power voltage area. Provide a control power
19 transformer (CPT), fuses for each leg of the primary and secondary side of the CPT, "Start" and "Stop"
20 pushbuttons, a red "Running" pilot light, and at least two normally open, and two normally closed
21 contractors for control interlocking. CPT shall be of sufficient size to accommodate all control power
22 needs of the starter/chiller combination.
23
24 Enclosure shall meet ANSI/NEMA ICS-6 enclosure standards, be NEMA 1 unless otherwise noted, be
25 completely accessible from the front and allow freestanding, against a wall or back-to-back mounting.
26
27 Starter assembly shall be UL listed, and bear the UL label of approval where a UL standard or code exists.
28
29 Starter shall include motor protection system incorporating electronic three-phase overloads and current
30 transformers. This electronic motor protection system shall monitor and protect against the following
31 conditions:
32 Three-phase overload protection
33 Overload protection during start-up
34 Phase imbalance
35 Phase loss
36 Phase reversal
37 Overvoltage — each phase
38 Undervoltage — each phase
39 Distribution fault protection with manual restart at the starter consisting of three-phase, current
40 sensing devices that monitor the status of the current. Distribution faults of 1-1/2 electrical cycle
41 duration shall be detected and the compressor motor shall be disconnected within six (6) electrical
42 cycles.
43 Alternately, the advanced motor protection system can be furnished in the chiller control panel
44 The starter shall be able to operate in temperatures up to 120 degrees F.
45 All field supplied wires, bus bars and fittings shall be copper only.
46

47 **VIBRATION ISOLATION**

48 The chiller supplier shall furnish refrigeration machine vibration isolation in accordance with 23 05 48 for
49 the installation by the mechanical contractor.
50

51 **PART 3 - EXECUTION**

52 **INSTALLATION**

53 Install chillers and refrigerant monitors in accordance with manufacturer's installation instructions.
54

55 Chillers shall be factory assembled, tested, and shipped to the job site. The chiller manufacturer is
56 responsible for unloading at the job site and the Mechanical Contractor is responsible for final setting and
57 installation.
58

59 **STARTUP**

1 Include the service of a factory-trained technician/mechanic employed by the chiller manufacturer for the
2 initial startup, one fall shutdown, and one additional spring startup. Accomplish initial startup before
3 acceptance of the installation. .
4
5 Furnish a startup log to the Owner's operating personnel with a copy to the state construction representative
6 for this project. Document each subsequent startup or shutdown procedure and send report to Owner's
7 operating personnel. Demonstrate the following items have been accomplished:
8
9 Examine areas to receive chillers for compliance with installation tolerances and other conditions affecting
10 performance and maintenance of chillers.
11
12 Include cost of crane in bid if proposed equipment cannot fit through existing building to point of
13 installation.
14
15 Examine proposed route of moving chillers into place and verify that it is free of interferences.
16
17 Verify piping roughing-in locations.
18
19 Verify branch circuit wiring suitability.
20
21 Do not proceed with installation until unsatisfactory conditions have been corrected.
22
23 Install chillers in accordance with manufacturer's written instructions.
24
25 Install chillers plumb and level. Use structural foot rails under chiller with vibration waffle isolators.
26
27 Maintain manufacturer's recommended clearances for service and maintenance.
28
29 Install piping connections maintaining clearances for service and maintenance of chillers.
30
31 Install piping to chiller utilizing either coupling or welded connections.
32
33 Install shutoff isolation valves at chiller inlet and outlet connections on condenser and evaporator.
34
35 Install the condenser, chilled water and heat exchanger pumps, plate frame heat exchanger, and controller,
36 along with the accessories specified.
37
38 Contractor to provide fused or non-fused (depending on code) manual disconnect to carry required
39 ampacity for specified chiller and any possible additions for later installation. Connect power wiring to
40 chiller buss bar connection device.
41
42 Refer to division 16 Sections for wiring devices, wires and cables, and electric installation requirements.
43
44 Install and connect remote flow switches and chiller control panel.
45
46 Install and connect control wiring from the PXC panel to the chiller control panel.
47
48 Group equipment: Tighten electrical connections and terminals, including grounding connections,
49 according to manufacturer's published torque-tightening values. Where torque values are not indicated,
50 use UL 486A and UL 486B.
51
52 The Chiller Manufacturer shall certify in writing that the proposed installation and wiring are in
53 accordance with their requirements for the use of Dedicated Heat Recovery Chillers.
54
55 The chiller manufacturer shall provide the services of a factory-trained and authorized service
56 representative to supervise field assembly and installation of the chiller and pump/heat exchanger/control
57 package. This also includes the piping and electrical connections. The representative shall report the
58 completion of the project to the engineer in writing.
59
60 The factory representative shall test and adjust the controls and safety devices. Replace damaged and
61 malfunctioning controls and equipment.
62

- 1 Energize chiller and operate controls and safety devices.
- 2
- 3 Lubricate rotating parts.
- 4
- 5 Verify that motor amperages conform to manufacturer's data.
- 6
- 7 Start chiller and verify performance data. Demonstrate operation to owner.
- 8
- 9 Train owner's maintenance personnel on procedures and schedules related to start-up, shutdown, trouble
- 10 shooting, servicing and preventive maintenance. Allocate at least 12 additional hours for owner training
- 11 and time for commissioning meetings. Provide complete Owners and Operation Manual describing in
- 12 detail the functioning of the equipment, and a check-list of periodic preventive maintenance items.
- 13
- 14
- 15

END OF SECTION

1 The entire drycooler system shall be furnished and installed complete with all components and accessories
2 as required. Verify all field requirements with the Manufacturer.

3

4 **SHOP DRAWINGS**

5 Submit shop drawings for all equipment specified under this section. Include data concerning sizes,
6 dimensions, weights, heating capacities, materials of construction, ratings, electrical data, wiring diagrams,
7 glycol piping diagrams, controls, options and manufacturers installation requirements, instructions and
8 recommendations.

9

10 The Manufacturer's shop drawing submittal shall include complete component descriptive literature,
11 detailed electrical wiring, water piping, glycol piping or refrigerant piping diagrams and drawings that have
12 been specifically prepared for this project.

13

14

15

PART 2 - PRODUCTS

16

17 **MANUFACTURERS**

18 McQuay, Applied Products, Data Aire Fluid Cooler, Guntner

19

20 Type AFS 005 Through AFS 107 / Type AFD 046 Through AFD 212

21

22 Furnish and install as specified and as shown on plans air cooled Fluid Cooler, arranged for vertical air
23 flow. Fluid Coolers shall be multiple fan design and shall perform in accordance with schedule on plan.

24

25 Each fluid cooler shall consist of cabinet, condenser coil, multiple direct drive propeller fans driven by
26 independent fan motors, fan guards and mounting legs. All fan motors shall be factory wired to a common
27 electrical junction box.

28

29 **COIL**

30 The condenser shall be constructed of seamless copper tubes on a staggered tube pattern. Tubes shall be
31 mechanically expanded into continuous, corrugated, rippled aluminum plate type fins for permanent metal-
32 to-metal contact. The fins shall have full depth fin collars completely covering the copper tube.

33

34 The coil shall be "floating tube type" with fluid carrying tubes not touching the galvanized end plates. The
35 coil shall be supported by non-refrigerant carrying copper tubes that are expanded into the coil.

36

37 Heavy wall copper headers shall have dimpled stub tubes from the coil and a beaded hole for the large
38 connection tube, both items to assure good brazing surface and joint strength.

39

40 Headers to be field piped to prevent excessive vibration.

41

42 Coils shall have a working pressure of 400 psig. A field supplied 450 psig relief device, one per circuit, is
43 required on units up to two circuits.

44

45 Coils shall be factory leak tested, dehydrated and connection ends spun closed. Unit shall be shipped under
46 pressure with a dry air or nitrogen holding charge.

47

48 **CABINET**

49 The cabinet shall be beige pre-painted G90 galvanized steel. Motors shall be supported by 11 gauge
50 galvanized steel rail fastened to the coil center and end supports. Each fan section shall be in an individual
51 compartment, separated from other fan sections by cabinetry. All legs and lifting brackets shall be 11
52 gauge galvanized steel.

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MOTORS

Motors shall be 460/3/60, 1140 rpm open drip proof motor with internal overloads.

FAN AND FAN GUARD

Fans shall have heavy gauge aluminum blades with painted steel spider. Fanguards shall be PVC coated steel.

ELECTRICAL

Unit shall have weatherproof electric control panel with factory mounted door interrupt switch. Control voltage shall be 120 volts with individual contactors and fuse protection for each motor.

TEMPERATURE CONTROL

Provide a means of fan cycling to maintain fluid temperatures. This shall be automatic in operation without daily or seasonal adjustment. Controls shall be factory mounted and wired in the weatherproof electric panel. Control shall be as follows: Temperature control for each contactor cycling individual fan motors.

E.T.L. LISTING

All 60-Hz. models shall be E.T.L. listed.

PART 3 - EXECUTION

INSTALLATION

Provide a weatherproof electrical disconnect switch to disconnect all electrical power to outside units.

The entire unit and all components shall be installed and operated in strict accordance with the Manufacturer's instructions.

Mount the outdoor units level.

Fan drive sheaves of fan speeds shall be adjusted or replaced by the Contractor at the job site as required to provide the design air volumes. Adjust all glycol liquid circuits to deliver the flows shown and required.

START-UP

The unit manufacturer shall provide the services of a factory trained serviceman to supervise the installation and initial startup and adjustment. Four copies of a written service report shall be submitted to the Engineer following the initial startup. It shall be signed by the serviceman responsible for performing the startup and adjustment work. It shall state all work done, indicate all readings taken and shall certify that the unit has been placed in proper running condition as recommended by the unit manufacturer and within the intent of the Contract Documents.

END OF SECTION

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SECTION 23 82 00
HEATING TERMINAL UNITS

PART 1 - GENERAL

SCOPE

This section includes specification for heating and cooling terminal equipment using water and/or steam 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

- Reheat Coils

PART 3 - EXECUTION

- Installation
- Reheat Coils
- Construction Verification Items
- Functional Performance Testing
- Owner Training

RELATED WORK

- Section 23 05 23 - General-Duty Valves for HVAC Piping
- Section 23 05 13 - Common Motor Requirements for HVAC Equipment
- Section 23 41 00 - Particulate Air Filtration
- 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 components and work must be in accordance with National Electrical Code.

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PART 2 - PRODUCTS

REHEAT COILS

Manufacturers: Carrier, Trane, McQuay, Marlo or approved equal.

Construct coils of copper tubes and aluminum fins in a serpentine arrangement with piping connections on the same end. Provide galvanized steel casing, end supports, top and bottom channels to allowance for expansion of finned tube section. Factory test coils at 200 psig.

Headers may be cast iron with tubes expanded into the header, steel pipe with tubes brazed to the header, or seamless copper with tubes brazed to the header.

Frames to be flanged for a gasketed connection to adjacent ductwork or constructed for slip and drive connection to the ductwork.

Minimum reheat coil size is 8 inches x 8 inches.

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.

REHEAT COILS

Comb bent or crushed fins and clean dust and debris from each coil before enclosing coils in ductwork. Pitch coil casings in accordance with manufacturer's instructions. Install a drain valve on the coil side of the shutoff valves for each reheat coil.

Pipe coils with multiple rows for counter flow arrangement.

CONSTRUCTION VERIFICATION ITEMS

Contractor is responsible for utilizing the construction verification checklists supplied under specification Section 01 91 01 or 01 91 02 in accordance with the procedures defined for construction verification checklists.

FUNCTIONAL PERFORMANCE TESTING

Contractor is responsible for utilizing the functional performance test procedures supplied under specification Section 01 91 01 or 01 91 02 in accordance with the procedures defined for functional performance test procedures.

OWNER TRAINING

All training provided for owner shall comply with the format, general content requirements and submission guidelines specified under Section 01 91 01 or 01 91 02.

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.

PROJECT OVERVIEW

Demolition of existing lighting, power and UPS systems. Extension of existing distribution systems, new lighting, controls, power and UPS systems and associated circuits. Demolition and installation of HVAC equipment.

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

- Project Overview
- 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 Firestopping
- Intent
- Omissions
- Submittals
- Project/Site Conditions
- Asbestos Abatement
- Work Sequence and Scheduling
- Work by Other Trades
- Offsite Storage
- Request and Certificate for Payment
- Salvage Materials
- Certificates and Inspections
- Operating and Maintenance Data
- Record Drawings

PART 2 - PRODUCTS

- Access Panels and Doors
- Identification
- Sealing and Firestopping

PART 3 - EXECUTION

- Cutting and Patching
- Building Access
- Equipment Access
- Coordination
- Sleeves
- Sealing and Firestopping
- Housekeeping and Clean Up
- Agency Training

RELATED WORK

Applicable provisions of Division 1 govern work under this Section.

1 **REFERENCE STANDARDS**

2 Abbreviations of standards organizations referenced in this and other sections are as follows:

- 3
- 4 ANSI American National Standards Institute
- 5 ASTM American Society for Testing and Materials
- 6 EPA Environmental Protection Agency
- 7 ETL Electrical Testing Laboratories, Inc.
- 8 IEEE Institute of Electrical and Electronics Engineers
- 9 IES Illuminating Engineering Society
- 10 ISA Instrument Society of America
- 11 NBS National Bureau of Standards
- 12 NEC National Electric Code
- 13 NEMA National Electrical Manufacturers Association
- 14 NESC National Electrical Safety Code
- 15 NFPA National Fire Protection Association
- 16 UL Underwriters Laboratories Inc.

17

18 **REGULATORY REQUIREMENTS**

19 All work and materials are to conform in every detail to applicable rules and requirements of the Wisconsin
20 State Electrical Code Volumes 1 and 2, the National Electrical Code (ANSI/NFPA 70), other applicable
21 National Fire Protection Association codes, the National Electrical Safety Code, and present manufacturing
22 standards (including NEMA).

23

24 All Division 26 work shall be done under the direction of a currently certified State of Wisconsin Certified
25 Master Electrician.

26

27 **QUALITY ASSURANCE**

28 Where equipment or accessories are used which differ in arrangement, configuration, dimensions, ratings,
29 or engineering parameters from those indicated on the contract documents, the contractor is responsible for
30 all costs involved in integrating the equipment or accessories into the system and the assigned space and for
31 obtaining the performance from the system into which these items are placed.

32

33 Manufacturer references used herein are intended to establish a level of quality and performance
34 requirements unless more explicit restrictions are stated to apply.

35

36 All material shall be listed by and shall bear the label of an approved electrical testing laboratory. If none
37 of the approved electrical testing laboratories has published standards for a particular item, then other
38 national independent testing standards, if available, applicable shall apply and such items shall bear those
39 labels. Where one of the approved electrical testing laboratories has an applicable system listing and label,
40 the entire system, except for medium voltage equipment and components, shall be so labeled.

41

42 **CONTINUITY OF EXISTING SERVICES AND SYSTEMS**

43 No outages shall be permitted on existing systems except at the time and during the interval specified by
44 the owner. The institution may require written approval. Any outage must be scheduled when the
45 interruption causes the least interference with normal institutional schedules and business routines. No
46 extra costs will be paid to the Contractor for such outages which must occur outside of regular weekly
47 working hours.

48

49 This Contractor shall restore any circuit interrupted as a result of this work to proper operation as soon as
50 possible. Note that institutional operations are on a seven-day week schedule.

51

52 **PROTECTION OF FINISHED SURFACES**

53 Furnish one can of touch-up paint for each different color factory finish furnished by the Contractor.
54 Deliver touch-up paint with other "loose and detachable parts" as covered in the General Requirements.

55

56 **APPROVED ELECTRICAL TESTING LABORATORIES**

57 The following laboratories are approved for providing electrical product safety testing and listing services
58 as required in these specifications:
59 Underwriters Laboratories Inc.
60 Electrical Testing Laboratories, Inc.

1 **SLEEVES AND OPENINGS**
2 Provide all sleeves and openings required for execution of required work.
3

4 **SEALING AND FIRESTOPPING**
5 Sealing and firestopping of sleeves/openings between conduits, cable trays, wireways, troughs, etc. and the
6 structural or partition opening shall be the responsibility of the contractor whose work penetrates the
7 opening. The contractor responsible shall hire individuals skilled in such work to do the sealing and
8 firestopping. These individuals hired shall normally and routinely be employed in the sealing and
9 fireproofing occupation.
10

11 **INTENT**
12 The Contractor shall furnish and install all the necessary materials, apparatus, and devices to complete the
13 electrical equipment and systems installation herein specified, except such parts as are specifically
14 exempted herein.
15

16 If an item is either called for in the specifications or shown on the plans, it shall be considered sufficient for
17 the inclusion of said item in this contract. If a conflict exists within the Specifications or exists within the
18 Drawings, the Contractor shall furnish the item, system, or workmanship, which is the highest quality,
19 largest, or most closely fits the A/E's intent. Refer to the General Conditions of the Contract for further
20 clarification.
21

22 It must be understood that the details and drawings are diagrammatic. The Contractor shall verify all
23 dimensions at the site and be responsible for their accuracy.
24

25 All sizes as given are minimum except as noted.
26

27 Materials and labor shall be new (unless noted or stated otherwise), first class, and workmanlike, and shall
28 be subject at all times to the A/E's inspections, tests and approval from the commencement until the
29 acceptance of the completed work.
30

31 Whenever a particular manufacturer's product is named, it is intended to establish a level of quality and
32 performance requirements unless more explicit restrictions are stated to apply.
33

34 **OMISSIONS**
35 No later than ten (10) days before bid opening, the Contractor shall call the attention of the A/E to any
36 materials or apparatus the Contractor believes to be inadequate and to any necessary items of work omitted.
37

38 **SUBMITTALS**
39 Submit for all equipment and systems as indicated in the respective specification sections, marking each
40 submittal with that specification section number. Mark general catalog sheets and drawings to indicate
41 specific items being submitted and proper identification of equipment by name and/or number, as indicated
42 in the contract documents. Failure to do this may result in the submittal(s) being returned to the Contractor
43 for correction and resubmission. Failing to follow these instructions does not relieve the Contractor from
44 the requirement of meeting the project schedule.
45

46 Submittals shall be grouped to include complete submittals of related systems, products, and accessories in
47 a single submittal. Mark dimensions and values in units to match those specified. Include wiring diagrams
48 of electrically powered equipment.
49

50 The submittals must be approved before fabrication is authorized.
51

52 Submit sufficient quantities of submittals to allow the following distribution:

53	Operating and Maintenance Manuals	2 copies
54	Owner	2 copies
55	A/E	2 copies
56	Contractors Use	as required

57

58 **PROJECT/SITE CONDITIONS**
59 Install Work in locations shown on Drawings, unless prevented by Project conditions.
60

1 Prepare drawings showing proposed rearrangement of Work to meet Project conditions, including changes
2 to Work specified in other Sections.

3
4 Tools, materials and equipment shall be confined to areas designated by the owner.
5

6 **ASBESTOS ABATEMENT**

7 The owner is responsible for identifying Asbestos Containing Materials (ACMs) in the building. The
8 Contractor is responsible for marking the extent of the identified ACMs that will be disturbed by the
9 Contractor's work and coordination with an asbestos abatement contractor under a direct contract with the
10 State. The asbestos abatement contractor will require sole occupancy of the work space during asbestos
11 abatement work. Contractor shall communicate with the asbestos abatement contractor and make adequate
12 allowance for the asbestos abatement work in the work schedule. Contractor shall not supply or install any
13 materials that contain any amount of asbestos.
14

15 **WORK SEQUENCE AND SCHEDULING**

16 Install work in phases to accommodate owner's occupancy requirements. During the construction period
17 coordinate electrical schedule and operations with owner.
18

19 The following phasing description is intended to be general in nature and not intended to provide
20 contractors means and methods. Phasing description is not all inclusive of every aspect of work required.
21 Complete coordination with owner shall be provided
22

23 Suggested Construction phasing:
24

25 Phase 1:

26 Provide power to 15 temporary workstations in annex area. Each workstation in annex area shall have
27 available a circuit and duplex receptacle connected to existing panel A, panel B, panel UPS A, and panel
28 UPS B.
29

30 Disruption to existing 911 operations shall be minimized.
31

32 Phase 2:

33 Power shall be available to and from existing panel A, panel B, panel UPS A, and panel UPS B at all times
34 to support all workstations in annex. Existing UPS A & UPS B systems shall remain functional until new
35 UPS systems A & B are available and functioning. Existing UPS feeders for annex shall be connected to
36 new UPS system when functional. Existing radio equipment and all other support equipment in radio
37 equipment room shall be maintained from existing UPS sources or new UPS sources. If services are
38 required to be interrupted, a temporary trailer mounted generator shall be provided to supply power to the
39 disrupted services or temporary circuits shall be provided from available acceptable power source. Service
40 interruptions shall be coordinated with owner.
41

42 Removal of existing batteries for UPS system A and B shall be completed as early as possible to allow
43 completion of installation of new AHU 1 and 2.
44

45 Demolition of phase 2 may begin following the completion of phase 1.
46

47 New UPS system A and B, new panel UPS A and UPS B, static transfer switch & new panel UC with
48 associated branch circuits shall be functional and available for connection to all existing equipment
49 connected to existing UPS C prior to demolition of existing UPS system C.
50

51 New UPS systems A and B with static transfer switch and panel C with all associated branch circuits to all
52 required equipment shall be completely functional at completion of phase 2.
53

54 All computer equipment shall be provided with dual power sources from both UPS A & UPS B for dual
55 corded equipment.

1
2 Phase 3:
3 Remove all lighting and power to temporary work stations in annex area.

4
5 Provide new lighting and devices in annex area.

6
7 **WORK BY OTHER TRADES**

8 Every attempt has been made to indicate in this trade's specifications and drawings all work required of this
9 Contractor. However, there may be additional specific paragraphs in other trade specifications and
10 addenda, and additional notes on drawings for other trades which pertain to this Trade's work, and thus
11 those additional requirements are hereby made a part of these specifications and drawings.

12
13 Electrical details on drawings for equipment to be provided by others is based on preliminary design data
14 only. This Contractor shall lay out the electrical work and shall be responsible for its correctness to match
15 equipment actually provided by others.

16
17 **OFFSITE STORAGE**

18 If payment will be requested for approved offsite stored material, then the Contractor shall complete an
19 "Off-site Storage Agreement". Prior approval by A/E for offsite storage will be needed. No material will
20 be accepted for offsite storage unless submittals for the material have been approved.

21
22 **REQUEST AND CERTIFICATE FOR PAYMENT**

23 Within 10 days after Notice to Proceed, the successful bidder will submit to the A/E in a form prescribed
24 below and by the General Conditions of the Contract, Scheduling and Coordination of Work, Reports,
25 Records and Data, and Payments to Contractor, a cost breakdown of the proposed values for work
26 performed which will become the basis for construction progress and monthly payments. The cost
27 breakdown items shall reflect actual work progress stages as closely as feasible.

28
29 In addition, if payment will be requested for approved off-site stored material, then that material shall be
30 listed as a line item and the Contractor shall complete an "Off-site Storage Agreement".

31
32 **SALVAGE MATERIALS**

33 No materials removed from this project shall be reused. All materials removed shall become the property
34 of and shall be disposed of by the Contractor.

35
36 **CERTIFICATES AND INSPECTIONS**

37 Obtain and pay for all required State installation inspections. Deliver originals of these certificates to the
38 A/E.

39
40 This contractor is responsible for coordination of all electrical inspection.

41
42 **OPERATION AND MAINTENANCE DATA**

43 All operations and maintenance data shall comply with the submission and content requirements specified
44 under section GENERAL REQUIREMENTS.

45
46 In addition to the general content specified under GENERAL REQUIREMENTS supply the following
47 additional documentation:

- 48 1. Manufacturer's wiring diagrams for electrically powered equipment.

49
50 **RECORD DRAWINGS**

51 The Contractor shall maintain at least one copy each of the specifications and drawings on the job site at all
52 times.

53
54 The A/E will provide the Contractor with a suitable set of contract drawings on which daily records of
55 changes and deviations from contract shall be recorded. Dimensions and elevations on the record drawings
56 shall locate all buried or concealed piping, conduit, or similar items.

57
58 The daily record of changes shall be the responsibility of Contractor's field superintendent. No arbitrary
59 mark-ups will be permitted.

60

1 At completion of the project, the Contractor shall submit the marked-up record drawings to the A/E prior to
2 final payment.

3 4 5 **PART 2 - PRODUCTS**

6 7 **ACCESS PANELS AND DOORS**

8 Lay-in Ceilings:

9 Removable lay-in ceiling tiles in 2 x 2 foot or 2 x 4 foot configuration provided under other divisions are
10 sufficient; no additional access provisions are required unless specifically indicated.

11 Concealed Spline Ceilings:

12 Removable sections of ceiling tile held in position with metal slats or tabs compatible with the ceiling
13 system used will be provided under other divisions.

14 Metal Pan Ceilings:

15 Removable sections of ceiling tile held in position by pressure fit will be provided under other divisions.

16 Plaster Walls and Ceilings:

17 16 gauge frame with not less than a 20 gauge hinged door panel, prime coated steel for general
18 applications, stainless steel for use in toilets, showers and similar wet areas, concealed hinges, screwdriver
19 operated cam latch for general application, key lock for use in public areas, UL listed for use in fire rated
20 partitions if required by the application. Use the largest size access opening possible, consistent with the
21 space and the equipment needing service; minimum size is 12" by 12".

22 **IDENTIFICATION**

23 See Electrical section 26 05 53 – Identification for Electrical Systems.

24 **SEALING AND FIRESTOPPING**

25 FIRE AND/OR SMOKE RATED PENETRATIONS:

26 Manufacturers:

27 3M, STI/SpecSeal, Tremco, Hilti or approved equal.

28 All firestopping systems shall be by the same manufacturer.

29 Submittals:

30 Contractor shall submit product data for each firestop system. Submittals shall include product
31 characteristics, performance and limitation criteria, test data, MSDS sheets, installation details and
32 procedures for each method of installation applicable to this project. For non-standard conditions where no
33 UL tested system exists, submit manufacturer's drawings for UL system with known performance for which
34 an engineering judgment can be based upon.

35 Product:

36 Firestop systems shall be UL listed or tested by an independent testing laboratory approved by the
37 Department of Commerce.

38 Use a product that has a rating not less than the rating of the wall or floor being penetrated. Reference
39 architectural drawings for identification of fire and/or smoke rated walls and floors.

40 Contractor shall use firestop putty, caulk sealant, intumescent wrapstrips, intumescent firestop collars,
41 firestop mortar or a combination of these products to provide a UL listed system for each application
42 required for this project. Provide mineral wool backing where specified in manufacturer's application detail.

43 NON-RATED PENETRATIONS:

44 Conduit Penetrations Through Below Grade Walls:

45 In exterior wall openings below grade, use a modular mechanical type seal consisting of interlocking
46 synthetic rubber links shaped to continuously fill the annular space between the uninsulated conduit and the
47 cored opening or a water-stop type wall sleeve.

48 Conduit and Cable Tray Penetrations:

1 At conduit and cable tray penetrations of non-rated interior partitions, floors and exterior walls above
2 grade, use urethane caulk in annular space between conduit and sleeve, or the core drilled opening.
3

4 5 **PART 3 - EXECUTION** 6

7 **CUTTING AND PATCHING**

8 Refer to Division 1, General Requirements, Cutting and Patching.
9

10 **BUILDING ACCESS**

11 Arrange for the necessary openings in the building to allow for admittance of all apparatus. When the
12 building access was not previously arranged and must be provided by this contractor, restore any opening
13 to its original condition after the apparatus has been brought into the building.
14

15 **EQUIPMENT ACCESS**

16 Install all piping, conduit, ductwork, and accessories to permit access to equipment for maintenance.
17 Coordinate the exact location of wall and ceiling access panels and doors with the General Contractor,
18 making sure that access is available for all equipment and specialties. Where access is required in plaster
19 or drywall walls or ceilings, furnish the access doors to the General Contractor and reimburse the General
20 Contractor for installation of those access doors.
21

22 **COORDINATION**

23 The Contractor shall cooperate with other trades in locating work in a proper manner. Should it be
24 necessary to raise or lower or move longitudinally any part of the electrical work to better fit the general
25 installation, such work shall be done at no extra cost to the owner, provided such decision is reached prior
26 to actual installation. The Contractor shall check location of electrical outlets with respect to other
27 installations before installing.
28

29 The Contractor shall verify that all devices are compatible for the surfaces on which they will be used.
30 This includes, but is not limited to light fixtures, panelboards, devices, etc. and recessed or semi-recessed
31 heating units installed in/on architectural surfaces.
32

33 Coordinate all work with other contractors prior to installation. Any installed work that is not coordinated
34 and that interferes with other contractor's work shall be removed or relocated at the installing contractor's
35 expense.
36

37 Cooperate with the testing consultant in ensuring specification Section 26 05 04 compliance. Verify
38 system completion to the testing consultant. Demonstrate the starting, interlocking and control features of
39 each system so the testing contractor can perform its work.
40

41 **SLEEVES**

42 Pipe sleeves for conduits 6" in diameter and smaller, in new poured concrete construction, shall be schedule
43 40 steel pipe, plastic removable sleeve or sheet metal sleeve, all cast in place.
44

45 In wet area floor penetrations, top of sleeve to be 2 inches above the adjacent floor. In existing wet area
46 floor penetrations, core drill sleeve openings large enough to insert schedule 40 sleeve and grout the area
47 around the sleeve. If a pipe clamp resting on the sleeve supports the pipe penetrating the sleeve, weld a
48 collar or struts to the sleeve that will transfer weight to the existing floor structure. Wet areas for this
49 paragraph are rooms or spaces containing air handling unit coils, converters, pumps, chillers, boilers, and
50 similar waterside equipment.
51

52 Pipe penetrations in existing concrete floors that are not in wet areas may omit the use of schedule 40
53 sleeve and use the core drilled opening as the sleeve.
54

55 **SEALING AND FIRESTOPPING**

56 Fire and/or Smoke Penetrations:

57 Install approved product in accordance with the manufacturer's instructions where a pipe (i.e. cable tray,
58 bus, cable bus, conduit, wireway, trough, etc.) penetrates a fire rated surface.
59

1 Where firestop mortar is used to infill large fire-rated floor openings that could be required to support
2 weight, provide permanent structural forming. Firestop mortar alone is not adequate to support any
3 substantial weight.

4
5 **Non-Rated Surfaces:**

6 When the opening is through a non-fire rated wall, floor, ceiling or roof the opening must be sealed using
7 an approved type of material.

8
9 Install escutcheons or floor/ceiling plates where conduit, penetrates non-fire rated surfaces in occupied
10 spaces. Occupied spaces for this paragraph include only those rooms with finished ceilings and the
11 penetration occurs below the ceiling.

12
13 In exterior wall openings below grade, assemble rubber links of mechanical seal to the proper size for the
14 conduit and tighten in place, in accordance with the manufacturer's instructions. Install so that the bolts
15 used to tighten the seal are accessible from the interior of the building or vault.

16
17 At interior partitions, conduit penetrations are required to be sealed for all clean rooms, laboratories, and
18 most hospital spaces, computer rooms, dormitory rooms, tele/data/com rooms and similar spaces where the
19 room pressure or odor transmission must be controlled. Apply sealant to both sides of the penetration in
20 such a manner that the annular space between the conduit sleeve and the conduit is completely filled.

21
22 **HOUSEKEEPING AND CLEAN UP**

23 The Contractor shall clean up and remove from the premises, on a daily basis, all debris and rubbish
24 resulting from its work and shall repair all damage to new and existing equipment resulting from its work.
25 When job is complete, this Contractor shall remove all tools, excess material and equipment, etc., from the
26 site.

27
28 **AGENCY TRAINING**

29 Contractor to provide factory authorized representative and/or field personnel knowledgeable with the
30 operations, maintenance and troubleshooting of the system and/or components defined within this section
31 for a minimum period of 8 hours.

32
33
34 **END OF SECTION**

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SECTION 26 05 02
ELECTRICAL DEMOLITION FOR REMODELING

PART 1 - GENERAL

SCOPE

The work under this section includes disconnection and removal of all noted lighting, power, HVAC connections. Included are the following topics:

PART 1 - GENERAL

Scope

Related Work

PART 2 - PRODUCTS

Material and Equipment

PART 3 - EXECUTION

Examination

Preparation

Demolition and Extension of the Existing Electrical Work

PCB Ballast Handling and Disposal

Lamp Handling and Disposal

Cleaning and Repair

Installation

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.

Verify whether or not PCB ballasts exist in light fixtures which will be disposed of. If PCB light fixture ballasts exist, then follow requirements in **PCB BALLAST HANDLING AND DISPOSAL** below.

Demolition Drawings are based on casual field observation and/or existing record documents. Report discrepancies to the owner and Architect/Engineer 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, Architect, and 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. In particular, all security and safety systems must be maintained in operation at all times as required by the Owner. This includes security and safety lighting.

1 Existing Fire Alarm System: Maintain existing system in service until new system is accepted. Disable
2 system only to make switchovers and connections. Obtain permission from the owner and local Authority
3 Having Jurisdiction at least 7 days before partially or completely disabling system. Minimize outage
4 duration. If required, make temporary connections to maintain service in areas adjacent to work area.
5

6 Existing Communication/Data System: Maintain existing system in service until new system is complete
7 and ready for service. Disable system only to make switchovers and connections. Obtain permission from
8 the owner and local Telephone Utility. If required, make temporary connections to maintain service in areas
9 adjacent to work area.
10

11 Existing UPS System: Maintain existing system in service until new system is complete and ready for
12 service. Disable system only to make switchovers and connections. Obtain permission from the owner at
13 least 7 days before partially or completely disabling system. Minimize outage duration. If required, make
14 temporary connections to maintain service in areas adjacent to work area.
15

16 **DEMOLITION AND EXTENSION OF EXISTING ELECTRICAL WORK**

17 Demolish and extend existing electrical work to meet all requirements of these specifications.
18

19 If certain raceways and boxes are abandoned but not scheduled for removal, those items must be shown on
20 the "As Built Drawings".
21

22 Remove, relocate, and extend existing installations to accommodate new construction.
23

24 Remove abandoned wiring to source of supply.
25

26 Remove exposed abandoned conduit, including abandoned conduit above accessible ceiling finishes. Cut
27 conduit flush with walls and floors, and patch surfaces.
28

29 Disconnect abandoned outlets and remove devices. Remove abandoned outlets if conduit servicing them is
30 abandoned and removed. Provide blank cover for abandoned outlets which are not removed.
31

32 Disconnect and remove abandoned panelboards and distribution equipment.
33

34 Disconnect and remove electrical devices and equipment serving utilization equipment that has been
35 removed.
36

37 Disconnect and remove abandoned luminaires. Remove brackets, stems, hangers, and other accessories.
38

39 Disconnect and remove UPS systems and distribution.
40

41 Repair adjacent construction and finishes damaged during demolition and extension work.
42

43 Maintain access to existing electrical installations which remain active. Modify installation or provide
44 access panel as appropriate.
45

46 Extend existing installations using materials and methods compatible with existing electrical installations,
47 or as specified. This includes the extension of the circuit from the last active device to the next device in
48 the system to be activated.
49

50 **PCB BALLAST HANDLING AND DISPOSAL**

51 Generally, all high power factor fluorescent light ballasts manufactured before 1978 and some HID ballasts
52 contain PCB compounds in their capacitors. The Contractor shall inspect all ballasts in all light fixtures
53 (which will become the property of the Contractor and will be removed from the project site as part of this
54 project) and take the actions described below.
55

56 All ballasts labeled as "NON-PCBs" or "NO PCBs" shall become the property of the Contractor.
57 If the PCB content is not stated on the ballast label, the ballast shall be handled as a PCB ballast.
58

59 All PCB ballasts shall be removed from the light fixtures and shall have the wires clipped off.
60 However, before removal, all PCB ballasts shall be carefully inspected for leaks. If a ballast
61 appears to be leaking(evidenced by potting compound leaking out or by an oily film on the ballast
62 surface) the ballast must be handled per EPA and DNR PCB regulations. Basically, this means

1 the ballast is to be carefully removed from the fixture and placed in an approved drum. See
2 paragraph below for the drum specifications. The person removing the ballast from the fixture
3 shall wear protective gloves, eye protection, and protective clothing as necessary.
4

5 If the fixture has also been contaminated, it must be cleaned to less than 10 micrograms/100
6 square centimeters contamination before disposal. This cleaning must be done by an approved
7 PCB contractor and is not considered a part of this contract. Contact owner for contractor
8 approval before commencing with the cleanup.
9

10 The ballasts shall then be placed in US DOT approved type 17C or type 17H drums (barrels)
11 furnished by the Contractor. 55 gallon and 30 gallon drums are available from most drum
12 suppliers. The quantity and size of the drums will be determined by the Contractor at the time of
13 construction.
14

15 These barrels shall be placed in storage with the cover that came with the barrels, in a location
16 within a building, as designated by the Building Manager. The barrels are not to be placed outside
17 where they are exposed to weather.
18

19 THESE BALLASTS ARE NOT TO BE REMOVED FROM THE WORK SITE BY THE
20 CONTRACTOR. To do so, would be a violation of DNR and DOT hazardous waste regulations
21 and may result in a fine to the Contractor.
22

23 The Contractor shall label and mark the PCB storage drums with EPA approved PCB labels and
24 the storage area with signs, marks and lines to meet the regulations of Wisconsin Code NR 157.
25

26 The Contractor shall also provide approved PCB absorbent materials to be stored immediately
27 adjacent to the drum storage area. Do not place loose absorbent material in the drums.
28

29 The Contractor shall provide to the owner, in written form, a total count of these ballasts(or their
30 total weight by barrel) and where they are stored.
31

32 When the ballast demolition is completed and all PCB ballasts are placed in drums ready to be picked up
33 for disposal. The owner will then make arrangements for pickup and disposal of the PCB ballasts.
34

35 **LAMP HANDLING AND DISPOSAL**

36 All lamps (fluorescent, incandescent, and HID) contain mercury and/or lead (in the base) as well as other
37 heavy metals and compounds which are regulated by the EPA and DNR during the disposal process. As a
38 result, regulations have been issued covering the handling and disposal of all lamps. Therefore, lamps
39 which have been removed from service for disposal shall be handled as follows by the Contractor.
40

41 The Contractor shall very carefully remove all lamps (fluorescent, incandescent, and HID) from
42 light fixtures before removal of the fixture from its mounted position. This is to reduce the
43 likelihood that the lamp(s) will be broken. If the Contractor breaks more than 1% of the total
44 lamps removed for the project, the Contractor will be charged the cost difference between disposal
45 of broken lamps and disposal of unbroken lamps for all lamps broken in excess of 1% of the total
46 lamps removed in the project.
47

48 The Contractor shall obtain containers from owner's lamp and ballast recycling vendor. Contact
49 the owner's rep for recycling vendor contact information. Removed lamps shall be placed in
50 containers provided by the Contractor and marked with the number and type of lamps. Containers
51 shall be placed in storage in a location on the owner's property (this may be in another building)
52 arranged by the owner's representative. The Contractor shall label the area as "Hazardous Material
53 Storage - Mercury".
54

55 The Contractor shall provide to the owner's representative, in written form, a count of all stored
56 lamps by type at the completion of the project.
57

58 Owner will make arrangements for the lamps to be picked up.
59

60 **CLEANING AND REPAIR**

61 Clean and repair existing materials and equipment which remain or are to be reused.
62

1 Panelboards: Clean exposed surfaces and check tightness of electrical connections. Replace damaged
2 circuit breakers and provide closure plates for vacant positions. Provide typed circuit directory showing
3 revised circuiting arrangement.

4
5 Luminaires: Remove existing luminaires for cleaning. Use mild detergent to clean all exterior and interior
6 surfaces; rinse with clean water and wipe dry. Replace lamps, ballasts (if required) and broken electrical
7 parts.

8
9 **INSTALLATION**

10 Install relocated materials and equipment under the provisions of other sections.

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13

END OF SECTION

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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
Lightning/Surge Arresters
Mechanical and Electrical Interlock System
Dry Type Transformers
Cables
Panelboards
Light Fixtures
Occupancy Sensors
Battery Pack Emergency Lighting
UPS System
Automatic Transfer Switches

RELATED WORK

Applicable provisions of Division 1 govern work under this Section.

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 testing, shall be reported to the A/E. 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.

1 Clean All Equipment:
2 Vacuum inside of panelboards, switchboards, transformer core and coils, fire alarm panels,
3 comm/data, security panel, etc.
4 Loosen attached particles and vacuum them away.
5 Wipe all insulators with a clean, dry, lint free rag.
6 Clean insulator grooves.
7 Re-vacuum inside surfaces as directed by the A/E.

8
9 Inspect equipment anchorage.

10 Inspect equipment and bus alignment.

11
12 Check all heater elements for operation and control.

13
14 Lubricate nonelectrical equipment per manufacturer's recommendations.

15
16 **GROUNDING SYSTEMS**

17 Inspect the ground system for adequate termination at all devices.

18
19 **LIGHTNING/SURGE ARRESTERS**

20 Inspect for physical damage such as chipped or fractured porcelain. Wipe clean.

21
22 Perform a ground continuity test to ground system.

23
24 Verify the proper mounting and adequate clearance.

25
26 Verify the voltage of the units with system one line diagram. Report any discrepancies.

27
28 Verify that the electronic surge protection is connected properly and status lights are normal.

29
30 **MECHANICAL AND ELECTRICAL INTERLOCK SYSTEM**

31 Physically test each system to insure proper function, operation and sequencing.

32
33 Closure attempt shall be made on locked open devices.

34
35 Opening attempt shall be made on locked closed devices.

36
37 Key exchange shall be made with devices operated in off normal positions.

38
39 **DRY TYPE TRANSFORMERS**

40 Test and adjust the cooling fans, controls and alarm functions.

41
42 Measure secondary voltage phase-to-phase and phase-to-ground after final energization and prior to loading.

43
44 Verify and/or connect transformer "XO" to ground, load side of "WYE" systems.

45
46 **CABLES**

47 Visual and Mechanical Inspections:

48 Inspect exposed sections for physical damage.

49 Verify cable is supplied and connected in accordance with single line diagram.

50 Inspect for shield grounding, cable support and termination.

51 If cables are terminated through window type C.T.'s make an inspection to verify that neutrals and grounds are properly terminated for normal operation of protective devices.

52 Inspect for visual jacket and insulation condition.

53 Visible cable bends shall be checked against ICEA or manufacturer's minimum allowable bending radii -- 12 times the diameter for tape shielded cables.

54 Inspect for proper fireproofing in common cable areas.

55 There shall be NO tests performed on existing cable without specific direction from the Consulting Engineer.

56
57
58
59
60
61 Electrical Tests -- Below 600 Volts:

1 All secondary cables from the substation transformers to the secondary switchboards shall be
2 subjected to insulation tests using a 500 vdc megger.
3 Visually inspect cables, lugs, connectors and all other components for physical damage and proper
4 connections
5 Check all cable connectors for tightness (with a torque wrench) and clearances. Torque test
6 conductor and bus terminations to manufacturer's recommendations.
7 Check for proper grounding resistance at all services and at transformers. Resistance shall be 2
8 ohms maximum.
9 -- Above 600 volts:
10 Above 600 volt testing will be performed under a separate contract.

11
12 **PANELBOARDS**

13 Torque all the connections per the manufacturers spec. Verify phase wires, color coding, separate neutral
14 and mechanical bonding. Verify circuit breaker operation. Verify the directory.

15
16 **LIGHT FIXTURES**

17 Check the bonding and proper lamping. Verify that recessed fixtures are installed with hold down clips.
18 Confirm operation of the fixture with the proper switch or sensor.

19
20 **OCCUPANCY SENSORS**

21 Confirm operation of the sensor per the manufacturers spec.

22
23 **BATTERY PACK EMERGENCY LIGHTING**

24 Verify the operation per the manufacturers spec and run all of the diagnostic steps. Confirm proper
25 grounding and location.

26
27 **UPS SYSTEM**

28 Operate and test the system per the manufacturers spec. Confirm the batteries and liquid level along with
29 the transfer scheme.

30
31 **AUTOMATIC TRANSFER SWITCHES**

32 Coordinate with the generator and the subsequent tests.

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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
- Modular Wiring Systems - Light Fixtures
- Modular Wiring Systems - Receptacles
- Wiring Connectors

PART 3 - EXECUTION

- General Wiring Methods
- Wiring Installation In Raceways
- Modular Wiring System Installation
- Wiring Connections and Terminations
- Field Quality Control
- Wire Color
- Branch Circuits
- Emergency Circuits

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.

REFERENCES

NFPA 70 - National Electrical Code.

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.

1
2
3 **PART 2 - PRODUCTS**
4

5 **GENERAL**

6 All wire shall be new, delivered to the site in unbroken cartons and shall be less than one year old out of
7 manufacturer's stock.

8
9 All conductors shall be copper.

10 Insulation shall have a 600 volt rating.

11
12 All conductors shall be stranded.

13
14
15 Stranded conductors may only be terminated with UL OR ETL Listed type terminations or
16 methods: e.g. stranded conductors may not be wrapped around a terminal screw but must be
17 terminated with a crimp type device or must be terminated in an approved back wired method.

18
19 **BUILDING WIRE**

20 Description: Single conductor insulated wire.

21
22 Insulation: Type THHN/THWN, XHHW-2 insulation for feeders and branch circuits.

23
24 **WIRING CONNECTORS**

25 Split Bolt Connectors: Not acceptable.

26
27 Solderless Pressure Connectors: High copper alloy terminal. May be used only for cable termination to
28 equipment pads or terminals. Not approved for splicing.

29
30 Spring Wire Connectors: Solderless spring type pressure connector with insulating covers for copper wire
31 splices and taps. Use for conductor sizes 10 AWG and smaller.

32
33 All wire connectors used in underground or exterior pull boxes shall be gel filled twist connectors or a
34 connector designed for damp and wet locations.

35
36 Mechanical Connectors: Bolted type tin-plated; high conductivity copper alloy; spacer between conductors;
37 beveled cable entrances.

38
39 Compression (crimp) Connectors: Long barrel; seamless, tin-plated electrolytic copper tubing; internally
40 beveled barrel ends. Connector shall be clearly marked with the wire size and type and proper number and
41 location of crimps.

42
43 **PART 3 - EXECUTION**
44

45 **GENERAL WIRING METHODS**

46 All wire and cable shall be installed in conduit.

47
48 Do not use wire smaller than 12 AWG for power and lighting circuits.

49
50 All conductors shall be sized to prevent excessive voltage drop at rated circuit ampacity. As a minimum
51 use 10 AWG conductor for 20 ampere, 120 volt branch circuit home runs longer than 100 feet (30 m), and
52 for 20 ampere, 277 volt branch circuit home runs longer than 200 feet (61 m).

53
54 Make conductor lengths for parallel conductors equal.

55
56 Splice only in junction or outlet boxes.

57
58 No conductor less than 10 AWG shall be installed in exterior underground conduit.

59
60 Identify ALL low voltage, 600v and lower, wire per section 26 05 53.
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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 wire pulling lubricant for pulling 4 AWG and larger wires and for other conditions when necessary.

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.

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 spring type pressure connectors 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 conductor.

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:

Equipment 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.

Contractor shall correct all deficiencies reported in the test report.

WIRE COLOR

General:

For wire sizes 10 AWG and smaller - Wire shall be colored as indicated below.

For wire sizes 8 AWG and larger – Use colored wire, or identify wire with colored tape at all terminals, splices and boxes. Colors to be as indicated below.

In existing facilities, use existing color scheme.

1 In new facilities, use black and red for single phase circuits at 120/240 volts, use Phase A black,
2 Phase B red and Phase C blue for circuits at 120/208 volts single or three phase, and use Phase A
3 brown, Phase B orange and Phase C yellow for circuits at 277/480 volts single or three phase.
4 Note: This includes fixture whips except for Listed whips mounted by the fixture manufacturer on
5 the fixture and Listed as a System.
6

7 All switch legs shall be the same color as their associated circuit. Traveler conductors run
8 between 3 and 4 way switches shall be colored pink or purple.
9

10 Neutral Conductors: White for 120/208V, Gray for 277/480V systems. Where there are two or more
11 neutrals in one conduit, each shall be individually identified with a different stripe.
12

13 Branch Circuit Conductors: Three or four wire home runs shall have each phase uniquely color coded.
14

15 Feeder Circuit Conductors: Each phase shall be uniquely color coded.
16

17 Ground Conductors: Green for 6 AWG and smaller. For 4 AWG and larger, identify with green colored
18 wire, or with green tape at both ends and at all access points, such as panelboards, motor starters,
19 disconnects and junction boxes. When isolated grounds are required, contractor shall provide green with
20 yellow tracer.
21

22 **BRANCH CIRCUITS**

23 The use of single-phase, multi-wire branch circuits with a common neutral is not permitted. All branch
24 circuits shall be furnished and installed with an individual accompanying neutral, sized the same as the
25 phase conductors.
26

27 **EMERGENCY CIRCUITS**

28 All emergency system wiring (level 1 and level 2) shall be installed in separate raceways after their
29 associated transfer switches. The wiring shall be separate from each other and from all normal system
30 wiring.
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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

- Mechanical Connectors
- Compression Connectors
- Exothermic Connections
- Wire

PART 3 - EXECUTION

- Examination
- General
- Less Than 600 Volt System Grounding
- Field Quality Control

RELATED WORK

Applicable provisions of Division 1 govern work under this Section.

REFERENCES

NFPA 70 - National Electrical Code.
ANSI/IEEE 142 (Latest edition) - Recommended Practice for Grounding of Industrial and Commercial Power Systems.

PERFORMANCE REQUIREMENTS

Grounding System Resistance: 2ohms maximum at building service entrance.

SUBMITTALS

Product Data: Provide data for grounding electrodes and connections.

Test Reports: Indicate overall resistance to ground [and resistance of each electrode].

Manufacturer's Instructions: Include instructions for preparation, installation and examination of exothermic connectors.

PROJECT RECORD DOCUMENTS

Accurately record actual locations of 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

MECHANICAL CONNECTORS

1 The mechanical connector bodies shall be manufactured from high strength, high conductivity cast copper
2 alloy material. Bolts, nuts, washers and lockwashers shall be made of Silicon Bronze and supplied as a part
3 of the connector body and shall be of the two bolt type.

4
5 Split bolt connector types are NOT allowed. Exception: the use of split bolts is acceptable for grounding of
6 wire-basket type cable tray, and for cable shields/straps of medium voltage cable.

7
8 The connectors shall meet or exceed UL 467 and be clearly marked with the catalog number, conductor
9 size and manufacturer.

10 **COMPRESSION CONNECTORS**

11 The compression connectors shall be manufactured from pure wrought copper. The conductivity of this
12 material shall be no less than 99% by IACS standards.

13
14 The connectors shall meet or exceed the performance requirements of IEEE 837, latest revision.

15
16 The installation of the connectors shall be made with a compression, tool and die system, as recommended
17 by the manufacturer of the connectors.

18
19 The connectors shall be clearly marked with the manufacturer, catalog number, conductor size and the
20 required compression tool settings.

21
22 Each connector shall be factory filled with an oxide-inhibiting compound.

23
24 **EXOTHERMIC CONNECTIONS**

25 As manufactured by Cadweld or similar.

26
27 **WIRE**

28 Material: Stranded copper (aluminum not permitted).

29
30 Grounding Electrode Conductor: Size as shown on drawings, specifications or as required by NFPA 70,
31 whichever is larger.

32
33 Feeder and Branch Circuit Equipment Ground: Size as shown on drawings, specifications or as required by
34 NFPA 70, whichever is larger. Differentiate between the normal ground and the isolated ground when both
35 are used on the same facility.

36
37
38
39 **PART 3 - EXECUTION**

40
41 **EXAMINATION**

42 Verify that final backfill and compaction has been completed before driving rod electrodes.

43
44 **GENERAL**

45 Install Products in accordance with manufacturer's instructions.

46
47 Mechanical connections shall be accessible for inspection and checking. No insulation shall be installed
48 over mechanical ground connections.

49
50 Ground connection surfaces shall be cleaned and all connections shall be made so that it is impossible to
51 move them.

52
53 Attach grounds permanently before permanent building service is energized.

54
55 All grounding electrode conductors shall be installed in PVC conduit, in exposed locations.

56
57 **LESS THAN 600 VOLT SYSTEM GROUNDING**

58 Supplementary Grounding Electrode: Use driven ground rod in main service equipment area.

1 Provide code sized copper grounding electrode conductor from secondary switchboard ground bus, each
2 separately derived system neutral, secondary service system neutral to street side of water meter, building
3 steel, ground rod, and any concrete encased electrodes. Provide bonding jumper around water meter.
4
5 Bond together system neutrals, service equipment enclosures, exposed non-current carrying metal parts of
6 electrical equipment, metal raceway systems, grounding conductor in raceways and cables, receptacle
7 ground connectors, and plumbing systems.
8
9 Install ground grid under access floors where indicated. Construct grid of #4 AWG bare copper wire
10 installed on 72 inch centers both ways. Bond each access floor support pedestal to grid.
11
12 Bond together each metallic raceway, pipe, duct and other metal object entering space under access floors.
13 Bond to underfloor ground grid. Use #4 AWG bare copper conductor.
14
15 Equipment Grounding Conductor: Provide separate, insulated equipment grounding conductor within each
16 raceway. Terminate each end on suitable lug, bus, enclosure or bushing. Provide a ground wire from each
17 device to the respective enclosure.
18
19 Provide communications system grounding conductor at point of service entrance and connect to building
20 common grounding electrode system.
21
22 Telecommunications and Audio Visual systems shall be installed with an isolated grounding system which
23 has only one ground point. That ground point is to be the common grounding electrode system at the
24 electrical service entrance for the building. Contractor is to provide an isolated grounding conductor from
25 the electrical service entrance of the building to each Telecommunications Grounding Bus Bar (TGBB) in
26 each Telecommunication Room. Use a minimum No. 2/0 AWG copper conductor, or as indicated on the
27 plans, for the telecommunications service grounding conductor. Leave 10 feet slack grounding conductor
28 at each Telecommunications Room. The grounding conductor MUST NOT be attached to building steel
29 (except as allowed at the main electrical service entrance).
30
31 Telecommunications Equipment Rack Grounding: Use a #6 or larger AWG copper conductor from all
32 telecommunications cabinets and racks to the Telecommunications Grounding Bus Bar (TGBB) in each
33 Telecommunication Room.
34
35 **FIELD QUALITY CONTROL**
36 Inspect grounding and bonding system conductors and connections for tightness and proper installation.
37
38
39

END OF SECTION

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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.

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.

Power-actuated fasteners and plastic wall anchors are not permitted.

File and de-bur cut ends of support channel and spray paint with cold galvanized paint to prevent rusting.

- 1
- 2 Do not fasten supports to piping, ductwork, mechanical equipment, cable tray or conduit. Do not fasten to
- 3 suspended ceiling grid system.
- 4
- 5 Do not drill structural steel members unless approved by A/E.
- 6
- 7 Fabricate supports from galvanized structural steel or steel channel, rigidly welded or bolted to present a
- 8 neat appearance. Use hexagon head bolts with spring lock washers under all nuts.
- 9
- 10 In wet locations, mechanical rooms and electrical rooms install free-standing electrical equipment on 3.5
- 11 inch (89 mm) concrete pads.
- 12
- 13 Install surface-mounted cabinets and panelboards with minimum of four anchors. Provide steel channel
- 14 supports to stand cabinet one inch (25 mm) off wall (7/8" Uni-strut or 3/4" painted, fire-retardant plywood is
- 15 acceptable).
- 16
- 17 Bridge studs top and bottom with channels to support flush-mounted cabinets and panelboards in stud
- 18 walls.
- 19
- 20 Furnish and install all supports as required to fasten all electrical components required for the project,
- 21 including free standing supports required for those items remotely mounted from the building structure,
- 22 catwalks, walkways etc.
- 23
- 24
- 25

END OF SECTION

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SECTION 26 05 33
RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

SCOPE

The work under this section includes conduits, surface raceways, multi-outlet assemblies, auxiliary gutters, wall duct, and boxes for electrical systems including wall and ceiling outlet boxes, floor boxes, and junction boxes. Included are the following topics:

PART 1 - GENERAL

Scope
Related Work
Submittals

PART 2 - PRODUCTS

Rigid Metal Conduit and Fittings
Intermediate Metal Conduit (IMC) and Fittings
Electrical Metallic Tubing (EMT) and Fittings
Flexible Metal Conduit and Fittings
Liquidtight Flexible Metal Conduit and Fittings
Rigid Nonmetallic Conduit and Fittings
Conduit Supports
Surface Metal Raceway
Multi-Outlet Assembly
Tele-Power Poles
Outlet Boxes
Floor Boxes
Pull and Junction Boxes
General

PART 3 - EXECUTION

Conduit Sizing, Arrangement and Support
Conduit Installation
Conduit Installation Schedule
Auxiliary Gutters (Wireways) Installation
Coordination of Box Locations
Outlet Box Installation
Tele-Power Pole Installation
Floor Box Installation
Pull and Junction Box Installation

RELATED WORK

Applicable provisions of Division 1 govern work under this section.

Section 26 05 29 – Hangers and Supports for Electrical Systems.

Section 26 27 26 – Wiring Devices.

Section 26 27 02 – Equipment Wiring Systems.

Section 28 31 00 – Fire Detection and Alarm.

Section 27 00 00 – Communications Cable and Equipment.

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.

PART 2 - PRODUCTS

RIGID METAL CONDUIT AND FITTINGS

Conduit: Heavy wall, galvanized steel, schedule 40, threaded.

Fittings and Conduit Bodies: Use all steel threaded fittings and conduit bodies.

1
2 **INTERMEDIATE METAL CONDUIT (IMC) AND FITTINGS**

3 Conduit: Galvanized steel, threaded.

4
5 Fittings and Conduit Bodies: Use all steel threaded fittings and conduit bodies.

6
7 **ELECTRICAL METALLIC TUBING (EMT) AND FITTINGS**

8 Conduit: Steel, galvanized tubing.

9
10 Fittings: All steel, set screw, concrete tight. No push-on or indenter types permitted.

11 Conduit Bodies: All steel threaded conduit bodies.

12
13 **FLEXIBLE METAL CONDUIT AND FITTINGS**

14 Conduit: steel, galvanized, spiral strip.

15
16 Fittings and Conduit Bodies: All steel, galvanized, or malleable iron (except as allowed in specification 26
17 51 13).

18
19 **LIQUIDTIGHT FLEXIBLE METAL CONDUIT AND FITTINGS**

20 Conduit: flexible, steel, galvanized, spiral strip with an outer Liquidtight, nonmetallic, sunlight-resistant
21 jacket.

22
23 Fittings and Conduit Bodies: ANSI/NEMA FB 1, compression type. There shall be a metallic cover/insert
24 on the end of the conduit inside the connector housing to seal the cut conduit end.

25
26 **CONDUIT SUPPORTS**

27 See section 26 05 29.

28
29 **MULTI-OUTLET ASSEMBLY**

30 Description: Sheet metal channel with fitted cover suitable for use as a multi-outlet assembly.

31
32 Size: 2 3/4" x 1 15/32".

33 Receptacles: Provide covers and accessories to accept convenience receptacles specified in Section 26 27
34 26, type 5-20R, single receptacle.

35
36 Finish: Ivory enamel.

37
38 Fittings: Couplings, elbows, outlet and device boxes and connectors designed for use with multi-outlet
39 system.

40
41 **TELE-POWER POLES**

42 Tele-Power Poles are to be utilized in dry interior locations, only as covered in Articles 353 and 352 Part A
43 of the National Electrical Code, as adopted by the National Fire Protection Association and as approved by
44 the American National Standards Institute. The Wiremold Tele-Power Pole Series are UL Listed by
45 Underwriters Laboratories Inc. under File Nos. E15191 Guide PVGT, E53857 Guide PVUR, E41751
46 Guide RJPR, and E169069 Guide ZTFR. They are also cUL Listed in the above files, or are CSA Certified
47 in File LR350.

48
49 The Tele-Power Pole Systems specified herein for extension of power branch circuit wiring and/or
50 communication cabling services shall be the 30TP-4V System as manufactured by The Wiremold
51 Company. Systems of other manufacturers may be considered equal if, in the opinion, and the written
52 approval of the engineer, they meet all the performance standards specified herein.

53
54 The Tele-Power Pole channel shall be steel, ivory baked enamel finish with cross section of 30 TP-4V - 3"
55 x 2.75" [76mm x 70mm) with two separate compartments. One compartment is to be factory wired with
56 one duplex 20A, 125V NEMA 5-20R grounding type specification grade receptacle and one NEMA 7-20R
57 and ivory colored to match the pole finish. The harness is to be multiple circuits (8 conductor plus ground)
58 with #12 AWG solid type THHN conductors, factory assembled to the receptacles. 6" [152mm) conductor
59 leads are to be furnished for termination to the overhead wiring system.

60
61 The second compartment is to be for field installation of telephone or data network cabling. A

1 12" [305mm) removable cover section in this compartment must be provided to assemble and mount
2 communications connectors. This section must be removable without dismantling or removing the Tele-
3 Power Pole after installation. The cover section is to have knockouts for modular voice-data jacks (RJ-type)
4 as indicated on drawings, and a 1.375" x 2.7" (35mm x 69mm) rectangular knockout for a modular
5 furniture outlet. A "mouse hole" knockout with furnished grommet is to be included for straight through
6 communication cable access.

7
8 The Tele-Power Pole shall be 12' 5" [3.78m] long.

9
10 A full complement of fittings for the Tele-Power Pole shall be available including, but not limited to,
11 entrance end fitting for top of the electrical channel, ceiling trim plate, pole-mounting bracket, Velcro
12 carpet gripper pad, and adhesive pad.

13
14 The Tele-Power Poles must be UL Listed for field modifications, changes and additions of receptacles,
15 devices and circuits. Field installed device plates shall be available to add duplex, single 1.40" (36mm) and
16 1.59" (40mm) dia., and rectangular-type receptacles. These plates must be ivory in color to match the Tele-
17 Power Pole.

18
19 Add-on communication covers must be available to mount workstation device faceplates, inserts, and
20 specialty mounting bezels. The power pole manufacturer will provide a complete line of connectivity
21 outlets and multi-media modular inserts for UTP, fiber optic, coaxial, and other cabling types.

22
23 UTP inserts shall feature a unique recessed area for port labeling and shall be able to accommodate
24 designation icon buttons or icon labels. Custom label capabilities shall be available using templates that can
25 be downloaded from the Internet.

26
27 **OUTLET BOXES**

28 Sheet Metal Outlet Boxes: galvanized steel, with stamped knockouts.

29
30 Luminaire and Equipment Supporting Boxes: Rated for weight of equipment supported; include 3/8 inch
31 male fixture studs where required.

32
33 Concrete Ceiling Boxes: Concrete type.

34
35 Cast Boxes: Cast ferroalloy, or aluminum type deep type, gasketed cover, threaded hubs.

36
37 **FLOOR BOXES**

38 The raised floor box shall provide the interface between power and communication cabling beneath a raised
39 floor and the workstation where recessed power and communication device outlets are required.

40
41 The raised floor box is designed for indoor, dry location applications only and shall have been examined
42 and tested by Underwriters Laboratories, Inc. to their Standard UL514 and to Canadian Standard C22.2,
43 No. 18-22 and bear the Listing Mark.

44
45 Raised floor boxes and modular wiring shall be manufactured by Hubbell Wiring Systems Series AFB 501
46 or equal by Wiremold Series AC 10105 or T&B Steel City Series 664. There will be individual floor boxes
47 each for power and telecommunications. DO NOT route power and telecommunications to the same floor
48 boxes. See drawings for telecommunications faceplate information.

49
50 The panel opening shall be 10" x 10" and have an overall module depth of 4". Box shall be provided with
51 factory assembled, flexible, modular wiring system and connectors. Box shall be complete with 3 duplex
52 outlets – one brown, one gray and one red.

53
54 Factory assembled modular wiring system shall consist of 3 hots, 3 neutrals, 2 grounds for 2 general
55 circuits and one for isolated ground. All circuits shall be rated for 20A at 120/208V.

56
57 Factory assembled modular wiring system shall be complete with cable whips complete with male and
58 female connectors with sufficient length to allow future relocations.

59

1 Zone distribution boxes shall be provided to convert from building wiring to factory assembled modular
2 wiring system.

3
4 System shall be complete with all required splitter modules, extender cables, etc.
5

6 The box lid shall be constructed of die-cast zinc material and shall also be removable and 180 degree
7 reversible. The lid shall provide a removable cable guard for egress of power and communication
8 workstation cables. The cable guard, when in use, should extend above the surface of the lid for the
9 purpose of added protection of the workstation cables.

10
11 The trim flange shall be constructed of die-cast zinc material and have a minimum overall dimension of 12"
12 x 12".
13

14 The wiring chamber shall provide two separate compartments to accommodate power wiring on both sides
15 of the box and communications cabling also on both side of the box. The chamber shall also provide
16 complete access to the communication wiring plate, which will allow for removal of the communication
17 plate, without the need to disconnect the wiring of any communication device outlets. The box shall be
18 supplied with a power plate which shall have four duplex receptacle knockouts. Refer to drawings for
19 telecommunications and radio faceplate configurations. All openings into box shall have bushings to
20 protect cabling entering.

21 **PULL AND JUNCTION BOXES**

22 Pull boxes and junction boxes shall be minimum 4 inch square (100 mm) by 2 1/8th inches (54 mm) deep
23 for use with 1 inch (25 mm) conduit and smaller. On conduit systems using 1 1/4 inch (31.75 mm) conduit
24 or larger, pull and junction boxes shall be sized per NEC but not less than 4 11/16 inch square (117 mm).
25

26
27 For telecommunication, fiber optic, security, and other low voltage cable installations the NEC box size
28 requirements shall apply. All boxes, used on telecommunication, security, other low voltage and fiber optic
29 systems with conduits of 1 1/4" and larger, shall be sized per the NEC conduit requirements. For
30 determining box size, the conduit is the determining factor not the wire size.
31

32 Sheet Metal Boxes: code gauge galvanized steel, screw covers, flanged and spot welded joints and corners.
33

34 Sheet Metal Boxes Larger Than 12 Inches (300 mm) in any dimension shall have a hinged cover or a chain
35 installed between box and cover.
36

37 Cast Metal Boxes for Outdoor and Wet Location Installations: Type 4 and Type 6, flat-flanged,
38 surface-mounted junction box, UL listed as raintight. Galvanized cast iron or aluminum box and cover
39 with ground flange, neoprene gasket, and stainless steel cover screws.
40

41 Fiberglass or Concrete Handholes with weatherproof cover of non-skid finish shall be used for
42 underground installations.
43

44 Box extensions and adjacent boxes within 48" of each other are not allowed for the purpose of creating
45 more wire capacity.
46

47 Junction boxes 6" x 6" or larger size shall be without stamped knock-outs.
48

49 Wireways shall not be used in lieu of junction boxes.
50

51 **GENERAL**

52 All steel fittings and conduit bodies shall be galvanized.
53

54 No cast metal, or split-gland type fittings permitted.
55

56 Mogul-type condulets larger than 2 inch (50 mm) not permitted except as approved or detailed.
57

58 All conduit covers must be fastened to the conduit body with screws and be of the same manufacture.
59

60 Wireways, gutters and c-condulets shall not be used in lieu of pull boxes and condulets.
61

1 All boxes shall be of sufficient size to provide free space for all conductors enclosed in the box and shall
2 comply with NEC requirements.

3 4 5 **PART 3 - EXECUTION**

6 7 **CONDUIT SIZING, ARRANGEMENT, AND SUPPORT**

8 EMT is permitted to be used in sizes 4" (50 mm) and smaller for power and telecommunication systems.
9 See CONDUIT INSTALLATION SCHEDULE below for other limitations for EMT and other types of
10 conduit.

11
12 Size power conductor raceways for conductor type installed. Conduit size shall be 1/2 inch (13 mm)
13 minimum except **all homerun conduits shall be 3/4"**, or as specified elsewhere. All conduits used for
14 telecommunications and radio communications shall be a minimum of 1inch in size. **Caution: Per the**
15 **NEC, the allowable conductor ampacity is reduced when more than three current-carrying**
16 **conductors are installed in a raceway. Contractor must take the NEC ampacity adjustment factors**
17 **into account when sizing the raceway and wiring system.**

18
19 Size conduit for all other wiring, including but not limited to data, control, security, fire alarm,
20 telecommunications, signal, video, etc. shall be sized per number of conductors pulled and their cross-
21 section. 40% fill shall be maximum for all new conduit fills.

22
23 Arrange conduit to maintain headroom and present a neat appearance.

24
25 Route exposed conduit and conduit above accessible ceilings parallel and perpendicular to walls and
26 adjacent piping.

27
28 Maintain minimum 6 inch (150 mm) clearance between conduit and piping. Maintain 12 inch (300 mm)
29 clearance between conduit and heat sources such as flues, steam pipes, and heating appliances.

30
31 Arrange conduit supports to prevent distortion of alignment by wire pulling operations. Fasten conduit
32 using galvanized pipe straps, conduit racks (lay-in adjustable hangers), clevis hangers, or bolted split
33 stamped galvanized hangers.

34
35 Group conduit in parallel runs where practical and use conduit rack (lay-in adjustable hangers) constructed
36 of steel channel with conduit straps or clamps. Provide space for 25 percent additional conduit.

37
38 Do not fasten conduit with wire or perforated pipe straps. Before conductors are pulled, remove all wire
39 used for temporary conduit support during construction.

40
41 Support and fasten metal conduit at a maximum of 8 feet (2.4 m) on center.

42
43 Supports shall be independent of the installations of other trades, e.g. ceiling support wires, HVAC pipes,
44 other conduits, etc., unless so approved or detailed.

45
46 In general, all conduit shall be concealed except where noted on the drawings or approved by the
47 Architect/Engineer. Contractor shall verify with Architect/Engineer all surface conduit installations except
48 in mechanical rooms.

49
50 Changes in direction shall be made with symmetrical bends, cast steel boxes, stamped metal boxes or cast
51 steel conduit bodies.

52
53 For indoor conduits, no continuous conduit run shall exceed 100 feet (30 meters) without a junction box.

54
55 All conduits installed in exposed areas shall be installed with a box offset before entering box.

56 57 **CONDUIT INSTALLATION**

58 Cut conduit square; de-burr cut ends.

59
60 Conduit shall not be fastened to the corrugated metal roof deck.

1 Bring conduit to the shoulder of fittings and couplings and fasten securely.
2
3 Use conduit hubs for fastening conduit to cast boxes. Use sealing locknuts or conduit hubs for fastening
4 conduit to sheet metal boxes in damp or wet locations.
5
6 All conduit terminations (except for terminations into conduit bodies) shall use conduit hubs, or connectors
7 with one locknut, or shall use double locknuts (one each side of box wall) and insulated bushing. Provide
8 bushings for the ends of all conduit not terminated in box walls. Refer to Section 26 05 26 – Grounding
9 and Bonding for Electrical Systems for grounding bushing requirements.
10
11 Install no more than the equivalent of three 90 degree bends between boxes.
12
13 Use hydraulic one-shot conduit bender or factory elbows for bends in conduit larger than 2 inch (50 mm)
14 size unless sweep elbows are required.
15
16 Conduit shall be bent according to manufacturers recommendations. Torches or open flame shall not be
17 used to aid in bend of PVC conduit.
18
19 Use suitable conduit caps or other approved seals to protect installed conduit against entrance of dirt and
20 moisture.
21
22 Provide 1/8 inch (3 mm) nylon pull string in empty conduit, except sleeves and nipples.
23
24 Install expansion-deflection joints where conduit crosses building expansion joints. Note: expansion-
25 deflection joints are not required where conduit crosses building control joints if the control joint does not
26 act as an expansion joint. Install expansion fitting in PVC conduit runs as recommended by the
27 manufacturer.
28
29 Avoid moisture traps where possible. Where moisture traps are unavoidable, provide junction boxes with
30 drain fittings at conduit low points.
31
32 Where conduit passes between areas of differing temperatures such as into or out of cool rooms, freezers,
33 unheated and heated spaces, buildings, etc., provide Listed conduit seals to prevent the passage of moisture
34 and water vapor through the conduit.
35
36 Route conduit through roof openings for piping and ductwork where possible.
37
38 Ground and bond conduit under provisions of Section 26 05 26.
39
40 **CONDUIT INSTALLATION SCHEDULE**
41 Conduit other than that specified below for specific applications shall not be used.
42
43 Exposed Outdoor Locations: Rigid steel conduit.
44
45 Concealed in Concrete and Block Walls: Rigid steel conduit. Electrical metallic tubing. Schedule 40 PVC
46 conduit.
47
48 Wet Interior Locations: Rigid steel conduit. Schedule 40 PVC conduit.
49
50 Concealed Dry Interior Locations: Rigid steel conduit. Intermediate metal conduit. Electrical metallic
51 tubing.
52
53 Exposed Dry Interior Locations: Rigid steel conduit. Intermediate metal conduit. Electrical metallic tubing.
54
55 Motor and equipment connections: Flexible PVC coated metal conduit (all locations). Minimum length
56 shall be one foot (300 mm), maximum length shall be three feet (900 mm). Conduit must be installed
57 perpendicular to direction of equipment vibration to allow conduit to freely flex.
58
59 Light fixtures: Direct box or conduit connection for surface mounted and recessed fixtures. Flexible metal
60 conduit from a J-box for recessed lay-in light fixtures. Conduit size shall be 3/8" (10 mm) minimum
61 diameter and six foot (1.8 M) maximum length. Conduit length shall allow movement of fixture for
62 maintenance purposes.

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SURFACE METAL RACEWAY AND MULTI-OUTLET ASSEMBLY INSTALLATION

Use flat-head screws to fasten channel to surfaces every twenty-four (24) inches. Mount plumb and level.

Use suitable insulating bushings and inserts at connections to outlets and corner fittings.

Maintain grounding continuity between raceway components to provide a continuous grounding path under provisions of Section 26 05 26.

Fastener Option: Use clips and straps suitable for the purpose.

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.

Boxes shall not be fastened to the metal roof deck.

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.

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.

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" maximum) outlet boxes in masonry, concrete or tile construction 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.

Low Voltage:

Recessed (1/4" maximum) outlet boxes in masonry, concrete or tile construction shall be minimum 4 11/16 inch square, 2-1/8" deep. 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 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.

1 Use multiple-gang boxes where more than one device are mounted together; do not use sectional boxes.
2 Provide non-metallic barriers to separate wiring of different voltage systems.

3
4 Install boxes in walls without damaging wall insulation.

5
6 Coordinate mounting heights and locations of outlets mounted above counters, benches, and backsplashes.

7
8 Ceiling outlets shall be 4 inch square, minimum 2-1/8 inch (54 mm) deep except that concrete boxes and
9 plates will be approved where applicable. Position outlets to locate luminaires as shown on reflected
10 ceiling plans.

11
12 In inaccessible ceiling areas, position outlets and junction boxes within 6 inches (150 mm) of recessed
13 luminaire, to be accessible through luminaire ceiling opening.

14
15 Provide recessed outlet boxes in finished areas; secure boxes to interior wall and partition studs, accurately
16 positioning to allow for surface finish thickness. Use stamped steel stud bridges for flush outlets in hollow
17 stud wall, and adjustable steel channel fasteners for flush ceiling outlet boxes.

18
19 Align wall-mounted outlet boxes for switches, thermostats, and similar devices.

20
21 Provide cast ferroalloy or aluminum outlet boxes in exterior and wet locations.

22
23 Surface wall outlets shall be 4 inch (100 mm) square with raised covers for one and two gang requirements.
24 For three gang or larger requirements, use gang boxes with non-overlapping covers.

25
26 **TELE-POWER POLE INSTALLATION**

27 Prior to and during installation, refer to system layout or approval drawings containing all elements of the
28 system. Installer shall comply with detailed manufacturer's instruction sheets, which accompany system
29 components, as well as complete system instruction sheets, whichever is applicable.

30
31 All raceway systems shall be mechanically continuous and connected to all electrical outlets, boxes, device
32 mounting brackets, and cabinets, also in accordance with manufacturer's installation sheets.

33
34 All metal raceway shall be electrically continuous and bonded in accordance with the National Electric
35 Code for proper grounding.

36
37 Raceway shall be securely supported at intervals not exceeding 5' (1.5m) or in accordance with
38 manufacturer's installation sheets.

39
40 All Tele-Power Pole Systems shall be installed complete in accordance with the manufacturer's installation
41 sheets. All unused openings shall be closed.

42
43 **FLOOR BOX INSTALLATION**

44 The floor box shall be secured to the raised floor by the use of two locking toggles. The locking toggles
45 shall be integral to the box and adjusted by use of their locking screws.

46
47 Prior to and during installation, refer to system layout or approval drawings. Installer shall comply with
48 detailed manufacturer's installation instruction sheets, which accompany the raised floor box. All
49 equipment shall be warranted for one year from the date of final acceptance.

50
51 Verify power wires and data cables are separated by a physical barrier. Power wires and data cables shall
52 not be combined in any channel.

53
54 Protect installed products until completion of project.

55
56 Touch-up, repair or replace damaged products before Substantial Completion.

57
58 Label all building wiring at all junction boxes to match floor box circuits.

59
60 **PULL AND JUNCTION BOX INSTALLATION**

1 Locate pull boxes and junction boxes above accessible ceilings, in unfinished areas or furnish and install
2 access panels in non-accessible ceilings where boxes are installed. All boxes are to be readily-accessible.
3
4 Support pull and junction boxes independent of conduit.

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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, lighting, general wiring, signal, fire alarm, and telecommunications wire and cabling. Further, this section includes labeling of all terminations and related sub-systems. Included are the following topics:

PART 1 - GENERAL

- Scope
- Related Work
- Submittals

PART 2 - PRODUCTS

- Materials

PART 3 - EXECUTION

- General
- Junction and Pullbox Identification
- Power and Control Wire Identification
- Wiring Device Identification
- Nameplate Engraving
- 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 26 05 23 – Control-Voltage Electrical Power Cables
Section 27 00 00 – Communications Cable and Equipment

SUBMITTALS

Include schedule for nameplates and stenciling.

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. Exception: back side of device plates and junction boxes may use handwritten, legible labeling on box covers, unless specifically prohibited by other specification sections.

Cable label size shall be appropriate for the conductor or cable size(s), outlet faceplate layout and patch panel design. All labels shall be self-laminating, white/transparent vinyl and be wrapped around the cable or sheath. Labels for power conductors (600V and lower) shall be cloth-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.

Nameplates: Engraved three-layer laminated plastic, black letters on a white background. Emergency system (level 1 and level 2) shall use white letters on red background.

Tape (phase identification only): Scotch #35 tape in appropriate colors for system voltage and phase.

1 Adhesive type labels not permitted except for phase and wire identification. Machine generated adhesive
2 labels shall be permitted for device plates, 4-11/16" and smaller junction boxes, Fire alarm and control
3 devices.

6 PART 3 - EXECUTION

8 GENERAL

9 Where mixed voltages are used in one building (e.g. 4160 volt, 480 volt, 208 volt) each switch,
10 switchboard, junction box, equipment, etc., on each system must be labeled for voltage in addition to other
11 requirements listed herein.

12
13 All branch circuit and power panels must be identified with the same symbol used in circuit directory in
14 main distribution center.

15
16 Clean all surfaces before attaching labels with the label manufacturer's recommended cleaning agent.

17
18 Install all labels firmly as recommended by the label manufacturer.

19
20 Labels shall be installed plumb and neatly on all equipment.

21
22 Install nameplates parallel to equipment lines.

23
24 Secure nameplates to equipment fronts using screws, rivets or manufacturer approved adhesive or cement.

25
26 Embossed tape will not be permitted for any application.

28 JUNCTION AND PULLBOX IDENTIFICATION

29 The following junction and pullboxes shall be identified utilizing spray painted covers:

31 System	31 Color(s)
32 Secondary Power – 480Y/277V	Brown
33 Secondary Power – 208Y/120V, 240/120V	White
34 Emergency Power – 480Y/277V	Brown/Red
35 Emergency Power – 208Y/120V	White/Red
36 Fire Alarm	Red
37 Temperature Control	Green
38 Door Control and Door Monitoring System	Orange
39 Sound and Intercom Systems	Blue
40 Video Surveillance System/MATV	Yellow

41
42 Provide circuit numbers, and source panel designations for power wiring. Other system shall be identified
43 as shown on details or approved shop drawings. Temperature control shall identify the source.

45 POWER AND CONTROL WIRE IDENTIFICATION

46 Provide wire markers on each conductor in panelboard gutters, pull boxes, outlet and junction boxes, and at
47 load connection. Identify with branch circuit or feeder number for power and lighting circuits, and with
48 control wire number as indicated on schematic and interconnection diagrams or equipment manufacturer's
49 shop drawings for control wiring.

50
51 All wiring shall be labeled within 2 to 4 inches of terminations. Each end of a wire or cable shall be
52 labeled as soon as it is terminated including wiring used for temporary purposes.

54 WIRING DEVICE IDENTIFICATION

55 Wall switches, receptacles, occupancy sensors, wall dimmers, device plates and box covers, poke-through
56 fittings, access floor boxes, photocells and time clocks shall be identified with circuit numbers and source.
57 In exposed areas, identifications should be made inside of device covers, unless directed otherwise. Use
58 machine-generated labels, or neatly hand-written permanent marker.

60 NAMEPLATE ENGRAVING

61 Provide nameplates of minimum letter height as scheduled below.

- 1
2 Panelboards, Switchboards and Motor Control Centers: 1 inch (25 mm); identify equipment designation.
3 1/2 inch (13 mm); identify voltage rating, source and room location of the source.
4
5 Equipment Enclosures: 1 inch (25 mm); identify equipment designation.
6
7 Circuit Breakers, Switches, and Motor Starters in Panelboards or Switchboards or Motor Control Centers:
8 1/2 inch (13 mm); identify circuit and load served, including location.
9
10 Individual Circuit Breakers, Disconnect Switches, Enclosed Switches, and Motor Starters: 1/2 inch (13 mm);
11 identify source and load served.
12
13 Transformers: 1 inch (25 mm); identify equipment designation. 1/2 inch (13 mm); identify primary and
14 secondary voltages, primary source, and secondary load and location.
15
16 Junction boxes: 1 inch (25 mm); identify system source(s) and load(s) served. Junction boxes may be
17 neatly identified using a permanent marker.

18
19 **PANELBOARD DIRECTORIES**

20 Typed directories for panels must be covered with clear plastic, have a metal frame. Room number on
21 directories shall be Owner's numbers, not Plan numbers unless Owner so specifies.
22
23

24
END OF SECTION

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**SECTION 26 24 16
PANELBOARDS**

PART 1 - GENERAL

SCOPE

The work under this section includes main, distribution and branch circuit panelboards. Included are the following topics:

PART 1 - GENERAL

- Scope
- Related Work
- Submittals
- Operation and Maintenance Data
- Spare Parts

PART 2 - PRODUCTS

- Main and Distribution Panelboards
- Branch Circuit Panelboards

PART 3 - EXECUTION

- Installation
- Field Quality Control

RELATED WORK

Applicable provisions of Division 1 govern work under this Section.

SUBMITTALS

Include outline and support point dimensions, voltage, main bus ampacity, integrated short circuit ampere rating, and circuit breaker arrangement and sizes.

OPERATION AND MAINTENANCE DATA

All operations and maintenance data shall comply with the submission and content requirements specified under section GENERAL REQUIREMENTS.

SPARE PARTS

Keys: Furnish 2 keys for each panelboard to Owner.

PART 2 - PRODUCTS

MAIN AND DISTRIBUTION PANELBOARDS

Panelboards: Circuit breaker type.

Enclosure: NEMA Type 1. Minimum cabinet size: 5-3/4 inches (144 mm) deep; 20 inches (508 mm) wide, with 5" minimum gutter space top and bottom. Constructed of galvanized code gauge steel.

Provide cabinet front with hinged door with flush lock. Front cover shall be hinged to allow access to wiring gutters without removal of panel trim. Hinged trim shall be held in place with screw fasteners. Finish in manufacturer's standard gray enamel.

Provide metal directory holders with clear plastic covers.

Provide panelboards with copper bus (phase buses, bus fingers, etc.), ratings as scheduled on Drawings. Provide ground bars in all panelboards. Neutral and ground bars can be dual rated ALCU9. All spaces shall have bus fully extended and drilled for the future installation of breakers.

Minimum System (i.e. individual component) Short Circuit Rating: As shown on the Drawings.

Molded Case Circuit Breakers: Provide circuit breakers with integral thermal and instantaneous magnetic trip in each pole. Provide circuit breakers UL listed as Type HACR for air conditioning equipment branch circuits.

1 Circuit breakers shall be bolt-on type with common trip handle for all poles. No handle ties of any sort will
2 be approved.

4 **BRANCH CIRCUIT PANELBOARDS**

5 Lighting and Appliance Branch Circuit Panelboards: Circuit breaker type.

6
7 Enclosure: Type 1. Minimum cabinet size: 5-3/4 inches (144 mm) deep; 20 inches (508 mm) wide with 5"
8 minimum gutter space top and bottom. Constructed of galvanized code gauge steel. Panel enclosure (back
9 box) shall be of non-stamped type (without KO's) to avoid concentric break out problem.

10
11 Provide [flush] [surface] cabinet front with concealed trim clamps, concealed hinge and flush cylinder lock
12 all keyed alike. Front cover shall be hinged to allow access to wiring gutters without removal of panel
13 trim. Hinged trim shall be held in place with screw fasteners. Finish in manufacturer's standard gray
14 enamel.

15
16 Provide metal directory holders with clear plastic covers.

17
18 Provide panelboards with copper bus (phase buses, bus fingers, etc.), ratings as scheduled on Drawings.
19 Provide ground bars in all panelboards. Neutral and ground bars can be dual rated ALCU9. All spaces
20 shall have bus fully extended and drilled for the future installation of breakers.

21
22 Minimum System (i.e. individual component) Short Circuit Rating: As shown on the Drawings.

23
24 Molded Case Circuit Breakers: Bolt-on type thermal magnetic trip circuit breakers. Provide UL Class A
25 ground fault interrupter circuit breakers where shown on Drawings. Provide circuit breakers UL listed as
26 Type HACR for air conditioning equipment branch circuits.

27
28 Do not use tandem circuit breakers.

29
30 Circuit breakers shall be bolt-on type with common trip handle for all poles. No handle ties of any sort will
31 be approved.

32
33 All of the panelboards provided under this section shall be by the same manufacturer.

35 **PART 3 - EXECUTION**

37 **INSTALLATION**

38
39 See section 26 05 29 for support requirements.

40
41 Install panelboards plumb with wall finishes.

42
43 Height: 6 ft (2 m) to top.

44
45 Install a crimp type stud termination to stranded conductor when terminating on circuit breakers without a
46 captive assembly rated for terminating stranded conductors.

47
48 Provide filler plates for unused spaces in panelboards.

49
50 See section 26 05 53 for identification requirements. Provide typed circuit directory for each branch circuit
51 panelboard. Revise directory to reflect circuiting changes required to balance phase loads.

52
53 Stub three (3) empty 3/4" conduits to accessible location above ceiling or below floor out of each recessed
54 panelboard. Cap these conduits to prevent material from entering them.

55 **FIELD QUALITY CONTROL**

56
57 If aluminum conductors size #1/0 and larger (per Section 26 05 19) are to be used as panelboard feeders, it
58 is the responsibility of the contractor to provide panelboards with adequate wire bending space to
59 accommodate the aluminum conductors and terminators to meet allowable code requirements. The
60 Contractor shall circuit the panelboards as shown on the drawings. Measure steady state load currents at

1 each panelboard feeder. Should the difference at any panelboard between phases exceed 10 percent,
2 rearrange circuits in the panelboard to balance the phase loads within 10 percent.
3
4 Visual and Mechanical Inspection: Inspect for physical damage, proper alignment, anchorage, and
5 grounding. Check proper installation and tightness of connections.
6
7

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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 motors, VFDs, and panels

Included are the following topics:

PART 1 - GENERAL

- Scope
- Related Work
- Submittals
- Coordination

PART 2 - PRODUCTS

- Cords and Caps
- Other Products

PART 3 - EXECUTION

- Inspection
- Preparation
- Installation
- HVAC Connections

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 19 – Low-Voltage Electrical Power Conductors and Cables.

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 multiconductor 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

1 **INSPECTION**

2 Verify that equipment is ready for electrical connection, wiring, and energization.
3

4 **PREPARATION**

5 Review equipment submittals prior to installation and electrical rough-in. Verify location, size, and type of
6 connections. Coordinate details of equipment connections with supplier and installer.
7

8 **INSTALLATION**

9 Use wire and cable with insulation suitable for temperatures encountered in heat-producing equipment.
10

11 Make conduit connections to equipment using flexible PVC-coated metal conduit.
12

13 Install pre-finished cord set where connection with attachment plug is indicated or specified, or use
14 attachment plug with suitable strain-relief clamps.
15

16 Provide suitable strain-relief clamps for cord connections to outlet boxes and equipment connection boxes.
17

18 Make wiring connections in control panel or in wiring compartment of pre-wired equipment in accordance
19 with manufacturer's instructions. Provide interconnecting wiring where indicated.
20

21 Install disconnect switches, controllers, control stations, and control devices such as limit switches and
22 temperature switches as indicated. Connect with conduit and wiring as indicated.
23

24 Coolers and Freezers: Cut and seal conduit openings in freezer and cooler walls, floor, and ceilings.
25

26 **HVAC CONNECTIONS**

27 Provide all power wiring including all circuitry carrying electrical energy from panelboard or other source
28 through starters, variable frequency drives (VFDs), and disconnects to motors or to packaged control
29 panels. Packaged control panels may include disconnects and starters and overcurrent protection. Provide
30 all wiring between packaged control panels and motors.
31

32 VFD Installations: Install VFD input wiring and output wiring in separate conduit systems. Do not mix
33 VFD input power and output power, or control wiring in a common raceway.
34

35 Provide 120 volts to each temperature control panel. Coordinate requirements with HVAC/DDC
36 contractors.
37

38 Unless otherwise specified, all electrical motors and control devices such as aquastats, float and pressure
39 switches, fan powered VAV boxes, switches, electro-pneumatic switches, solenoid valves and damper
40 motors requiring mechanical connections shall be furnished and installed and wired by the Contractor
41 supplying the devices.
42

43 Each motor terminal box shall be connected with a minimum 12", maximum 36" piece of flexible PVC-
44 coated metal conduit to a fixed junction box. Conduit must be installed perpendicular to direction of
45 equipment vibration to allow conduit to freely flex.
46

47 Check for proper rotation of each motor.
48
49

50 **END OF SECTION**

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SECTION 26 27 26
WIRING DEVICES

PART 1 - GENERAL

SCOPE

The work under this section includes wall switches, receptacles, occupancy sensors, wall dimmers, device plates and box covers, poke-through service fittings, access floor boxes, photo cells and time clocks. Included are the following topics:

PART 1 - GENERAL

- Scope
- Related Work
- Submittals

PART 2 - PRODUCTS

- Wall Switches
- Receptacles
- Occupancy Sensors
- Wall Dimmers
- Device Plates and Box Covers
- Daylighting Controller

PART 3 - EXECUTION

- Installation
- Field Quality Control
- Occupancy Sensors
- Adjusting

RELATED WORK

Applicable provisions of Division 1 govern work under this Section.

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

Wall Switches for Lighting Circuits [and Motor Loads Under 1/2 HP]: 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 with separate green ground screw.

All switches shall be back and side wired, screw clamp type, suitable for solid or stranded wire up to #10 AWG. Switches shall be Leviton model 1221-S, Hubbell model CS1221, Pass & Seymour model CSB20, Cooper model CSB120, or approved equal.

Handle: Ivory made of nylon or high impact resistant material.

RECEPTACLES

Convenience and Straight-blade Receptacles: 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. 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.

1 Receptacles shall be Leviton model 5362-S, Hubbell model CR5362, Pass & Seymour model CRB5362,
2 Pass & Seymour model PT5362 with 90° connector, Cooper model 5362C, or approved equal.

3
4 Generally, all receptacles shall be duplex convenience type unless otherwise noted.

5
6 All receptacles installed within 6 feet of the outside edge of sinks, and in other damp or wet locations shall
7 be GFCI type.

8
9 GFCI Receptacles: Duplex convenience receptacle, Specification Grade, with integral ground fault current
10 interrupter meeting the requirements of UL standard 943 Class A and UL standard 498. GFCI receptacles
11 shall be Leviton model 8899, Hubbell model GRF5352, Pass & Seymour model 2095 or approved equal.

12
13 All receptacles on emergency circuits shall have a red face.

14
15 All receptacles designated as isolated ground shall have an isolated ground triangle imprint on the face of
16 the receptacle.

17
18 Locking-Blade Receptacles: As indicated on drawings.

19
20 Specific-use Receptacle Configuration: As indicated on drawings.

21
22 **OCCUPANCY SENSORS**

23 All occupancy sensors shall be hardwired type; battery type shall not be permitted.

24
25 Wall Mounted (Wall Switch Type)

26 The sensor shall use either passive infrared or, if dual technology, passive infrared and passive acoustic
27 sensing, or passive infrared and ultrasonic, for detecting room occupancy. The unit shall fit in/on a
28 standard single gang switch box.

29
30 Rated capacity: 600 watts minimum at 120 volts, 60 Hz; 1000 watts minimum at 277 volts, 60 Hz

31
32 Sensitivity shall be user adjustable or self adjusting type.

33
34 The delay timer shall be adjusted within a range of 6 to 30 minutes by the contractor in the field. The
35 sensor shall have a test mode for performance testing.

36
37 The off switch shall have manual override for positive off and automatic on.

38
39 The test LED shall indicate motion.

40
41 The area of coverage shall be approximately 180 degrees by 35-40 feet.

42
43 The unit shall have a five year warranty.

44
45 Ceiling Mounted

46 The sensor shall use either passive infrared or, if dual technology, passive infrared and passive acoustic
47 sensing, or passive infrared and ultrasonic, for detecting room occupancy. The unit shall fit in/on a
48 standard octagon box. All ceiling mounted sensors shall be installed to a box with ring and box support.

49
50 Rated capacity shall be 20 amps at 120 or 277 volts, for fluorescent lamps. Provide power pack as required
51 for low voltage sensors.

52
53 Sensitivity shall be user adjustable or self adjusting type.

54
55 The delay timer shall be adjusted within a range of 6 to 30 minutes by the contractor in the field. The
56 sensor shall have a test mode for performance testing.

57
58 The coverage area shall be 360 degrees by approximately 15 feet radius when mounted at 9 foot height.
59 The sensor shall have provisions, such as masking, to block out problem areas.

60
61 Test LED to indicate motion.

1 The unit shall have a five year warranty.

2
3 See drawings for actual type of sensor.

4
5 **WALL DIMMERS**

6 Wall Dimmers: linear slide semiconductor type.

7
8 Rating: 600 Watts minimum, larger size to accommodate load shown on Contract Drawings.

9
10 **DEVICE PLATES AND BOX COVERS**

11 Decorative Cover Plate: Ivory, smooth thermoplastic nylon. Note requirement for red plates on emergency
12 outlets.

13
14 Surface Cover Plate: Raised galvanized steel.

15
16 **DAYLIGHTING CONTROLLER**

17 The light level controller shall be capable of detecting changes in lighting levels.

18
19 The light level controller shall utilize an internal photocell that measures light in a 100 degree angle cutting
20 the unwanted light from bright sources outside of this cone.

21
22 The light level controller shall be capable of controlling any type of lighting through use of power packs.
23 Light level controller shall operate from a 24 volt DC power supply; current draw is 22 milliamps.

24
25 The light level controller shall be capable of turning lighting on and off for a single zone and has a light
26 sensor over 1 to 1400fc.

27
28 The light level controller shall have an adjustable deadband feature with 25%, 50%, 75% or 100% in
29 relation to the setpoints. This prevents lighting from cycling when lighting goes on and off and from minor
30 changes due to cloud cover.

31
32 The light level controller shall have an adjustable time delay range of 3, 10, 15 or 30 minutes. This will
33 prevent cycling on partly cloudy days and is necessary with HID lighting.

34
35 The light level controller shall provide a connection for an optional low voltage, normally open momentary
36 contact watt switch override.

37
38 The light level controller provides a "hold on while occupied" feature that prohibits high levels from
39 turning OFF the controlled lights as long as the space remains occupied.

40
41 The light level controller has an ON setpoint range from 1-850fc and when the daylight drops below that
42 setpoint for 20 seconds the electric lights will be turned ON.

43
44 The light level controller has a microprocessor that allows the photosensor to respond with precision to
45 deliver the desired intensity of electric lighting for the space.

46
47 The light level controller has a LED status indicator making it easy to identify if the device has been forced
48 on or off by an override switch or if the device is in test mode.

49
50 The light level controller has a threaded nipple that mounts on a ceiling tile and for more challenging
51 applications such as a side wall or hard rock ceiling the nipple pops off and the LS-101 can be screwed
52 down.

53
54 The light level controller shall be low profile device, its round form blends in to any ceiling and has a
55 removable cover that will integrate to the architecture.

56
57 Light level controller shall have standard 5 year warranty.

58
59 **PART 3 - EXECUTION**

60
61 **INSTALLATION**

- 1 Install wall switches 48 inches (1.2 m) above floor, OFF position down.
2
3 Install wall dimmers 48 inches (1.2 m) above floor; de-rate ganged dimmers as instructed by manufacturer;
4 do not use common neutral.
5
6 Install convenience receptacles 24 inches (600 mm) above floor, 4 inches (100 mm) above backsplash,
7 grounding pole on bottom.
8
9 Install box for information outlet 24 inches (600 mm) above finished floor. Install box for telephone jack
10 for wall telephone 48 (1.2 M) above finished floor.
11
12 Install specific-use receptacles at heights shown on Contract Drawings.
13
14 Install decorative plates on switch, receptacle, and blank outlets in finished areas.
15
16 Install galvanized steel plates on outlet boxes and junction boxes in unfinished areas, above accessible
17 ceilings, and on surface-mounted outlets.
18
19 Install devices and wall plates flush and level.
20
21 Receptacles shall have a bonding conductor from grounding terminal to the metal conduit system. Self-
22 grounding receptacles using mounting screws as bonding means are not approved.
23
24 **FIELD QUALITY CONTROL**
25 Inspect each wiring device for defects.
26
27 Operate each wall switch and sensor with circuit energized and verify proper operation.
28
29 Verify that each receptacle device is energized.
30
31 Test each receptacle device for proper polarity.
32
33 Test each GFCI receptacle device for proper operation.
34
35 The user agency and DSF personnel reserve the right to be present at all tests.
36
37 **OCCUPANCY SENSORS**
38 Power packs used in return air plenum ceiling areas shall be installed in an approved enclosure or UL listed
39 for return air plenum.
40
41 Provide a minimum of 4' of coiled cable for ceiling-mounted sensors.
42
43 Sensitivity Test: After the sensor has been energized for at least 15 minutes, walk to the middle of the
44 room (if conference room) or sit at the normal desk position (if and office). Make no motion for 20
45 seconds. Move one arm up and down slowly. The test LED should blink.
46
47 Time Delay Test: Set the time delay for 10 minutes. Walk into the room to activate the sensor then leave
48 room. Sensor must turn lights off at approximately 10 minutes. Walk into the room again to reactivate the
49 lights. Lights should activate within 1 second.
50
51 For lights on emergency power without a remote transfer device, route the emergency circuit through a
52 separate relay controlled by the occupancy sensor(s) in the respective area. For lights on emergency power
53 with a remote transfer device, the emergency power does not get routed through the occupancy sensor
54 relay, but the normal power does get routed through the occupancy sensor relay.
55
56 **ADJUSTING**
57 Adjust devices and wall plates to be flush and level.
58
59 Mark all conductors with the panel and circuit number serving the device with a machine generated label,
60 at the device, and on the back of the device cover.
61
62

END OF SECTION

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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
Submittals
Operation and Maintenance Data

PART 2 - PRODUCTS

Disconnect Switches
Fuses

PART 3 - EXECUTION

Installation

RELATED WORK

Applicable provisions of Division 1 govern work under this Section.

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.

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 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: NEMA Type as indicated on Drawings.

Provide manufacturer's equipment ground kit in all disconnect switches.

FUSES

Fuses 600 Amperes and Less: Dual element, time delay, 250 or 600 volt, UL Class RK 1. Interrupting Rating: 200,000 rms amperes.

Provide three (3) spares of each size and type fuse. Provide enclosure for spare fuse.

PART 3 - EXECUTION

INSTALLATION

Install disconnect switches where indicated on Drawings.

1 Provide identification as specified in Section 26 05 53.
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END OF SECTION

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**SECTION 26 28 13
FUSES**

PART 1 - GENERAL

SCOPE

The work under this section includes 250 and 600 volt fuses. Included are the following topics:

PART 1 - GENERAL

- Scope
- Related Work
- Submittals
- Regulatory Requirements
- Extra Materials

PART 2 - PRODUCTS

- 250 Volt Fuses
- 600 Volt Fuses

PART 3 - EXECUTION

- Installation

RELATED WORK

Applicable provisions of Division 1 govern work under this Section.

SUBMITTALS

Provide device dimensions, nameplate nomenclature, and electrical ratings.

Submit manufacturer's product data sheets with installation instructions.

REGULATORY REQUIREMENTS

Listed by Underwriter's Laboratories, Inc., and suitable for specific application.

EXTRA MATERIALS

Provide three (3) spares of each size and type fuse.

PART 2 - PRODUCTS

250 VOLT FUSES

Fuses 600 Amperes and Less: Dual element, time delay, 250 volt, UL Class RK 1. Interrupting Rating: 200,000 rms amperes.

600 VOLT FUSES

Fuses 600 Amperes and Less: Dual element, time delay, 600 volt, UL Class RK 1. Interrupting Rating: 200,000 rms amperes.

Provide enclosure for spare fuses.

PART 3 - EXECUTION

INSTALLATION

Fuses shall not be installed until equipment is ready to be energized.

Install spare fuse storage enclosure in Electrical Room.

END OF SECTION

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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

RELATED WORK

Applicable provisions of Division 1 shall govern work under this Section.

Section 26 05 29 – Hangers and Supports for Electrical Systems.

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.

For the sake of consistency and conformity of manufacturer, design and construction, all motors shall conform to the following description unless otherwise noted or required.

- Motors 1/3 HP and smaller shall be wound for operation on single phase, 60 Hz. service unless otherwise noted.
- Motors 1/2 HP and above shall be wound for operation on 3 phase, 60 Hz service unless otherwise noted.
- Refer to drawings in each case in order to verify voltage characteristics required.

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

1 terminate in the conduit fittings on the motors, the final connection being made with flexible, PVC-coated
2 metal conduit.

3
4 Provide all necessary labor and material to completely connect all electrical motors and controls (where
5 required) in connection with the building utility equipment, including fans, pumps, overhead door
6 operators, etc.

7
8 All conduits and wiring required for control work from the holding coil circuit of the starter, including the
9 furnishing and installation of control devices such as auxiliary contacts, control relays, time delay relays,
10 pilot lights, selector switches, alternators, etc., shall be provided and installed by other trades unless
11 otherwise indicated.

12
13 **Power Branch Circuits:**

14 Wire sizes for branch circuits not specifically called for on drawings or in specifications shall be based on
15 125 percent of the full load current of the motor unless the voltage drop of motor branch circuits exceeds 1-
16 1/2 percent from the distribution panel to the motor; in which case, voltage drop shall govern wire sizes. A
17 power factor of 80 percent shall be used for motors in such calculations.

18
19 **REFERENCES**

20 ANSI/NEMA ICS 6 - Enclosures for Industrial Controls and Systems.

21 ANSI/UL 198E - Class R Fuses.

22 NEMA AB 1 - Molded Case Circuit Breakers.

23 NEMA ICS 2 - Industrial Control Devices, Controllers, and Assemblies.

24 NEMA KS 1 - Enclosed Switches.

25 NEMA PB 1 - Panelboards.

26 NEMA PB 1.1 - Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600
27 Volts or Less.

28
29 **SUBMITTALS**

30 Indicate on shop drawings, front and side views of motor control center enclosures with overall dimensions.
31 Include conduit entrance locations and requirements; nameplate legends; size and number of bus bars per
32 phase, neutral and ground; electrical characteristics including voltage, frame size and trip ratings, withstand
33 ratings, and time-current curves of all equipment and components.

34
35 Provide product data on motor starters and combination motor starters, relays, pilot devices, and switching
36 and overcurrent protective devices.

37
38 **OPERATION AND MAINTENANCE DATA**

39 All operations and maintenance data shall comply with the submission and content requirements specified
40 under section GENERAL REQUIREMENTS.

41
42 **DELIVERY, STORAGE, AND HANDLING**

43 Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy
44 plastic cover to protect units from dirt, water, construction debris, and traffic.

45
46 Handle in accordance with manufacturer's written instructions. Lift only with lugs provided for the
47 purpose. Handle carefully to avoid damage to motor control center components, enclosure, and finish.

48
49 **SPARE PARTS**

50 Keys: Furnish two (2) each to Owner.

51
52 **Provide three (3) spares of each size and type fuse used. Provide enclosure for spare fuses.**

53
54 Fuse Pullers: Furnish one fuse puller to Owner.

55
56
57 **PART 2 - PRODUCTS**

58
59 **MANUAL MOTOR STARTERS**

1 Manual Motor Starter: NEMA ICS 2; size as shown on Drawings. AC general-purpose Class A manually
2 operated full-voltage controller for induction motors rated in horsepower, with overload protection, red
3 pilot light and toggle operator.

4
5 Enclosure: NEMA Type: As indicated on the drawings.

6
7 Provide manufacturer's equipment ground kit in all starter enclosures.

8
9 **MAGNETIC MOTOR STARTERS**

10 Magnetic Motor Starters: NEMA ICS 2; AC general-purpose Class A magnetic controller for induction
11 motors rated in horsepower; size 0 minimum.

12
13 Full Voltage Starting: Non-reversing type.

14
15 Size: NEMA ICS 2; size as shown on Drawings, size 0 minimum.

16
17 Coil Operating Voltage: 120 volts, 60 Hz.

18
19 Overload Protection: bimetal or melting alloy.

20
21 Enclosure: NEMA Type: As indicated on the drawings.

22
23 Provide manufacturer's equipment ground kit in all starter enclosures.

24
25 Auxiliary Contacts: NEMA ICS 2; two and normally open contacts in addition to seal-in contact.

26
27 Selector Switches: NEMA ICS 2; HAND/OFF/AUTO, in front cover.

28
29 Indicating Lights: NEMA ICS 2; LED Push-to-test type. RUN: red in front cover.

30
31 Provide phase loss protection relay with each motor starter, with contacts to de-energize each motor starter.

32
33 Control Power Transformers: Each magnetic starter shall have a fused primary and a fused 120Vsecondary
34 control transformer, sized for the load, 100 VA minimum. Additionally, the X2 terminal of the control
35 transformer shall be grounded.

36
37 Combination Motor Starters: Fusible switch disconnect in common enclosure.

38
39 **CONTROLLER OVERCURRENT PROTECTION AND DISCONNECTING MEANS**

40 Fusible Switch Assemblies: NEMA KS 1; quick-make, quick-break, load interrupter enclosed knife switch
41 with externally operable handle. Provide interlock to prevent opening front cover with switch in ON
42 position. Handle lockable in OFF position. Fuse Clips: Designed to accommodate Class R fuses.

43

44

45

PART 3 - EXECUTION

46

47

INSTALLATION

48

Install motor control equipment in accordance with manufacturer's instructions.

49

50

Motor Starter Panelboard Installation: In conformance with NEMA PB 1.1.

51

52

Select and install heater elements in motor starters to match installed motor characteristics.

53

54

Motor Data: Provide neatly typed label inside each motor starter enclosure door identifying motor served,
55 nameplate horsepower, full load amperes, code letter, service factor, and voltage/phase rating.

56

57

58

END OF SECTION

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SECTION 26 33 53
UNINTERRUPTIBLE POWER SUPPLY SYSTEMS

PART 1 - GENERAL

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SUMMARY

This specification defines the electrical and mechanical characteristics and requirements for a continuous-duty three-phase, solid-state, uninterruptible power system (UPS). The UPS shall provide high-quality AC power for Data Center loads.

STANDARDS

The UPS shall be designed in accordance with the applicable sections of the current revision of the following documents. Where a conflict arises between these documents and statements made herein, the statements in this specification shall govern.

- ANSI C62.41 (IEEE 587)
- ASME
- CSA 22.2, No. 107.1
- FCC Part 15, Class A
- ISO 9001
- National Electrical Code (NFPA-70)
- NEMA PE-1
- OSHA
- UL Standard 1778

The UPS shall be ETL listed per UL Standard 1778 Uninterruptible Power Supplies, and shall be CSA Certified.

SYSTEM DESCRIPTION

DESIGN REQUIREMENTS - UPS MODULE

Voltage: Input/output voltage specifications of the UPS shall be:

UPS A:

Rectifier Input: 480 volts, three-phase, 3-wire-plus-ground.
Bypass Input (for dual-input modules): 480 volts, three-phase, 3-wire-plus-ground.
Output: 208 volts, three-phase, 4-wire-plus-ground.

UPS B:

Rectifier Input: 208 volts, three-phase, 3-wire-plus-ground.
Bypass Input (for dual-input modules): 208 volts, three-phase, 3-wire-plus-ground.
Output: 208 volts, three-phase, 4-wire-plus-ground.

Output Load Capacity: Specified output load capacity of the UPS shall be 40 kVA at 0.8 lagging power factor.

DESIGN REQUIREMENTS - MATCHING BATTERY CABINET

Battery Cells: Sealed, lead-acid, valve-regulated.

Reserve Time: Minimum 14 minutes at full load, 0.8 power factor, with ambient temperature between 20° and 30°C.

1 Recharge Time: to 95% capacity within ten (10) times discharge time.

2

3 **MODES OF OPERATION**

4 The UPS shall be designed to operate as an on-line, double-conversion, reverse-transfer system in the
5 following modes:

6

7 Normal - The mission critical AC equipment is to be continuously powered by the UPS inverter. The
8 rectifier/charger derives power from a utility AC source and supplies DC power to the inverter while
9 simultaneously float-charging a power reserve battery.

10

11 Emergency - Upon failure of utility AC power, the mission critical AC equipment is to be powered by the
12 inverter, which without any switching obtains its power from the battery. There shall be no interruption in
13 power to the critical load upon failure or restoration of the utility AC source.

14

15 Recharge - Upon restoration of utility AC power, after a utility AC power outage, the rectifier/charger shall
16 automatically restart, walk-in, and gradually resume providing power to the inverter and also recharge the
17 battery system.

18

19 Bypass - If the UPS must be taken out of service for maintenance or repair, or should the inverter overload
20 capacity be exceeded, the static bypass transfer switch shall perform a reverse transfer of the connected
21 equipment from the inverter to the bypass source without interruption in power to the mission critical AC
22 equipment.

23

24 **PERFORMANCE REQUIREMENTS**

25 **AC INPUT TO UPS**

26 Voltage Configuration for Standard Units: three-phase, 3-wire plus ground.

27

28 Voltage Range: +10%, -20% of nominal.

29

30 Frequency: Nominal frequency +/-5%.

31

32 Power Factor: Up to 0.96 lagging at nominal input voltage and full rated UPS output with the optional
33 input filter. Minimum 0.80 lagging without optional input filter.

34 Inrush current: 800% of full load current maximum.

35

36 Current Limit: 115% of nominal AC input current maximum and 100% of nominal for optional generator
37 operation.

38

39 Input Current Walk-In: 15 seconds to full rated input current maximum. Field selectable 5 or 20 seconds.

40

41 Current Distortion: 10% reflected input THD maximum at full load with the optional input filter; 30%
42 reflected input THD maximum at full load without the optional input filter.

43

44 Surge Protection: The UPS shall be able to sustain input surges without damage per criteria listed in ANSI
45 C62.41 Category A and B.

46

47 **AC OUTPUT, UPS INVERTER**

48 Voltage Configuration: three-phase, 4-wire plus ground

49

50 Voltage Regulation:

1 Storage/Transport Ambient Temperature
2 UPS Module: -4°F to 158°F (-20°C to 70°C).
3 Battery: -4°F to 92°F (-20°C to 33°C)
4
5 Relative Humidity
6 0 to 95%, non-condensing.
7
8 Altitude
9 Operating: to 6,600 ft. (2,000 meters) above Mean Sea Level. Derated for higher altitude
10 applications.
11 Storage/Transport: to 40,000 ft. (12,200 meters) above Mean Sea Level.
12 Audible Noise
13 Noise generated by the UPS under any condition of normal operation shall not exceed 65 dBA
14 measured 1 meter from surface of the UPS.
15

16 **SUBMITTALS**

17 **PROPOSAL SUBMITTALS**

18 Submittals with the proposal shall include:

- 19
- 20 • System configuration with single-line diagrams.
- 21 • Functional relationship of equipment including weights, dimensions, and heat dissipation.
- 22 • Descriptions of equipment to be furnished, including deviations from these specifications.
- 23 • Size and weight of shipping units to be handled by installing contractor.
- 24 • Detailed layouts of customer power and control connections.
- 25 • Detailed installation drawings including all terminal locations.
- 26

27 **UPS DELIVERY SUBMITTALS**

28 Submittals upon UPS delivery shall include a complete set of submittal drawings and one (1) instruction
29 manual that shall include a functional description of the equipment with block diagrams, safety
30 precautions, instructions, step-by-step operating procedures and routine maintenance guidelines, including
31 illustrations.
32

33 **WARRANTY**

34 **UPS MODULE**

35 The UPS manufacturer shall warrant the UPS module against defects in materials and workmanship for 12
36 months after initial start-up or 18 months after ship date, whichever period expires first.
37

38 **BATTERY**

39 The battery manufacturer's standard warranty shall be passed through to the end user.
40

41 **QUALITY ASSURANCE**

42 **MANUFACTURER QUALIFICATIONS**

43 A minimum of twenty year's experience in the design, manufacture, and testing of solid-state UPS systems
44 is required. The system shall be designed and manufactured according to world-class quality standards.
45 The manufacturer shall be ISO 9001 certified.
46

47 **FACTORY TESTING**

48 Before shipment, the manufacturer shall fully and completely test the system to assure compliance with the
49 specification.
50
51

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2
3 **PART 2 - PRODUCTS**

4 **MANUFACTURERS**

5 Liebert NPower series model #37 SA 040 CCC 6E J68 Base Bid.

6 Alternate Bid: GE, MGE, Eaton Powerware.

7
8 **FABRICATION**

9 **MATERIALS**

10 All materials of the UPS shall be new, of current manufacture, high grade and free from all defects and
11 shall not have been in prior service except as required during factory testing.

12
13 The maximum working voltage, current, and di/dt of all solid-state power components and electronic
14 devices shall not exceed 75% of the ratings established by their manufacturer. The operating temperature
15 of solid-state component sub-assembly shall not be greater than 75% of their ratings. Electrolytic
16 capacitors shall be computer grade and be operated at no more than 95% of their voltage rating at the
17 maximum rectifier charging voltage.

18 **WIRING**

19 Wiring practices, materials and coding shall be in accordance with the requirements of the National
20 Electrical Code (NFPA 70). All bolted connections of bus bars, lugs, and cables shall be in accordance
21 with requirements of the National Electrical Code and other applicable standards. All electrical power
22 connections are to be torqued to the required value and marked with a visual indicator.

23
24 Provision shall be made for power cables to enter or leave from the top or bottom of the UPS cabinet.

25
26 **CONSTRUCTION AND MOUNTING**

27 The UPS unit, comprised of input transformer (if required), rectifier/charger with input filter, inverter,
28 static transfer switch, output transformer and maintenance bypass switch, shall be housed in a single free-
29 standing NEMA type 1 enclosure. Cabinet doors/covers shall require a tool for gaining access. Casters and
30 stops shall be provided for ease of installation. Front access only shall be required for expedient servicing,
31 adjustments, and installation. The UPS cabinet shall be structurally adequate and have provisions for
32 hoisting, jacking, and forklift handling.

33
34 The UPS cabinet shall be cleaned, primed, and painted with the manufacturer's standard color. The UPS
35 shall be constructed of replaceable subassemblies. Printed circuit assemblies shall be plug connections.
36 Like assemblies and like components shall be interchangeable.

37
38 **COOLING**

39 Cooling of the UPS shall be by forced air. Low-velocity fans shall be used to minimize audible noise
40 output. Fan power shall be provided by the UPS output.

41
42 The thermal design, along with all thermal and ambient sensors, shall be coordinated with the protective
43 devices before excessive component or internal cabinet temperatures are exceeded.

44
45 **GROUNDING**

46 The AC output neutral shall be electrically isolated from the UPS chassis. The UPS chassis shall have an
47 equipment ground terminal. Provisions for local bonding shall be provided.

48
49 **COMPONENTS**

50 **INPUT TRANSFORMER**

51 The input transformer shall be factory installed inside the UPS module cabinet without increasing the
52 standard footprint.

1 Insulated Gate Bipolar Transistors (IGBTs) in a phase-controlled, pulse width modulated (PWM) design
2 capable of providing the specified AC output.
3

4 **OVERLOAD CAPABILITY**
5 The inverter shall be capable of supplying current and voltage for overloads exceeding 100% and up to
6 200% of full load current. A status indicator and audible alarm shall indicate overload operation. The UPS
7 shall transfer the load to bypass when overload capacity is exceeded.
8

9 **FAULT CLEARING AND CURRENT LIMIT**
10 The inverter shall be capable of supplying an overload current of 150% of its full-load rating for one
11 minute. For greater currents or longer time duration, the inverter shall have electronic current-limiting
12 protection to prevent damage to components. The critical load will be transferred to the static bypass
13 automatically and uninterrupted. The inverter shall be self-protecting against any magnitude of connected
14 output overload. Inverter control logic shall sense and disconnect the inverter from the critical AC load
15 without the requirement to clear protective fuses.
16

17 **STEP LOAD RESPONSE**
18 The output voltage shall be maintained to within $\pm 5.0\%$ with a 0-to-100% step load change or a 100%-to-0
19 step load change. The output voltage shall recover to within 1% of nominal voltage within 1 cycle.
20

21 **VOLTAGE DISTORTION**
22 For linear loads, the output voltage total harmonic distortion (THD) shall not be greater than 1%. For
23 100% rated load of 3:1 crest factor nonlinear loads, the output voltage total harmonic distortion shall not be
24 greater than 2.5%. The output rating is not to be derated in kVA or kW due to the 100% nonlinear load
25 with 3:1 crest factor.

26 **OUTPUT POWER TRANSFORMER**
27 A dry-type power transformer shall be provided for the inverter AC output. It shall have copper wiring
28 exclusively. The transformers hottest spot winding temperature shall not exceed the temperature limit of
29 the transformer insulation class of material when operating at full load at maximum ambient temperature.
30

31 **PHASE BALANCE**
32 Electronic controls shall be provided to regulate each phase so that an unbalanced loading will not cause
33 the output voltage to go outside the specified voltage unbalance or phase displacement. With 100% load
34 on one phase and 0% load on the other 2 phases or 100% load on 2 phases and 0% load on the other phase,
35 the voltage balance is to be within 1% and the phase displacement is to be 120 degrees within ± 1 degree.
36

37 **FUSE FAILURE PROTECTION**
38 Power semiconductors in the inverter shall be fused with fast-acting fuses, so that loss of any one-power
39 semiconductor will not cause cascading failures.
40

41 **INVERTER SHUTDOWN**
42 For rapid removal of the inverter from the critical load, the inverter control electronics shall
43 instantaneously turn off the inverter transistors. Simultaneously, the static transfer switch shall be turned
44 on to maintain continuous power to the critical load.
45

46 **INVERTER DC PROTECTION**
47 The inverter shall be protected by the following disconnect levels:
48

- 49 • DC Over voltage Shutdown
- 50 • DC Under voltage Warning (Low Battery Reserve), user adjustable from 1 to 99 minutes
- 51 • DC Under voltage Shutdown (End of Discharge)

52

1 **OVER DISCHARGE PROTECTION**

2 To prevent battery damage from over discharging, the UPS control logic shall automatically raise the
3 shutdown voltage set point as discharge time increases beyond fifteen (15) minutes.
4

5 **INVERTER OUTPUT VOLTAGE ADJUSTMENT**

6 The inverter shall use a software control to adjust the output voltage from +/- 5% of the nominal value.
7

8 **OUTPUT FREQUENCY**

9 An oscillator shall control the output frequency of the inverter. The oscillator shall be temperature
10 compensated and hold the inverter output frequency to +/- 0.1% for steady state and transient conditions.
11 Frequency drift shall not exceed 0.1% during a 24-hour period. Total frequency deviation, including short
12 time fluctuations and drift, shall not exceed 0.1% from the rated frequency.
13

14 **DISPLAY AND CONTROLS**

15 **MONITORING AND CONTROL**

16 The UPS shall be provided with a microprocessor based unit status display and controls section designed
17 for convenient and reliable user operation. A graphical display shall be used to show a single-line diagram
18 of the UPS, and shall be provided as part of the monitoring and controls sections of the UPS. All of the
19 operator controls and monitors shall be located on the front of the UPS cabinet. The monitoring functions
20 such as metering, status and alarms shall be displayed on the graphical LCD display. Additional features
21 of the monitoring system shall include:
22

- 23 • Menu-driven display with pushbutton navigation
- 24 • Real time clock (time and date)
- 25 • Alarm history with time and date stamp
- 26 • Battery backed-up memory
27

28 **METERING**

29 The following parameters shall be displayed:
30

- 31 • Input AC voltage line-to-line
- 32 • Input AC current for each phase
- 33 • Input frequency
- 34 • Battery voltage
- 35 • Battery charge/discharge current
- 36 • Output AC voltage line-to-line and line-to-neutral for each phase
- 37 • Output AC current for each phase
- 38 • Output frequency
- 39 • Percent of rated load being supplied by the UPS
- 40 • Battery time left during battery operation
41

42 **ALARM MESSAGES**

43 The following alarm messages shall be displayed:
44

- 45 • Input Line Fault
- 46 • Input Phase Rotation Error
- 47 • Input Over/Under Frequency
- 48 • Input Current Limit
- 49 • Rectifier Fail
- 50 • Battery Test Failed
- 51 • Battery Low Warning (Adjustable 1 To 99 Minutes)

- 1 • Battery Low Transfer
- 2 • DC Over Voltage Steady State
- 3 • Bypass Frequency Error
- 4 • Load On Bypass
- 5 • Excessive Auto Retransfers
- 6 • SBS SCR Shorted
- 7 • Bypass Sync Error
- 8 • Input Phase Loss
- 9 • I DC Peak
- 10 • Output Under Voltage Transfer
- 11 • Output Over Voltage Transfer
- 12 • Inverter Overload
- 13 • SBS Overload
- 14 • Inverter Overload Transfer
- 15 • Transfer Failed Shutdown
- 16 • Hardware Shutdown
- 17 • Output Power Supply Fail
- 18 • Inverter Control Fault Transfer
- 19 • EPO Latched (remote EPO activated)
- 20 • System Fan Fail
- 21 • Ambient Over Temperature Limit
- 22 • Over Temperature Timeout Shutdown

23 An audible alarm shall be provided and activated by any of the above alarm conditions.

24 STATUS MESSAGES

25 The following UPS status messages shall be displayed:

- 26
- 27
- 28 • Normal operation
- 29 • On SBS
- 30 • Load on UPS
- 31 • Load on bypass
- 32 • User Shutdown
- 33 • Battery Discharging
- 34

35 CONTROLS

36 UPS start-up, shutdown, and bypass operations shall be accomplished through the front-panel pushbutton
37 controls. Menu-driven user prompts shall be provided to guide the operator through system operation
38 without the use of additional manuals. Pushbuttons shall be provided to display the status of the UPS and
39 to test and reset visual and audible alarms. A mimic diagram screen shall be available on the LCD screen
40 to depict a single-line diagram of the UPS and indicate switch positions and power flow.

41 ON-LINE BATTERY TEST

42 The UPS shall be provided with a menu-driven On-Line Battery Test feature. The test shall ensure the
43 capability of the battery to supply power to the inverter while the load is supplied power in the normal
44 mode. If the battery fails the test, the system shall automatically do the following:

- 45
- 46
- 47 • Maintain the load through the UPS
- 48 • Display a warning message
- 49 • Sound an audible alarm
- 50

51 The battery test feature shall have the following user selectable options:

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- Interval between tests (2 to 9 weeks)
- Date and time of initial test
- Enable/disable test

STATIC TRANSFER SWITCH

GENERAL

A static transfer switch and bypass circuit shall be provided as an integral part of the UPS. The static switch shall be a naturally commutated high-speed static (SCR-type) device rated to conduct full load current continuously. The switch shall have an overload rating of 110% rated load continuously, 200% rated load for five seconds. The static transfer switch shall also have fault-clearing capabilities of 1100 amperes for 1 second, 3000 amperes for 10 cycles, and 6000 amperes peak for the first half cycle.

The static transfer switch control logic shall contain an automatic transfer control circuit that senses the status of the inverter logic signals, and operating and alarm conditions. This control circuit shall provide an uninterrupted transfer of the load to an alternate bypass source, without exceeding the transient limits specified herein, when an overload or malfunction occurs within the UPS, or for bypassing the UPS for maintenance.

UNINTERRUPTED TRANSFER

The transfer control logic shall automatically turn on the static transfer switch, transferring the critical AC load to the bypass source, after the transfer logic senses any of the following conditions:

- Inverter overload capacity exceeded
- AC output over voltage or under voltage
- Battery protection period expired
- UPS fault condition

The transfer control logic shall inhibit an automatic transfer of the critical load to the bypass source if any of the following conditions are present:

- Inverter/bypass voltage difference exceeding preset limits
- Bypass frequency out of limits
- Bypass out-of-synchronization range with inverter output

UNINTERRUPTED RETRANSFER

Retransfer of the mission critical AC equipment from the bypass source to the inverter output shall be automatically initiated unless inhibited by manual control. The transfer control logic shall inhibit an automatic retransfer of the critical load to the inverter if one of the following conditions exists:

- Bypass out of synchronization range with inverter output
- Inverter/bypass voltage difference exceeding preset limits
- Overload condition exists in excess of inverter full load rating
- UPS fault condition present

INTERNAL MAINTENANCE BYPASS SWITCH

GENERAL

A manually operated maintenance bypass switch shall be incorporated into the UPS cabinet to directly connect the critical load to the bypass AC input power source, bypassing the rectifier/charger, inverter, and static bypass transfer switch.

1 ISOLATION
2 All energized terminals shall be shielded to ensure that maintenance personnel do not inadvertently come
3 in contact with energized parts or terminals. A means to de-energize the static bypass switch shall be
4 provided when the UPS is in the maintenance bypass mode of operation.
5
6 MAINTENANCE CAPABILITY
7 With the critical load powered from the maintenance bypass circuit, it shall be possible to check out the
8 operation of the rectifier/charger, inverter, battery, and static bypass transfer switch.
9
10 BATTERY CABINET SYSTEM
11 The matching battery cabinet shall include sealed, lead-acid valve regulated battery cells housed in a
12 separate cabinet that matches the UPS cabinet styling to form an integral system line-up. Battery cells shall
13 be mounted on slide-out trays for ease of maintenance. A battery disconnect circuit breaker with under
14 voltage release (UVR) shall be included for isolation of the battery system from the UPS module. The
15 UPS shall automatically be disconnected from the battery by opening the breaker when the battery reaches
16 the minimum discharge voltage level. Casters and leveling feet shall also be provided with the battery
17 cabinet for ease of installation. When the application calls for the battery cabinet to be bolted to the UPS
18 cabinet, the interconnecting cables are to be provided, precut to the correct length and cable lugs installed,
19 by the UPS manufacturer. Liebert model #37BP040HPR1BNL
20
21 **ACCESSORIES**
22 **INPUT FILTER OPTION**
23 The rectifier/charger shall include an input filter to reduce reflected input current distortion to 10% THD at
24 full load with nominal input voltage. Another benefit of the input filter shall be to maintain the input
25 power factor at 0.90-0.96 lagging minimum from full load to half load with nominal input voltage.
26
27 **EXTERNAL MAINTENANCE BYPASS CABINET**
28 A matching external maintenance bypass cabinet shall be provided to enable the UPS module to be
29 completely isolated from the electrical system while the critical load is powered through the external
30 maintenance bypass line. This cabinet shall provide make-before-break operation for transfers to and from
31 the external maintenance bypass line with a single rotary switch. The following components shall be
32 standard: single rotary switch with auxiliary contacts, inter-cabinet wiring, isolation transformer, two (2)
33 load distribution breakers rated 150A and 125A, casters, and leveling feet. The following components
34 shall be provided: input circuit breaker, shielded isolation transformer, and two output circuit breaker. This
35 matching cabinet shall bolt to the side of the UPS module with a barrier shield to separate the two cabinets.
36 Only front access shall be required for installation and service. Liebert #37MB0040CC62P
37
38 **LOAD BUS SYNCHRONIZATION**
39 The Load Bus Sync circuit shall synchronize the output of two independent UPSs even if the UPSs are
40 operating from asynchronous bypass sources (e.g. backup generator sets) or on battery power. The Load
41 Bus Sync (LBS) circuit shall consist of a control enclosure and an option card inside each UPS module.
42 The LBS control enclosure shall enable the operator to designate which bypass source will be the
43 Designated Master source and both UPS systems will synchronize their outputs to that source.
44
45 **PROGRAMMABLE RELAY BOARD**
46 Eight sets of isolated Form C contacts shall be provided to indicate a change of status of any of the alarm
47 conditions. Any of the UPS alarms can be programmed onto any channel of the programmable relay
48 board.
49
50 **BATTERY CIRCUIT BREAKER**
51 A battery circuit breaker shall be provided to isolate the battery from the UPS. This breaker shall have an
52 under voltage release (UVR) and auxiliary contacts, and shall be in a separate wall mounted NEMA-1

1 enclosure. The battery breaker provides a manual disconnecting means, short circuit protection, and over
2 current protection for the battery system. When opened, there shall be no battery voltage in the UPS
3 enclosure. The UPS shall be automatically disconnected from the battery by opening the breaker when the
4 battery reaches the minimum discharge voltage level.

5 6 **SNMP**

7 The UPS shall come equipped with an internal SNMP adapter, which will connect the UPS directly to any
8 I.P. based network using Ethernet communications. The UPS will become a managed device on the
9 network. From a network management station the system administrator shall be capable of monitoring
10 important system measurements, alarm status and alarm history data. In the event of a utility failure the
11 SNMP shall continue with live communication without the requirement of additional or separate UPS
12 equipment until such time as the UPS shuts down for Low battery. On resumption of Utility power the
13 SNMP shall resume full SNMP communication automatically.

14 15 16 **PART 3 - EXECUTION**

17 18 **FIELD QUALITY CONTROL**

19 Factory-trained field service personnel shall perform the following inspections and test procedures during
20 the UPS startup.

21 22 **VISUAL INSPECTION**

- 23 • Inspect equipment for signs of damage
- 24 • Verify installation per drawings
- 25 • Inspect cabinets for foreign objects
- 26 • Verify neutral and ground conductors are properly sized and configured
- 27 • Inspect battery cases
- 28 • Inspect battery for proper polarity
- 29 • Verify all printed circuit boards are configured properly

30 **MECHANICAL INSPECTION**

- 31 • Check all control wiring connections for tightness
- 32 • Check all power wiring connections for tightness
- 33 • Check all terminal screws, nuts, and/or spade lugs for tightness

34 35 **ELECTRICAL INSPECTION**

- 36 • Check all fuses for continuity
- 37 • Confirm input voltage and phase rotation is correct
- 38 • Verify control transformer connections are correct for voltages being used
- 39 • Assure connection and voltage of the battery string(s)

40 41 **MANUFACTURER'S FIELD SERVICE**

42 **SERVICE PERSONNEL**

43 The UPS manufacturer shall directly employ a nationwide service organization, consisting of factory
44 trained field service personnel dedicated to the start-up, maintenance, and repair of UPS and power
45 equipment. The organization shall consist of regional and local offices.

46 The manufacturer shall provide a fully automated national dispatch center to coordinate field service
47 personnel schedules. One toll-free number shall reach a qualified support person 24 hours/day, 7
48 days/week, and 365 days/year. If emergency service is required, response time shall be 20 minutes or less.
49 An automated procedure shall be in place to insure that the manufacturer is dedicating the appropriate
50 technical support resources to match escalating customer needs.

1 REPLACEMENT PARTS STOCKING
2 Parts shall be available through an extensive network to ensure around-the-clock parts availability
3 throughout the country.
4 Recommended spare parts shall be fully stocked by local field service personnel with back-up available
5 from national parts center and the manufacturing location. The national parts center Customer Support
6 Parts Coordinators shall be on-call 24 hours/day, 7 days/week, and 365 days/year for immediate parts
7 availability. Parts from the national parts center shall be shipped within 4 hours on the next available flight
8 out and delivered to the customer's site within 24 hours.
9
10 UPS OPERATOR TRAINING
11 Operator training courses for customer employees shall be available by the UPS manufacturer. The
12 training course shall cover UPS theory, safety, battery considerations and UPS operational procedures.
13
14 MAINTENANCE CONTRACTS
15 A complete offering of preventive and full service maintenance contracts for both the UPS system and
16 battery system shall be available. An extended warranty and preventive maintenance package shall be
17 available. Factory-trained service personnel shall perform warranty and preventive maintenance service.
18
19
20

END OF SECTION

**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
- Submittals
- Operation and Maintenance Data
- Extra Material

PART 2 - PRODUCTS

- Interior Luminaires and Accessories
- Lamps
- Fluorescent Ballasts
- Dimming 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.

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 in the following example table format, and submit catalog cuts with highlighted catalog numbers and required accessories.

LUMINAIRE		BALLAST	LAMP	ANSI INPUT WATTS
Type	Manufacturer and Catalog No.	Manufacturer, Quantity per Fixture, and Catalog No.	Manufacturer, Quantity per Fixture, and Catalog No.	

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 fixture type, but not less than one (1) fixture of each type.

Provide ten (10) percent of each lamp type, but not less than one (1) of each type.

Provide three (3) percent of each ballast type, but not less than one (1) ballast of each type.

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

1 by others are equally acceptable provided they meet or exceed the performance of the indicated fixtures,
2 and meet the intent of the design.

3
4 Provide fluorescent fixtures with quick-connect disconnecting means, similar to Thomas & Betts Sta-Kon.

5
6 **LAMPS**

7 Four Foot Fluorescent Lamps: High Performance T8 Lamps:

- 8 • Minimum 3000 initial lumens and minimum of 2820 mean lumens.
- 9 • Minimum 24,000 hour rated life at three-hour starts.
- 10 • Color Rendering Index (CRI) of 81 or higher.
- 11 • 3500°K color temperature.
- 12 • Lamps shall be suitable for use with instant start ballasts and occupancy sensors.
- 13 • Lamps shall meet "TLCP" requirements for low mercury.
- 14 • Mean system efficiency equal to 90MLPW minimum, with instant start ballasts.

15 Acceptable lamp manufacturers and catalog numbers are (or equal):

- 16 Philips F32T8/ADV85/ALTO
- 17 GE F32T8/XL/SPX50/HL/ECO
- 18 Sylvania F032/850/XP/ECO
- 19 SLI Lighting F32T8/HL/850
- 20 Standard Products F32T8/850/XL31
- 21 MaxLite F32T8/850XL
- 22 Technical Consumer Products, Inc. F32T8/850/H

23
24
25 Manufacturer names and catalog numbers are used to develop quality and performance
26 requirements only. Lamps manufactured by others will be accepted provided they meet or exceed
27 the specifications.

28
29 Compact Fluorescent Lamps:

30 Compact fluorescent lamp temperature shall be 5000°K with a color rendering index (CRI) at or above
31 80. See lighting fixture schedule on drawings.

32
33 All lamps shall be new.

34
35 **FLUORESCENT BALLASTS**

36 All fluorescent ballasts shall be electronic type and shall meet the following specs:

- 37 • UL Listed (Class P) sound rating A and CSA certified.
- 38 • Comply with EMI and RFI limits set by the FCC (CFR 47 part 18) or NEMA and not interfere
39 with normal electrical equipment.
- 40 • Meet any applicable standards set forth by ANSI.
- 41 • Be potted or conformal coated in a metallic case and not contain PCBs.
- 42 • Provide normal rated lamp life as stated by lamp manufacturers (i.e. rated life at 3 hour burn time
43 per start).
- 44 • Provide independent test results from an approved testing laboratory for all of the specifications
45 below. This is required for all submitted ballasts.
- 46 • Nominal power factor of .90 or higher.
- 47 • Total harmonic distortion of less than 10% at 120 or 277 volts (universal voltage).
- 48 • Ballast factor 0.70 through 1.2, as shown on the lighting fixture schedule.
- 49 • Frequency of operation shall be 40 kHz - 50 kHz and units shall operate without visible flicker.
- 50 • Ballast efficiency factor shall meet Consortium of Energy Efficiency (www.ceel.org)
51 specifications (adopted by Focus on Energy program).
- 52 • Multi-lamp ballasts shall operate in parallel so that when one lamp burns out, the other lamps will
53 continue to operate at full light output.
- 54 • Ballast Efficiency Factor (BEF) shall be as shown in the table below.

55

Number of Lamps	Low (BF ≤ 0.85)	Normal (0.85 < BF ≤ 1)	High (BF > 1.0)
INSTANT – START BALLASTS (T8 lamps)			

1	≥ 3.08	≥ 3.11	N.A.
2	≥ 1.60	≥ 1.58	≥ 1.55
3	≥ 1.04	≥ 1.05	≥ 1.04
4	≥ 0.79	≥ 0.80	≥ 0.77
PROGRAMMED – START BALLASTS (T5 lamps)			
1	≥ 2.85	≥ 2.84	N.A.
2	≥ 1.48	≥ 1.47	≥ 1.51
3	≥ 0.97	≥ 1.00	≥ 1.00
4	≥ 0.76	≥ 0.75	≥ 0.75

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- 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 instant-start ballasts shall be as follows:

1. Instant-Start, Low Ballast Factor (BF = 0.77-0.78)

Lamps	Nominal Lamp Watts	System Input (Watts @ Univ Volt)
1 – F32T8	32	25
2 – F32T8	32	48
3 – F32T8	32	73
4 – F32T8	32	97

2. Instant-Start, Normal Ballast Factor (BF = 0.87-0.88)

Lamps	Nominal Lamp Watts	System Input (Watts @ Univ Volt)
1 – F32T8	32	28
2 – F32T8	32	56
3 – F32T8	32	83
4 – F32T8	32	109

- **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

1	3 – F32T8	32	88
2	4 – F32T8	32	118

3
4 Acceptable ballast manufacturer’s names and product lines are as follows:
5 Osram Sylvania – Quicktronic High Efficiency and Quicktronic PROstart.
6 GE Lighting – Ultramax and UltraStart.
7 Maxlite – High Efficiency Ballast.
8 Advance – Optanium.
9 Universal Lighting Technologies – F32T8.

10
11 Manufacturer names are used to develop quality and performance requirements only. All
12 manufacturers and their products shall meet the system performance requirements and this entire
13 specification.

14
15 **COMPACT FLUORESCENT BALLASTS (ELECTRONIC)**

- 16 • Ballasts shall be high power factor, class P, with voltage rating matching the branch circuit
- 17 voltage.
- 18 • Ballast factor shall be 0.85 or higher.
- 19 • Ballast shall have lamp fault shut-off circuitry to prevent starting of a faulty lamp.
- 20 • Cold-weather ballast must reliably start and operate the lamp in ambient temperatures down to 0°F
- 21 for the rated life of the lamp.

22
23 **DIMMING BALLASTS (Fluorescent)**

- 24 • Ballast shall provide continuous, flicker-free dimming from 100% to 5%.
- 25 • Ballast shall have Total Harmonic Distortion of less than 10%.
- 26 • Ballast power factor shall be greater than 0.95.
- 27 • Ballast factor shall be 0.85 or higher for T8 lamps, 0.95 or higher for T5 lamps.
- 28 • Ballast shall be high frequency electronic type and operate lamps at a frequency above 25kHz for
- 29 T5 lamps.
- 30 • Ballast shall have built-in inrush current limiting circuitry, maximum of 7 amps for 120 volts and
- 31 3 amps for 277 volts.
- 32 • Ballast shall have internal fusing.
- 33 • Ballast shall have ultra-quiet operation.
- 34 • Operating temperature shall not exceed 75° C on the case during normal operation.
- 35 • Minimum lamp starting temperature shall be 10°C / 50° F.

36
37
38 **PART 3 - EXECUTION**

39
40 **INSTALLATION**

41 Install in accordance with manufacturer’s instructions.

42
43 Install suspended luminaires and exit signs using pendants supported from swivel hangers. Heavy duty jack
44 chain supports may be used where indicated on the fixture schedule. Provide pendant or chain length
45 required to suspend luminaire at indicated height.

46
47 Support luminaires larger than 2 x 4 foot (600 x 1 200 mm) size independent of ceiling framing.

48
49 Locate ceiling luminaires as indicated on reflected ceiling plan.

50
51 Install surface mounted luminaires and exit signs plumb and adjust to align with building lines and with
52 each other. Secure to prohibit movement.

53
54 The Contractor shall install fixture supports as required. Fixture installations with fixtures supported only
55 by insecure boxes will be rejected. It shall be the Contractor’s responsibility to support all lighting fixtures
56 adequately, providing extra steel work for the support of fixtures if required. Any components necessary
57 for mounting fixtures shall be provided by the Contractor. No plastic, composition or wood type anchors
58 shall be used.

59
60 Exposed Grid Ceilings: Provide auxiliary members spanning ceiling Ts to support surface mounted
61 luminaires. Provide independent support for all fixtures over 50 lbs.

1 Install recessed luminaires to permit removal from below.
2
3 Install recessed luminaires using accessories and firestopping materials to meet regulatory requirements for
4 fire rating.
5
6 Install code required hardware to secure recessed grid-supported luminaires in place.
7
8 Install wall mounted luminaires and exit signs at height as scheduled.
9
10 Install accessories furnished with each luminaire.
11
12 Make wiring connections to branch circuit using building wire with insulation suitable for temperature
13 conditions within luminaire.
14
15 Bond fixtures and metal accessories to branch circuit equipment grounding conductor.
16
17 Install specified lamps in each luminaire and exit sign.
18
19 All lamps shall be delivered to the job in sealed cartons and protected from dirt and dust during storage on
20 the project. Lamps shall be taken directly from the cartons and installed in the fixture with special care so
21 that they do not become dusty and are not soiled in the operation.
22
23 Lamps installed in fixtures using dimming ballasts shall be burned in at 100% rated output by the
24 contractor for a minimum of 100 hours as recommended by the ballast manufacturer.
25
26 All new lamps shall be operational at the Substantial Completion of the project.
27
28 **ADJUSTING AND CLEANING**
29 Align luminaires and clean lenses and diffusers at completion of Work. Clean paint splatters, dirt, and
30 debris from installed luminaires.
31
32 Aim and adjust luminaires as indicated on Drawings or as directed by the A/E.
33
34 Touch up luminaire finish at completion of work.
35
36 **INTERFACE WITH OTHER PRODUCTS**
37 Interface with air handling accessories furnished and installed under Division 23.
38
39 **FIELD QUALITY CONTROL**
40 Operate each luminaire after installation and connection. Inspect for proper connection and operation.
41
42 **ALL FIXTURE CONNECTIONS INCLUDING MASTER-SLAVE**
43 Direct box or conduit connections for surface and recessed fixtures. Flexible metal conduit from a J-box
44 for recessed lay-in light fixtures. Flexible metal conduit shall be minimum 3/8" (10 mm) minimum
45 diameter and six foot (1.8 M) maximum length. Flexible whip between master and slave fixtures may be
46 supported off of the ceiling grid wires. Conduit length shall allow movement of the fixture for maintenance
47 purposes. Minimum wire size shall be #18 AWG for single fixture or master-slave fixture.
48
49 The flexible connectors shall be all steel, galvanized, clamp type with locknut or snap-in connector
50 including those used on the master-slave unit.
51
52
53

END OF SECTION

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SECTION 27 00 00
COMMUNICATIONS CABLE AND EQUIPMENT

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PART 1 - GENERAL

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SCOPE

This section describes the products and execution requirements relating to furnishing and installation of Telecommunications Cabling and Termination Components and related sub-systems as part of a Structured Cabling System at the remodeled location. Horizontal (Station) cabling comprised of Copper Cabling is covered under this document. Included are the following topics:

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PART 1 - GENERAL

- Scope
- Related Work
- Regulatory References
- Design Intent
- Work Sequence
- Submittals
- Project Record Documents
- Quality Assurance
- Delivery, Storage and Handling
- Drawings

PART 2 - PRODUCTS

- Horizontal Media (Station Cables)
 - Horizontal Data and Voice Station Cable (Copper)
 - Low Skew Cable for Clear Cube connectivity
- Information Outlet
 - Data and Voice Jacks
 - Wall-Mount Voice-Only Outlets
- Data Patch Panel
- Voice (Horizontal) Termination Field
 - Jumper Management
- Flexible Nonmetallic Innerduct and Fittings
- Miscellaneous Materials
 - Voice Station Patch Cords
- Surface Raceway

PART 3 - EXECUTION

- General
- System Topology and Cable Size Requirements
- Station Cabling
- Information Outlet
- Innerduct
- Cable Termination
 - General
 - Cable Termination - Voice UTP
 - Cable Termination - Data UTP
 - Identification and Labeling
 - Work by Owner
 - Cooperation
- Testing and Acceptance
 - General
 - Voice Station Cabling Category 6
 - Data Station Cabling Category 6
 - Category 6 Performance Testing
 - Low Skew Cable Performance Testing
- Documentation
 - General
 - Test Data - Copper Media
 - Cross Connect Data
- As-Built Construction Drawings
- Warranty

1 As-Built Communication Cable Costs
2 Construction Verification Items
3

4 **RELATED WORK**

5 Applicable provisions of Division 1 govern work under this Section.

- 6
7 Section 26 05 00 – Common Work Results For Electrical
8 Section 26 05 33 – Raceway and Boxes for Electrical Systems
9 Section 26 27 26 – Wiring Devices
10 Section 26 05 26 – Grounding and Bonding for Electrical Systems
11 Section 26 05 29 – Hangers and Supports for Electrical Systems
12 Section 26 05 53 – Identification for Electrical Systems
13

14 **REGULATORY REFERENCES**

15 All work and materials shall conform in every detail to the rules and requirements of the National Fire
16 Protection Association, the Wisconsin Electrical Code and present manufacturing standards.
17 All materials shall be listed by UL and shall bear the UL label. If UL has no published standards for a
18 particular item, then other national independent testing standards shall apply and such items shall bear
19 those labels. Where UL has an applicable system listing and label, the entire system shall be so labeled.
20

21 Other applicable standards are as follows:

- 22 ANSI/IEEE C2 - National Electrical Safety Code
23 NFPA 70- 2002 - National Electrical Code
24 COMM 16 - Wisconsin Electrical Code
25 TIA/EIA Standards 568B.2 (Category 6 and Low Skew Cable for Clear Cube), 568B.3, 569A, 606A, and
26 607 (with exception)
27 IEEE/ANSI 142-1982 - Recommended Practice for Grounding of Industrial and Commercial Power
28 Systems.
29 ICEA publication S-80-576-2002
30

31 **DESIGN INTENT**

32 The Horizontal (Station) Cabling System is based on the installation of 4-Pair Unshielded Twisted Pair
33 (UTP) DATA Category 6 and Low Skew Cable for the Clear Cube connectivity, and 4-Pair UTP VOICE
34 Category 6 Copper Cables. The cables shall be installed from the Standard Information Outlet (SIO) in the
35 work area to the Telephone Equipment Room or Computer Equipment Room or the Radio Equipment
36 Room serving that area and terminated as specified in this document.
37

38 Station cables shall be installed in cable tray. Permanent outlets shall be mounted flush on a raised floor-
39 mounted box or wall mounted box. Temporary outlets will be installed in telecommunications Information
40 Outlet locations are to be identified on Project Drawings.
41

42 All cables and related termination, support and grounding hardware, bonding, shall be furnished, installed,
43 wired, tested, labeled, and documented by the Contractor, as detailed in the following section.
44

45 The Contractor shall provide all labor and materials necessary to construct the system as described herein.
46 This includes - but is not limited to - furnishing and installing cable, cable supports, innerduct, racking and
47 termination components, termination, testing, labeling and documentation.
48

49 **WORK SEQUENCE**

50 During the construction period, coordinate telecommunications schedule, phasing and operations with the
51 Owner.
52

53 **SUBMITTALS**

54 Under the provisions of Section 26 05 00 and Division 1, prior to the start of work the Contractor shall
55 submit:
56

57 six (6) sets of Manufacturer's Data covering all products proposed indicating construction, materials,
58 ratings and all other parameters identified in Part 2 (Products) below.
59

60 Manufacturer's installation instructions, and
61

1 one (1) two-foot section of each cable type to be utilized for final approval by the Engineer. This two-foot
2 section shall have the manufacturer's cable markings visible. Upon request, samples from every reel sent
3 to the site shall be provided.
4

5 Submittals should be grouped to include complete documentation of related systems, products and
6 accessories in a single submittal. Where applicable, dimensions should be marked in units to match those
7 specified.
8

9 Submittals shall be original catalog sheets, photocopies, or electronic format (ADOBE Portable Document
10 format ".pdf") thereof. Facsimile (fax) sheets shall not be accepted.
11

12 Two sets of submittals. The Engineer shall review the Submittals and annotate them indicating approvals
13 and shall return to the contractor.
14

15 Work shall not proceed without the Engineer's approval of the submitted items.
16

17 If materials are furnished as specified no further qualifications is necessary, except for items requiring shop
18 drawings. However, if the Contractor wishes to substitute another manufacturer and/or catalog number, the
19 following information in triplicate shall be submitted to the Engineer:
20

21 A complete description of the material which the contractor proposes to substitute (shop drawings,
22 illustrations, catalog data, performance characteristics, etc.) and the reason for the substitution
23 identifying any benefit to the Owner.
24

25 The Contractor shall receive approval from the Engineer on all substitutions of material. No substituted
26 materials shall be installed except by written approval from the Engineer.
27

28 **PROJECT RECORD DOCUMENTS**

29 Submit and record documents under provisions of 26 05 00.
30

31 Accurately record exact sizes, locations and quantities of cables.
32

33 **QUALITY ASSURANCE**

34 The manufacturer shall be a company specializing in communication cable and/or accessories with a
35 minimum of five years documented experience in producing cable and/or accessories similar to those
36 specified below.
37

38 The contractor shall have been in this line of business for a minimum of five (5) years and completed four
39 (4) jobs of the magnitude specified in the following sections.
40

41 The installing contractor shall have at a minimum one (1) Certified Installer trained to the latest industry
42 standards to ensure the most reliable installation available. The Certified Installer shall have been trained
43 by a company(s) that offers a minimum fifteen (15) year system warranty.
44

45 **DELIVERY, STORAGE AND HANDLING**

46 Cable shall be stored according to manufacturer's recommendations as minimum. In addition, cable must be
47 stored in a location protected from vandalism and weather. If cable is stored outside, it must be covered
48 with opaque plastic or canvas with provision for ventilation to prevent condensation and for protection
49 from weather. If air temperature at cable storage location will be below 4 degrees C., the cable shall be
50 moved to a heated (10 degrees C. minimum) location.
51

52 If the contractor wishes to have a trailer on site for storage of materials, arrangements shall be made with
53 the Owner. If necessary, cable shall be stored off site at the contractor's expense.
54

55 **DRAWINGS**

56 It shall be understood that the electrical and telecommunication details and drawings provided with the
57 specification package are diagrammatic. They are included to show the intent of the specifications and to
58 aid the Contractor in bidding the job. The Contractor shall make allowance in the bid proposal to cover
59 whatever work is required to comply with the intent of the plans and specifications.
60

61 The Contractor shall verify all dimensions at the site and be responsible for their accuracy.
62

1 Prior to submitting the bid, the Contractor shall call the attention of the Engineer to any materials or
2 apparatus the Contractor believes to be inadequate and to any necessary items of work omitted, within ten
3 (10) days prior to the Bid Due Date.
4

6 **PART 2 - PRODUCTS**

8 **HORIZONTAL MEDIA (STATION CABLES)**

9 **General**

10 The Horizontal (Station) Cable System is based on the installation of Un-shielded Twisted Pair (UTP)
11 DATA Category 6 and Low Skew Cables for the Clear Cube Connections and VOICE (Telephone)
12 Category 6 copper cables to install from the work area to the wiring hub locations(s). Refer to the Floor
13 plan Drawings(s) which identify the location of the wiring hubs and Standard Information Outlets (SIO)
14 locations.
15

16 Voice and Data Station Cables shall be constructed of individually twisted pairs with 24-AWG insulated
17 solid copper conductors.
18

19 All Cables and Termination hardware shall be technically compliant with and installed in accordance with
20 the referenced TIA/EIA documents.
21

22 All cables shall be suitable for installation in the environment defined and shall meet a CMP rating.
23

24 Cables shall be Underwriters Laboratory (UL) listed, comply with Article 800 (Communications Circuits)
25 of the National Electrical Code and shall meet the specifications of NEMA (low loss), UL 444, and ICEA.
26

27 Pairs of all 4-pair cables shall be unshielded and shall be identified by a banded color code in which
28 conductor insulation is marked with a dominant color and banded with a contrasting color. By pair
29 number, the pair colors or dominant band are:
30

- 31 Pair 1: Tip - White/Blue; Ring - Blue (or Blue/White)
- 32 Pair 2: Tip - White/Orange; Ring - Orange (or Orange/White)
- 33 Pair 3: Tip - White/Green; Ring - Green (or Green/White)
- 34 Pair 4: Tip - White/Brown; Ring - Brown (or Brown/White)

36 **Horizontal Data and Voice Station Cable (Copper)**

37 All horizontal Data Station Cables shall terminate on modular Patch Panels as specified on the drawings.
38

39 All horizontal Voice Station Cables shall terminate on modular Category 6 Patch Panels. All horizontal
40 Data Station Cables shall terminate on modular Category 6 Patch Panels.
41

42 All cables, termination components and support hardware shall be furnished, tested, installed and wired by
43 the Contractor.
44

45 Transmission characteristics of the Data and Voice Station Cables shall meet full Category 6 cable
46 performance criteria as defined by the referenced TIA/EIA documents. Refer to the Execution Section
47 which details the required performance criteria of the completed Link of which the Cable is a part
48

49 In addition a low skew cable having a propagation delay skew not exceeding 25ns/100meter capable of
50 supporting Clear Cube product C7130. Refer to the Execution Section which details the required
51 performance criteria of the completed Link of which the Cable is a part.
52

53 **IMPORTANT:** Cable and Termination Components (Jack, Patch Panel, Wiring Blocks) are specified to
54 function as a System. The compatibility of the Cable to be installed with the proposed termination
55 components shall be recognized and documented by the Termination Component Manufacturer.
56

57 The jacket color for Data cables shall be orange.
58

59 The jacket color for Voice cables shall be white
60

61 Cable shall be packaged in a way that minimizes tangling and kinking of the cable during installation.
62 Examples are open reels or packages that incorporate a rotating reel.

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INFORMATION OUTLET

Station cables shall each be terminated at their designated workstation location in the connector types described in the sub-sections below. Included are modular jacks (Voice & Data). These connector assemblies shall snap into a mounting frame and exit flush. All ports that are wall mounted shall be installed such that the opening faces the floor. All ports that are floor mounted shall be installed such that the opening faces toward the work station. The combined assembly is referred to as the Standard Information Outlet (SIO).

SIO mounting configurations shall be as follows:
Flush where existing boxes are in place

The Telecommunications Outlet Frame shall accommodate:

a minimum of four (4) Modular Jacks when installed on a wall-mounted assembly.

a minimum of four (4) Modular Jacks when installed on a Floor-mounted assembly.

the outlet frame shall incorporate a mechanism for adjusting the surface plate to a plumb position.

Multiple Jacks - identified in close proximity on the drawings (and not separated by a physical barrier) - may be combined in a single assembly. The contractor shall be responsible for determining the optimum compliant configuration based on the products proposed and documenting these in the as-built records.

The same orientation and positioning of Jacks and Connectors shall be utilized throughout the installation. Prior to installation, the Contractor shall submit the proposed configuration for each SIO type for review by the Engineer.

Wall Mount Outlet Faceplates shall incorporate recessed designation strips at the top and bottom of the frame for identifying labels. Designation strips shall be fitted with clear plastic covers.

Where stand-alone "Data" or "Voice" only Jacks are identified, the SIO Frame shall be configured as to allow for the addition of one (1) additional jack (Voice or Data) to be installed to supplement each jack as defined by this project. The installation of these supplemental Jacks ARE NOT part of this project. Any unused jack positions shall be fitted with a removable blank inserted into the opening.

The faceplate of the SIO shall be constructed of High Impact Plastic. Faceplate color shall (1) match the faceplate color used for other utilities in the building or (2) when installed in Surface Raceway (if applicable), match the color of the Raceway.

Wall-mounted "Voice Only" outlets shall be installed where identified on the Floorplan Drawings to accommodate wall-mounted telephone sets. The Wall Plate shall be of Stainless Steel construction, accommodate one (1) voice jack as defined below, mount on a standard single gang outlet box or bracket and include mating lugs for wall phone mounting.

All Standard Information Outlets and the associated Jacks shall be of the same manufacturer throughout the project. An allowable exception, however, is the Wall-mounted "Voice Only" Outlet described above.

Data and Voice Jacks

Data and Voice jacks shall be an 8-pin Modular Jack.

The interface between the jack and the station cable shall be a 110-Style block or insulation displacement type contact. Termination components shall be designed to maintain the cable's pair twists as closely as possible to the point of mechanical termination

Data Jacks shall be pinned TIA-568B with the pairs as follows:
Voice Jacks shall be pinned TIA-568B with the pairs as follows:

- TIA-568B: Pair 1 - Pins 5 & 4
- Pair 2 - Pins 1 & 2
- Pair 3 - Pins 3 & 6

Pair 4 - Pins 7 & 8

Transmission characteristics of the Data and Voice Jack shall be as required to meet the TIA/EIA Category 6 performance criteria. Refer to the Execution Section which details the required performance criteria of the completed Link of which the Jacks are a part.

The Jack shall be UL verified and listed.

Jack contacts shall have a minimum of 50 micro-inches of gold plating.

The color of the Data Jack shall be orange. Where used for another application a color unique from the data and voice jack shall be used. Alternately, a color-coded Bezel or Icon may be used to identify the Data and Voice Jack.

The Color of the Voice Jack shall be white.

Wall-mount Voice-Only Outlets

Wall mounted "voice Only" outlets shall be installed where identified ("W") on the Project Drawing(s) to accommodate wall-mounted telephone sets. The Wall Plate shall be of Stainless Steel construction, accommodate one (1) voice jack as previously defined, mounted on a standard single gang outlet box or bracket and include mating lugs for wall phone mounting.

IMPORTANT: It is the responsibility of the Contractor to insure that their proposed design considers the available mounting depth in both the existing wall boxes and possible Surface Raceway. This may include the provision of Right Angle Cable Plugs, Feed through Couplings or other means.

DATA PATCH PANEL

Data cabling shall be terminated as indicated on the drawings on panels incorporating Modular Jacks meeting the specifications for the Telecommunications Outlet detailed in the Section above.

As indicated on the drawings these panels shall be rack mounted.

The Data Patch Panel shall consist of a Modular to 110-type connector system. Modular jacks shall meet the specifications detailed above (NON-KEYED 8-pin).

The largest single patch panel configuration shall not exceed 72 ports. Panels which are modular shall be fully populated (all ports occupied by jacks) and be provided in increments of no less than 12-jacks. High density patch panel configurations must incorporate horizontal cable management systems sized to accommodate the quantity of patch panel jacks being installed.

The Patch Panel blocks shall have the ability to seat and cut 8 conductors (4 pairs) at a time and shall have the ability of terminating 22- through 26-gauge plastic insulated, solid and stranded copper conductors. Data blocks shall be designed to maintain the cable's pair twists as closely as possible to the point of mechanical termination.

The Data Patch Panel as a system (including jack, cable interface and intermediate components) must maintain Category 6 performance per the referenced TIA/EIA documents. All pair combinations must be considered, with the worst-case measurement being the basis for compliance.

Panels shall incorporate cable support and/or strain relief mechanisms to secure the horizontal cables at the termination block and to insure that all manufacturers minimum bend radius specifications are adhered to.

The Patch Panel shall have color coded designation strips to identify cable count.

Transmission performance shall be maintained by the Data Patch Panel as a system (including jack, cable interface and intermediate components).

VOICE (HORIZONTAL) TERMINATION FIELD

At the Telephone Room each Horizontal Voice Cable shall be terminated on high density 110 blocks. Wall mounted patch panels and terminal blocks must be mounted on a prepared surface consisting of 5/8 inch plywood securely fastened to the building walls. All six surfaces of the plywood must be painted with fire retardant paint.

1
2 Each horizontal row shall be cable of terminating six (6) four pair groups (Station Cable).
3
4 Blocks shall identify pair position by color designation.
5
6 The blocks shall be designed to maintain the cable's pair twists as closely as possible to the point of
7 mechanical termination.
8
9 The voice termination field (blocks) must maintain Category 6 performance per the referenced EIA/TIA
10 documents. All pair combinations must be considered, with the worst-case measurement being the basis
11 for compliance.
12
13 Each row of blocks shall be provided with a label holder which is to be used to identify the cable pairs.
14
15 The Voice Termination Hardware shall be 110-style.
16 Voice Horizontal Cabling Termination
17 Four (4) Pair Termination Clips (e.g. C4) shall be used in the termination of Voice Station Cabling
18
19 Horizontal Troughs incorporating metal distribution rings shall be provided by the Contractor to
20 accommodate routing of jumpers. Troughs shall be positioned at the top of each column of termination
21 blocks and between each 100-pair wiring block.
22
23 Vertical Troughs incorporating metal distributing rings shall be provided in the 911 Telephone Equipment
24 Room for vertical routing of jumper and/or cross-connect wire. A backboard incorporating plastic
25 distribution rings allowing for a change in direction in cross connect wiring shall be installed between the
26 blocks on which station and backbone cabling are terminated.
27
28 **Jumper Management**
29 Existing rack to be equipped with the following jumper management hardware shall be as follows:
30
31 Horizontal Jumper Management Panels shall be painted steel (3.5" panel), have a minimum of five
32 (5) Jumper distribution rings (1.75" x 3.75" minimum dimension).
33
34 At minimum, horizontal cable management hardware shall be shall be positioned above and below
35 each grouping of two rows of Jacks Data Patch Panels.
36
37 Each rack shall be supplied with a minimum of twelve (12) releasable (e.g. "hook & loop") cable
38 support ties.
39
40 **NOTE:** Where Cable Termination Hardware is wall mounted, the contractor shall be responsible for
41 establishing a cable pathway for jumpers routed from the Equipment Rack(s) to the wall. This shall be in
42 the form of slotted ducts, troughs, "D" rings or other means. Routing of jumpers via the overhead ladder
43 rack system is not acceptable. The proposed method shall be included in the submittals required by this
44 document and shall be approved by the Engineer prior to installation.
45
46 **FLEXIBLE NONMETALLIC INNERDUCT AND FITTINGS**
47 **General**
48 Flexible Non-metallic Innerduct (e.g. "Innerduct") may be used as follows:
49 to segment conduit(s), increasing their capacity,
50
51 Innerduct shall be corrugated.
52
53 Where not installed in a continuous length, innerduct segments should be spliced using couplings designed
54 for that purpose.
55
56 Any vacant innerduct shall be equipped with a pull cord and capped at all ends to inhibit the entry of water
57 and contaminants.
58
59 Nominal duct size shall be 1-inch (minimum).
60
61 Innerduct should be rated (e.g. General, Flame-retardant, Riser or Plenum) as required by the installation
62 environment. Riser and Plenum innerduct shall be of a color contrasting to that of the "Standard" and

1 Flame-retardant innerduct. The preferred colors are Orange (“Standard & Flame-retardant) and White
2 (Riser and Plenum).

3
4 **Flame-retardant Innerduct**

5 Innerduct installed within buildings (not including riser paths) or utility tunnels shall meet all of the above
6 General requirements plus:

7
8 be fabricated of flame-retardant materials suitable for installation such environments, and

9
10 meet or exceed all requirements for flame resistant duct as required by BELLCORE TR-NWT-000356
11 (Section 4.33).

12
13 **Riser-rated Innerduct**

14 Innerduct installed within building riser shafts shall meet all of the above General requirements plus:

15 be fabricated of flame-retardant materials suitable for installation such environments, and

16
17
18 meet or exceed all requirements for flame propagation as specified by test method UL-1666 and
19 referenced by the National Electrical Code (NEC) Section 770-53 for listed optical fiber raceways
20 being installed in vertical runs in a shaft between floors.

21
22 **MISCELLANEOUS MATERIALS**

23 **Voice Station Patch Cords**

24 The contractor is to furnish voice station patch cords (use the above quantity plus 20%) which are eighteen
25 inches or less in length and consist of an 8P8C plug 568B with Category 6 cable.

26
27
28 **PART 3 - EXECUTION**

29
30 **GENERAL**

31 Copper Pair counts of the cables to be supplied are detailed on the Project Drawings. Contractor shall
32 furnish and install all cables, connectors and equipment as shown on drawings and as specified above. It
33 shall be noted that all cables shall be installed in continuous lengths from endpoint to endpoint. No splices
34 shall be allowed unless noted otherwise.

35
36 Refer to Project Drawings which indicate the cable routes to follow and the termination location(s) within
37 each building. Duct allocation shall be coordinated as part of the construction.

38
39 It is the contractor's responsibility to survey the site and include all necessary costs to perform the
40 installation as specified. This includes any modifications required to route and conceal horizontal
41 distribution wiring.

42
43 Beginning installation means contractor accepts existing conditions.

44
45 Contractor shall furnish all required installation tools to facilitate cable pulling without damage to the cable
46 jacket. Such equipment is to include, but not limited to, sheaves, winches, cable reels, cable reel jacks, duct
47 entrance tunnels, pulling tension gauge and similar devices. All equipment shall be of substantial
48 construction to allow steady progress once pulling has begun. Makeshift devices, which may move or wear
49 in a manner to pose a hazard to the cable, shall not be used.

50
51 All cable shall be pulled by hand unless installation conditions require mechanical assistance. Where
52 mechanical assistance is used, care shall be taken to insure that the maximum tensile load for the cable as
53 defined by the manufacturer is not exceeded. This may be in the form of continuous monitoring of pulling
54 tension, use of a “break-away” or other approved method.

55
56 The contractor will be responsible for identifying and reporting to the Site Coordinator(s) any existing
57 damage to walls, flooring, tiles and furnishings in the work area prior to start of work. All damage to
58 interior spaces caused by the installation of cable, raceway or other hardware must be repaired by the
59 Contractor. Repairs must match preexisting color and finish of walls, floors and ceilings. Any contractor-
60 damaged ceiling tiles are to be replaced by the contractor to match color, size, style and texture.

1 Where unacceptable conditions are found, the Contractor shall bring this to the attention of the construction
2 supervisor immediately. A written resolution will follow to determine the appropriate action to be taken.
3
4 Qualified personnel utilizing state-of-the-art equipment and techniques shall complete all installation work.
5 During pulling operation an adequate number of workers shall be present to allow cable observation at all
6 points of duct entry and exit as well as the feed cable and operate pulling machinery.
7
8 Cable pulling shall be done in accordance with cable manufacturer's recommendations and ANSI/IEEE C2
9 standards. Manufacturer's recommendations shall be a part of the cable submittal. Recommended pulling
10 tensions and pulling bending radius shall not be exceeded. Any cable bent or kinked to radius less than
11 recommended dimension shall not be installed. If any installed cable is kinked to a radius less than
12 recommended dimension it shall be replaced by the contractor with no additional cost to the project.
13
14 All wiring shall be run "free-air", in conduit, in a secured metal raceway or in modular furniture as
15 designated on the floorplan(s). All cable shall be free of tension at both ends.
16
17 Avoid abrasion and other damage to cables during installation.
18
19 Pulling Lubricant may be used to ease pulling tensions. Lubricant shall be of a type that is non-injurious to
20 the cable jacket and other materials used. Lubricant shall not harden or become adhesive with age.
21
22 The Cable system will be tested and documented upon completion of the installation as defined in the
23 Section below.
24
25 A pull cord (nylon; 1/8" minimum) shall be co-installed with all cable installed in any conduit.
26
27 Should it be found by the Engineer, that the materials or any portion thereof, furnished and installed under
28 this contract, fail to comply with the specifications and drawings, with the respect or regard to the quality,
29 amount of value of materials, appliances or labor used in the work, it shall be rejected and replaced by the
30 Contractor and all work distributed by changes necessitated in consequence of said defects or imperfections
31 shall be made good at the Contractor's expense.
32
33 **SYSTEM TOPOLOGY AND CABLE SIZE REQUIREMENTS**
34 **Station Cabling**
35 Information Outlets cables with copper media Voice & Data UTP shall be located as detailed on the Project
36 Drawings.
37
38 The Bidder in determining materials quantities and routing should utilize these documents.
39
40 Station Cabling at each work area shall be routed to the Telephone Equipment Room, the Computer
41 Equipment Room and the Radio Equipment Room on this floor or to the designated TR if on another floor.
42 Provide one data cable to each CCTV camera location.
43
44 Station cables shall be run to the Information Outlet from the Room serving each area in conduit, free-air
45 above drop ceiling, in cable tray and/or in modular furniture.
46
47 The maximum station cable drop length for Data and Voice UTP (Category 6 and Low Skew Cable) shall
48 not exceed 295-feet (90-meters) in order to meet data communications performance specifications. This
49 length is measured from the termination panel in the wiring closet to the outlet and must include any slack
50 required for the installation and termination. The Contractor is responsible for installing station cabling in a
51 fashion as to avoid unnecessarily long runs. Any area that cannot be reached within the above constraints
52 should be identified and reported to the Engineer prior to installation. Changes to the plan shall be
53 approved by the Engineer.
54
55 All cables shall be installed splice-free unless otherwise specified.
56
57 During pulling operation an adequate number of workers shall be present to allow cable observation at all
58 points of duct entry and exit as well as the feed cable and operate pulling machinery.
59
60 Avoid abrasion and other damage to cables during installation.
61

1 All cable shall be free of tension at both ends. In cases where the cable must bear some stress, Kellom grips
2 may be used to spread the strain over a longer length of cable.

3
4 Where installed free-air, installation shall consider the following:

5
6 Cable shall run at right angles and be kept clear of other trades work.

7
8 Cables shall be supported according to code utilizing "J-" or "Bridal-type" mounting rings
9 anchored to ceiling concrete, piping supports or structural steel beams. Rings shall be designed to
10 maintain cables bend to larger than the minimum bend radius (typically 4 x cable diameter).

11
12 Supports shall be spaced at a maximum 4-foot interval unless limited by building construction. If
13 cable "sag" at mid-span exceeds 6-inches, another support shall be used.

14
15 Cable shall never be laid directly on the ceiling grid or attached in any manner to the ceiling grid
16 wires.

17
18 Cables shall not be attached to existing cabling, plumbing or steam piping, ductwork, ceiling
19 supports or electrical or communications conduit.

20
21 Manufacturer's minimum bend radius specifications shall be observed in all instances.

22
23 Care should be taken in the use of cable ties to secure and anchor the station cabling. Ties should not be
24 over tightened as to compress the cable jacket. No sharp burrs should remain where excess length of the
25 cable tie has been cut.

26
27 Cable sheaths shall be protected from damage from sharp edges. Where a cable passes over a sharp edge, a
28 bushing or grommet shall be used to protect the cable.

29
30 A coil of 4 feet in each cable shall be placed in the raised floor at the last support (e.g. J-Hook, Bridal Ring,
31 etc.) before the cables enter a fishable wall, conduit, surface raceway or box. At any location where cables
32 are installed into movable partition walls or modular furniture via a service pole, approximately 15-feet of
33 slack shall be left in each station cable under 250-feet in length to allow for change in the office layout
34 without re-cabling. These "service loops" shall be secured at the last cable support before the cable leaves
35 the floor and shall be coiled from 100% to 200% of the cable recommended minimum bend radius.

36
37 At Telephone Equipment Room, Computer Equipment Room and Radio Equipment Room approximately
38 10-feet of slack shall be left in each station cable under 250-feet in length to allow for changes in the
39 telecommunication room layout without re-cabling. These "service loops" shall be secured to the ladder
40 rack, with "J" hooks, or "D" rings above the equipment, racks, and patch panels and shall be coiled from
41 100% to 200% of the cable recommended minimum bend radius.

42
43 To reduce or eliminate EMI, the following minimum separation distances from $\leq 480V$ Power lines shall be
44 adhered to:

45
46 Twelve (12) inches from power lines of $<5\text{-kVa}$.

47
48 Eighteen (18) inches from high voltage lighting (including fluorescent).

49
50 Thirty-nine (39) inches from power lines of 5-kVa or greater.

51
52 Thirty-nine (39) inches from transformers and motors.

53
54 All openings shall be sleeved and firestopped per prevailing code requirements upon completion of cable
55 installation.

56
57 **IMPORTANT:** Within the room in which any telecommunications cabling is to be terminated, Hook and
58 Loop (e.g. "Velcro") ties only shall be used from room entry to the point of termination. This is to
59 facilitate the addition of future cables.

60
61 **Information Outlet**

62 General

1 Information Outlets shall be flush mounted on wall-mounted boxes, in floor-mounted boxes, on Surface
2 Raceway and on modular furniture.

3
4 Any outlets to be added where these conditions are not met shall be positioned at a height matching that of
5 existing services or as directed otherwise by the Site Coordinator and the Engineer. Nominal height (from
6 finished floor to center line of Outlet) in new installation shall be as follows:

7		
8	Standard Voice & Data Outlet	18-inches
9		
10	Wall-Mounted Telephone Outlet (Standard Voice only)	54-inches.
11		
12	Wall-mounted Telephone Outlets for Wheelchair Persons:	
13	Approach head on	per ADA regulations
14	Approach parallel	per ADA regulations
15		
16		

17 **CABLE TERMINATION**

18 **General**

19 At the Telephone Rooms, the Radio Room and the Computer Equipment Room, all Data and Voice Cables
20 shall be positioned on termination hardware in sequence of the Outlet I.D. starting with the lowest number.

21 Termination Hardware (Blocks and Patch Panels) Positioning and Layout must be reviewed and approved
22 by the Engineer prior to construction. The review does not exempt the Contractor from meeting any of the
23 requirements stated in this document.

24 **Cable Termination - Voice UTP**

25 Category 6 horizontal voice cabling may be terminated on patch panels.

26
27 Voice pairs shall terminate on wall mounted 110 type blocks at the Telephone Room. The contractor shall
28 coordinate the placement of blocks with the Engineer in order to integrate with other cabling.

29 Station Blocks shall be provided to accommodate a minimum of 20% growth in the quantity of stations
30 relative to the initial installation.

31 The contractor shall furnish and install cable management hardware (e.g. D Rings and cable guides) to
32 neatly and securely route the cable from cable tray to the cable termination hardware.

33 The Height of the Voice Termination Field shall not exceed 6-feet (72-inches) above floor level to facilitate
34 cable maintenance.

35 Blocks on which Backbone and Station Cabling are terminated shall be positioned in separate columns.
36 Backbone Cabling should be positioned to the Left; Station cabling to the Right and be in close proximity
37 as to simplify installation and subsequent tracing of cross-connect wiring. Where new cabling is to be
38 integrated with existing cabling at the building entrance, it will be the responsibility of the Contractor, in
39 cooperation with the Owner, to coordinate placement of Voice Termination hardware with the Local
40 Exchange Carrier(s) serving the site.

41 Cables shall be fed from below the Termination Hardware in a manner that will facilitate growth.

42 Horizontal Troughs incorporating split plastic distribution rings shall be provided by the Contractor to
43 accommodate routing of jumpers. Troughs shall be positioned at the top of each column of termination
44 blocks and between each 100-pair wiring block. Rings shall be positioned between the Backbone and
45 Station blocks for vertical routing of jumpers and/or cross-connect wiring.

46 Termination of Horizontal Voice (Station) cabling shall be accomplished by using four-pair (e.g. C4-type)
47 clips. The twenty-fifth pair of each row on the 110 type block located in the TR shall not be used for
48 termination of horizontal voice cable.

49 A jumper wire spool holder shall be installed at the Main Equipment Room. Two full (1000-foot) spools of
50 24-AWG one-pair jumper wire, shall be supplied with the holder. The spool holders shall be assemblies
51 designed for that purpose.

1 **Voice Multiplier Blocks**

2 At the Telephone Equipment Room, Voice "Multiplier Blocks" shall be installed to accommodate the
3 potential for multiple extensions of a single line. Each Multiplier Block shall be formed by running short
4 sections of Cross-connect wire vertically through each index strip on a 100 pair block (4 rows). Five (5)
5 Pair connecting clips shall be used. These multiple connections shall be clearly marked on the designation
6 strips. Jumpers can then be wired (by others) from this common point to as many cable terminations as
7 required.

8
9 One (1) each such 100 pair block shall be so configured at each telecommunication room.

10 **Cable Termination - Data UTP**

11 Data Patch Panels shall be designed and installed in a fashion as to allow future station cabling to be
12 terminated on the panel without disruption to existing connections.

13
14 Data Patch panels shall be sized to accommodate a minimum of 20% growth in the quantity of stations
15 relative to the initial installation.

16
17 At Information Outlets and Data Patch Panel, the installer shall insure that the twists in each cable pair are
18 preserved to within 0.5-inch of the termination for Data cables. The cable jacket shall be removed only to
19 the extent required to make the termination.
20

21
22 **Voice Cross Connects**

23 The contractor shall be responsible for the "Cross-connect" wiring between the Station (horizontal) and
24 Backbone Voice cabling.

25
26 Four (4) pairs in each station cable shall be cross-connected to the Backbone (riser or tie) cable. 4-pair
27 Cross-connect wire, color coded to identify each pair, shall be used. The 25TH pair position (50TH, 75TH,
28 etc.) of each riser voice block shall remain vacant.
29

30
31 Fastening cables directly to support brackets with wire or plastic ties will not be accepted. All cabling shall
32 be neatly laced, dressed and supported. Retainer Clips shall be used on each 110-type block to secure
33 jumper wires on the wiring block(s).
34

35 It shall be the responsibility of the Contractor, to work with the Owner and Site Coordinator(s) and provide
36 the necessary assistance to allow Owner and/or Telephone Company personnel to make the necessary
37 connections to establish service on the new cable system. These activities include, but are not limited to
38 cross connect documentation, general wiring overview and cable pair identification.
39

40 The contractor shall be responsible for removal and disposal of all existing station cable.

41
42 The rack(s) shall be grounded to the Telecommunications Ground Busbar (TGB) using a #6 AWG (or
43 larger) insulated stranded copper conductor (GREEN jacket or GREEN jacket with one or more yellow
44 stripes). (See NEC 2002, section 250.119.)
45

46 **Identification and Labeling**

47 Individual labels shall be placed on all Telecommunications Outlets, Data Patch Panels, Radio Termination
48 Blocks, Voice Termination Blocks, and cables. This is inclusive of each voice, data, radio, clear cube, or
49 any configuration thereof, as identified on the drawings.
50

51 Each component shall be clearly labeled using a code identifying each information outlet location
52 throughout the facility. The project documents identify the numbering at each outlet location. Each media
53 type shall be numbered separately. The format of the identifier shall be as follows:
54

55 TR-####X

56 Where: TR = Telecommunication Room identifier serving that location

57 #### = a sequential number assigned to that port starting at 001

58 X = an alpha character identifying cable type. V=Voice, D=Data, R=Radio, REP=Radio

59 Existing Proprietary.
60

1 For example: "1A-001D" represents the first data jack served from the Telecommunications
2 Room on the first floor identified as room 1A for that building. A voice outlet at the same
3 location would be labeled as "1A-001V".
4

5 Telecommunication Rooms identifiers shall be unique in this space.
6

7 Telecommunications Outlets are to be labeled 1) on the cover of the assembly and 2) on each cable
8 terminated at that location.
9

10 All new outlet faceplates shall incorporate recessed label holders and shall be fitted with clear plastic
11 covers. Where no such label holders are present on existing to remain outlets, the faceplate labels shall be
12 protected with a clear over-laminate.
13

14 Labels shall be White background with Black lettering. Lettering size shall be as large as practicable (up to
15 16-point) to fit properly on the outlet label. No lettering shall be smaller than 12-point.
16

17 Copper Data Patch Panels shall be labeled identifying Outlet ID. Modular Jacks shall be positioned in
18 sequence of Outlet ID.
19

20 Each Station Cable shall be labeled within 4 inches of the cable end at the Data Patch Panel, 110 blocks and
21 information outlet.
22

23 All Copper Backbone and Station Cables, Outlet Faceplates and Termination components (e.g. Voice Field
24 & Data Patch Panel) shall be clearly labeled.
25

26 Prior to installation, the Contractor shall provide samples of all label types planned for the project. These
27 samples shall include examples of the lettering to be used.
28

29 **Work by Owner**

30 All Network Electronics equipment will be by Owner.
31

32 **Cooperation**

33 The Contractor shall cooperate with other trades and County personnel in locating work in a proper
34 manner. Should it be necessary to raise or lower or move longitudinally any part of the work to better fit
35 the general installation, such work shall be done at no extra cost to the project, provided such decision is
36 reached prior to actual installation. The Contractor shall check the location of electrical outlets with respect
37 to other installations before installing.
38

39 **TESTING AND ACCEPTANCE**

40 **General**

41 The contractor is responsible to perform acceptance tests as indicated below for each sub-system (e.g.
42 backbone, station, etc.) as it is completed
43

44 All tests shall be documented.
45

46 The Contractor is responsible for supplying all equipment and personnel necessary to conduct the
47 acceptance tests. Prior to testing, the Contractor shall provide a summary of the proposed test plan for each
48 cable type including equipment to use used, set-up, test frequencies or wavelengths, results format, etc.
49 The method of testing shall be approved by the Engineer.
50

51 The Contractor shall visually inspect all cabling and termination points to insure that they are complete and
52 conform to the wiring pattern defined herein. The contractor shall provide the Engineer with a written
53 certification that this inspection has been made.
54

55 The Contractor shall conduct acceptance testing according to a schedule coordinated with the owner.
56 Representatives of the Owner may be in attendance to witness the test procedures. The contractor shall
57 provide a minimum of one (1) week advance notice to the Engineer as to allow for such participation. The
58 notification shall include a written description of the proposed conduct of the tests including copies of
59 blank test result sheets to be used.

60 **IMPORTANT:** Failure to provide the above information shall be grounds for the Owner/Engineer to reject
61 any and all Documentation of Results on related testing and to require a repeat of the affected test.
62

1 Tests related to connected equipment of others shall only be done with the permission and presence of
2 Contractor involved. The Contractor shall ascertain that testing only as required to prove the wiring
3 connections are correct.

4
5 The Contractor shall provide test results and describe the conduct of the tests including the date of the tests,
6 the equipment used and the procedures followed. At the request of the Engineer, the contractor shall
7 provide copies of the original test results.

8
9 All cabling shall be 100% fault free unless noted otherwise. If any cable is found to be outside the
10 specification defined herein, that cable and the associated termination(s) shall be replaced at the expense of
11 the contractor. The applicable tests shall then be repeated.

12
13 Should it be found by the Engineer that the materials or any portion thereof furnished and installed under
14 this contract fail to comply with the specifications and drawings, with the respect or regard to the quality,
15 amount of value of materials, appliances or labor used in the work, it shall be rejected and replaced by the
16 Contractor and all work distributed by changes necessitated in consequence of said defects or imperfections
17 shall be made good at the Contractor's expense.

18 19 **Voice Station Cabling (Category 6)**

20 Testing shall be done from the voice jack at the SIO to the voice 110 blocks/patch panel at the Telephone
21 Equipment Room where the cables are terminated. Cat 6 cable testing, in this case, will be done with the
22 patch cord. The cabling must pass all Cat 6 TIA requirements.

23
24 Horizontal "Station" cables shall be free of shorts within the pairs, and be verified for continuity, pair
25 validity and polarity, and Wire Map (Conductor Position on the Modular Jack). Any defective, split or
26 mis-positioned pairs must be identified and corrected.

27
28 Testing of the Cabling Systems rated at TIA Category 6 shall be performed to confirm proper functioning
29 and performance.

30
31 Where cross-connection of cabling sub-systems by the Contractor is specified, each subsystem shall be
32 tested separately as defined above followed by a Voice Channel Test after the cross-connection is
33 complete.

34 35 **Voice Channel**

36 The end-to-end voice transmission between the Telephone Equipment and the Standard Information Outlet
37 (Voice) including patch cords/jumper cables.

38 39 **Voice Channel Test**

40 The contractor shall perform a voice channel test on all voice cable pairs from the Standard Information
41 Outlet (Voice) to the pair appearance at the Telephone Equipment Room. All 4 pairs are to be free of
42 shorts; verified for continuity, pair validity, polarity, and conductor position on the terminating blocks.
43 Any mis-positioned pairs shall be identified and corrected. Any patch cords/jumper cables which cause the
44 voice channel test to fail shall be replaced and the channel retested.

45 46 **Data Station Cabling (Category 6 and Low Skew Cable)**

47 Testing shall be from the Jack at the SIO to the Data Patch Panel at the Computer Equipment or Radio
48 Equipment Room on which the cables are terminated. Cat 6 and cable testing, in this case, will be done
49 with the patch cord. The cabling must pass all Cat 6 and Cat 6e TIA requirements.

50
51 Horizontal "Station" cables shall be free of shorts within the pairs, and be verified for continuity, pair
52 validity and polarity, and Wire Map (Conductor Position on the Modular Jack). Any defective, split or
53 mis-positioned pairs must be identified and corrected.

54
55 Testing of the Cabling Systems rated at TIA Category 6 and Low Skew Cable shall be performed to
56 confirm proper functioning and performance.

57 58 **Category 6 and Low Skew Cable Performance Testing**

59 In addition to the above, Performance Testing shall be performed on all cables. Testing of the
60 Transmission Performance of station cables (Category 6 and Low Skew Cable) shall include the following:

61
62 Length

1 determined necessary by the Engineer, including a 100% re-test. This re-test shall be at no additional cost
2 to the Owner.

3
4 **Test Data - Copper Media**

5 Test results shall include a record of test frequencies, cable type, conductor pair and cable (or Outlet) I.D.,
6 measurement direction, test equipment type, model and serial number, date, reference setup, and crew
7 member name(s).

8
9 Printouts generated for each cable by the wire test instrument (e.g. *PentaScanner*) shall be submitted as part
10 of the documentation package. Alternately the contractor may furnish this information in electronic form
11 on CD-ROM (preferred) or (3.5" diskette).

12
13 **Cross-Connect Data**

14 As noted above, it shall be the responsibility of the Contractor to work with the Owner and Site
15 Coordinator(s) and provide the necessary assistance to allow Owner and/or Telephone Company personnel
16 to make the necessary connections to establish telephone service on the new cable system. These activities
17 include, but are not limited to (1) a general wiring overview and (2) detailed cross connect documentation
18 (relating SIO I.D., Room Number and Riser pair). The latter shall be in the form of an electronic format
19 database (dBase, MS Excel or convertible format).

20
21 **AS-BUILT CONSTRUCTION DRAWINGS**

22 Drawings included with the specifications set shall be modified by the contractor to denote as-built
23 information.

24
25 The drawings are to include cable routes and outlet locations. Outlet locations shall be identified by their
26 sequential number as defined elsewhere in this document. Numbering, icons and drawing conventions used
27 shall be consistent throughout all documentation provided.

28
29 The Consultant will provide floor plans in paper and electronic (".dwg", *AutoCAD* rel. 2006) formats on
30 which as-built construction information can be added. These documents will be modified accordingly by
31 the contractor to denote as-built information as defined above and returned to the Consultant for
32 acceptance. This information shall be supplied to the Consultant/Engineer no later than four (4) weeks
33 prior to the scheduled occupancy of the affected floors.

34
35 The Contractors shall annotate the base drawings and return to the A/E in hard copy (same plot size as
36 originals) and electronic (*AutoCAD* rel. 2006) form.

37
38 Each drawing submitted by the Contractor as part of the Project Documentation shall be identified as an
39 "As-built" drawing and include the following (1) The Contractor name and/or logo (2) The date of the
40 drawing.

41
42 All fonts, color, layer, Model Space/Paper Space conventions established in the base drawings shall be
43 retained by the Contractor in preparation of the As-built drawings.

44
45 Prior to generation of the drawings, the Contractor shall provide a sample file and test plot to the Engineer
46 for review and approval.

47
48 **All documentation, including hard copy and electronic forms shall become the property of Dane**
49 **County.**

50
51 **WARRANTY**

52 This Contractor shall guarantee all materials, equipment, etc., two (2) years from date of substantial
53 completion of this work. In the case of data cabling the contractor shall furnish complete Category 6
54 system warranty consisting of no less than fifteen (15) years. This guarantee shall include all labor,
55 material and travel time. In the case of multi-mode fiber cabling the contractor shall furnish a complete
56 system warranty consisting of no less than fifteen (15) years. Provide warranty certificate form
57 manufacturer. See Division 1, GENERAL CONDITIONS, and GENERAL REQUIREMENTS - Guarantee
58 Documents for further requirements.

1 **AS-BUILT COMMUNICATION CABLE COSTS**

2 The contractor determine the “installed” price for the telecommunication cabling: 1) the average installed
3 cost of a Cat 6 voice and a Cat 6 and Cat 6e data cable from the equipment rooms to the outlet jack, 2) the
4 average installed cost for a coaxial run from the F connector to the DOT monitors. The costs are to include
5 material, labor, installation, testing, documentation, manuals, training, warranty; and the
6 telecommunications proportion of the Schedule of Values consisting of general conditions, bond,
7 mobilization, record drawings, punch list, cleanup, and demobilization.

8
9 **CONSTRUCTION VERIFICATION ITEMS**

10 Contractor is responsible for utilizing the construction verification checklists supplied in accordance with
11 the procedures defined for construction verification checklists.

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END OF SECTION

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SECTION 28 20 00
CLOSED CIRCUIT TELEVISION SYSTEM

PART 1 - GENERAL

RELATED WORK

Refer to section 27 00 00 for related sections. All related work noted in 27 00 00 applies to this section.

REFERENCE

The Work under this section is subject to requirements of the Contract Documents including the General Conditions, Supplementary Conditions, and sections under Division 1 General Requirements.

SUBMITTALS

Product Data: Components for closed circuit television (CCTV) system. Include dimensions and data on features, performance, electrical characteristics, ratings, and finishes.

Shop Drawings: Detail assemblies of standard components that are custom assembled for specific application on this Project.

Outline Drawings: Indicate dimensions, weights, arrangement of components, and clearance and access requirements.

Control Panel Layout: At full scale, show required artwork and device identification.

Wiring Diagrams: Detail specific power, control, signal, communication, and data wiring and cabling to suit Project. Coordinate nomenclature and presentation with block diagram.

Raceway Riser Diagrams: Detail raceway runs required for television surveillance system and for systems integration. Include designation of devices connected by raceway, raceway type and size, and type and size of wire and cable fill for each raceway run.

Coordination Drawings:

Functional Block Diagram: Show single-line interconnections between components including interconnections between components specified in this Section and those furnished under other Sections. Indicate methods used to achieve systems integration.

Indicate control, signal, and data communication paths, control interface devices, and media to be used. Describe characteristics of network and other data communication lines.

Describe methods used to protect against power outages and transient voltages including types and ratings of isolation and surge suppression devices used in data, communication, signal, control, and ac and dc power circuits.

Dimensioned Outline Drawings of Control Panels: Identify equipment by name and function. Equipment must mount within standard 19" rack width.

FCC COMPLIANCE

Equipment furnished under this contract shall have been tested and made to comply with limits for Class A computing device pursuant to Subpart J of Part 15 of FCC Rules, which are designed to provide reasonable protection against interference when operated in commercial environment. Literature shall so note and equipment shall be so labeled to show this compliance.

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OPERATING AND MAINTENANCE INSTRUCTIONS

In addition to complying with Section 26 05 00 - Basic Electrical Requirements, furnish to Owner, upon completion of work, but before final acceptance of system and required training sessions three (3) sets of bound typewritten copies of complete instruction manuals, service manuals, schematics, parts lists, recommended spare parts lists, and current list of local manufacturer approved service centers.

OWNER TRAINING

Contractor shall conduct hands-on user training sessions. Provide initial training for Owner's personnel on operation and maintenance of system; 6 (six) hours minimum to consist of 4 (four) hours for the Communications Supervisor and 2 (two) hours for any other employees. Employee training shall take place simultaneously to be coordinated with the owner's representative for time and place. Training shall be complete to enable each level of personnel to perform associated tasks and functions in a competent and skillful manner. This training will be necessary for all users of the system as determined by the Owner. Training shall be conducted during normal business hours after system start-up and Owner acceptance.

Contractor shall be available by telephone at no additional charge for up to 1 (one) hour per month for the six (6) months following job completion to discuss issues with the system as required by owner.

GUARANTEE

Contractor shall guarantee CCTV system and components are free from defects in workmanship and materials for period of 1 year from date of Owner acceptance. During guarantee period, manufacturer shall perform services necessary on CCTV system, and supplier shall provide monthly inspections, written reports to Owner detailing findings of each inspection, and documentation of action(s) taken to remedy abnormal conditions.

DESCRIPTION

Intent is to provide an IP based system capable of being inserted on the Ethernet network for multiple viewing locations and call-up.

The Division 27 cabling contractor will provide cable from the Public Safety Communications Main Computer Equipment Room 120 to each camera location, dedicated security data ports, and final terminations. The cabling contractor provides all riser cable; wall mounted cable termination blocks, patch panels, and final riser cable termination and cross connections. Final test and certification of security cable system and terminations will be by the cabling contractor. Any additional cable, patch cords, final system interconnections required for a complete and operating system shall be the responsibility of the CCTV contractor. Contractor to use existing floor mounted equipment racks in Public Safety Communications Main Computer Equipment Room 120 for security CCTV system component mounting. Wall space is also available for equipment mounting in the main Public Safety Communications Main Telephone Equipment Room 121.

Major system components (Digital Video Recorder -DVR, hard disk storage, transceivers, etc.) shall reside in Public Safety Communications Main Computer Equipment Room 120 or as directed by owner. Daily viewing and administration will occur at a security access control workstation. The system shall be networked to allow remote monitoring at multiple locations as determined by owner.

Contractor shall provide all labor and materials necessary to construct the systems as described herein. This includes - but is not limited to - furnishing and installing all system equipment and software, interconnecting cabling for equipment, Security room wall mounted rack, termination components, mounting hardware, incidentals, accessories, programming and start-up, testing, labeling, documentation and training as detailed in the following section.

The extent of the CCTV security system is shown on the drawings and shall include, but not limited to, furnishing and installation of all components complete with the following:

1
2 Intent is a UTP based structured wiring scheme with Cat 6 cable system components provided under section 27
3 00 00. Contractor shall install data cable to each CCTV camera location for use by this contractor.
4
5 This contractor 28 00 00 shall provide other cables as required for power or signal.
6
7 Interior fixed video cameras and related sub-systems that include all mounting hardware, centralized power
8 supplies, DVR, video transceivers, and spot/call monitor. Interior cameras will be installed as recessed
9 dome type.
10
11 Separate 18/2 power cable may be provided to supply remote power as required.
12
13 The Digital Recorder shall be comprised of manufacturer specific hardware and software. The software shall be
14 a MS-Windows® based and shall provide a Graphical User Interface (GUI) for viewing of system images,
15 searching and retrieving of archived images and outputting incident specific images to a portable recording
16 medium. Owner to provide SERVER for camera operations and DVR storage based upon shop drawings
17 submitted by contractor.
18
19 CCTV system shall accept alarm inputs from the existing card access system to provide camera priority call-up
20 on duress alarm and secure access controlled points for all cameras.
21
22

23 **PART 2 - PRODUCTS**

24 **MANUFACTURER**

25 Cameras – Pelco, Integral, Bosch, General Electric, Panasonic, Sony or pre-approved equal.
26
27

28 Recording System – ASL (Alpha Systems Lab, Inc.), Integral, Panasonic, Bosch, Pelco, Access or pre-
29 approved equal
30

31 IP Integration hardware/software:

32 UTP Solution – Standard Category 6 cable as proposed by contractor shall be used for signal. Section 27
33 contractor to provide this cable.

34 Cable as required to connect to DVR.
35

36 Provide design and shop drawing for PC required (operator work station) for system function. Include all
37 hardware and standard operating system requirements for server. Contractor will purchase server and
38 configure it for use. Software required for system function must be able to function on standards based
39 Window operating system and hardware.
40

41 **MONITORS**

42 Provide monitor as indicated on plans. Monitor shall be high-resolution color, LCD flat screen and include
43 front mounted controls for brightness, contract, and vertical, horizontal hold power on/off.
44 Monitor shall be mounted on desk, tilt adjustable. Submit monitor during submittal process.
45

46 During brightness and/or color contrast adjustments, within reasonable limits the picture focus or size shall not
47 change and there shall be no blooming. Adjustment of the vertical and/or horizontal synchronization controls,
48 within the hold-in range shall have minimal effect on picture linearity or size.
49

50 The design of the CCTV System is to provide for multiple viewing options of all cameras and at each of the
51 operator workstations. Views shall be manually selectable via operator control or by automatic, user definable,
52 events.

1
2 Because solution is to be IP based, other owner-provided monitor or workstations shall be able to call up images
3 in addition to monitors provided.
4
5 **CAMERAS**
6 Features:
7
8 Fixed position ceiling mounted dome located on drawings.
9 Smoked dome cover.
10 Flush ceiling mount interior.
11 24 VAC power utilizing 23 AWG UTP structured cabling system or 18/2 cable where required.
12 UTP Cat 6 - 23 AWG compatibility with baluns, transceivers or converters as required.
13
14 High resolution, color CCD camera shall meet or succeed the following design and performance specifications:
15
16 The camera shall provide a minimum horizontal resolution of 450 TV lines.
17 The camera shall have automatic white balance with programmable override.
18 The camera shall provide an automatic shutter speed range of 1/2 to 1/30,000 with programmable override.
19 The camera shall have automatic iris control with manual and programmable override.
20 The camera shall have automatic gain control with programmable override.
21 All programmable camera functions shall be stored within the camera using non-volatile memory, without
22 the need for battery backup.
23
24 Provide lenses as required for focal length.
25
26 **CCTV Security System Control and Recording**
27 System software and hardware by Pelco, Integral, Linel or pre-approved equal.
28
29 Head end control and view software system shall reside on the security Access Control System operator
30 workstation. Provide remote view capability via the owner data network for remote view access.
31
32 System may receive analog or digital camera input, but must be IP compatible.
33
34 All recording shall be in digital format, using Digital Video Recorder (DVR) technology.
35
36 Input/Output interfaces for UTP (Unshielded Twisted Pair), fiber, coax or compatible with various cable
37 types with use of balun or transceiver as required.
38
39 Preferred method of video signal transport is Cat 6 UTP structured cabling. Baluns or transceivers may be
40 used at camera or DVR to convert UTP to required interfaces.
41
42 Recording shall be on a continuous basis 24 (twenty four) hours a day, 7 (seven) days a week, at 5 (five)
43 frames per second per camera. Recordings shall be stored for a period of 30 (thirty) days before being
44 overwritten on a first in first out basis.
45
46 The unit shall include displaying real-time and recorded images on: (1) a conventional NTSC Analog Video
47 Spot/Call Monitor; (2) from Remote location(s) via LAN/WAN connections (Network system by owner)
48 (3) via workstation SVGA Monitor. Display via the SVGA Monitor shall be Full Screen. System shall
49 permit viewing of camera images from multiple locations or the operator work station using the Owners
50 data network.
51

1 Contractor installation requirements shall include providing coordination with owner for Owner to provide
2 appropriate patch cords and Owner making the connection to the Owner's LAN.
3
4 The Contractor shall make the Owner aware of manufacturer's recommendations relating to such security
5 considerations. The Contractor shall furnish guidance as to the minimum PC platform system requirements
6 for Remote locations (incl. Processor Type/Speed, RAM, HDD Space, Operating System and Display
7 requirements). The Owner shall furnish this PC hardware for installation by contractor.
8
9 Miscellaneous:
10 Power Strip / Surge Suppressor: Power Strip / Surge Suppressor(s) shall be provided for powering of (1) all
11 camera power supplies, (2) copper cable transceivers, and (3) all CCTV head end equipment.
12
13 Power Strip / Surge Suppressor shall:
14 Rack mountable (19-inch rack).
15 Compliant with UL-1449, UL 1283 and UL-497A.
16 Provide Transient suppression to 13,000-A. Protection shall be in all 3 modes (hot-neutral, hot-ground &
17 neutral-ground).
18 Shall meet or exceed IEEE 587 Category A & B specification.
19 Provide High Frequency Noise Suppression.
20
21

22 **PART 3 - EXECUTION**

23 **INSTALLATION**

24 Install system in accordance with manufacturer's recommendations. System wiring shall be approved for
25 environment in which it is installed. Wiring shall be placed in communications cable trays or supported
26 from building members and suspended ceiling wires by listed devices (Caddy #4-Z-3-4 w/Caddy threaded
27 bridle rings, or equal assemblies).
28
29
30 Perform final connection, system start-up and testing under supervision of manufacturer-trained personnel.
31 Owner shall approve final lens selection after system is operational. Contractor to provide, coordinate and
32 cooperate with owner for final lens selection to meet field of view requirements.
33
34 DVR with main disk storage and control PC will be located as directed by owner. Mount equipment on
35 wall as required.
36
37 Provide consolidated camera power supplies and video transceivers as required located where indicated on
38 the drawings.
39
40 This contractor is responsible to coordinate with Division 27 communications contractor for use of patch
41 panel and data rack space.
42
43 The Contractor shall be responsible for initial programming all view monitor pre-set views associated with
44 each Camera location. The Owner shall provide guidance as to the desired settings. For bid purposes,
45 assume 8 (eight) hours of additional time to make modifications to the initial programming of titling, access
46 control alarm/event sequences, etc. associated with each Camera location at the owner's direction.
47
48 Provide lenses as required for each area, camera location and focal length.
49
50 Coordinate with Owner to install software required on PC workstation to be furnished by owner.
51

1 **DOCUMENTATION**

2 Provide as-built documentation to indicate actual cables (power, signal, control) provided at each camera.
3 Provide one line diagram indicating all recording equipment provided with all cables and connections.

4
5 **TESTING**

6 Contractor shall be responsible for supplying test equipment and qualified personnel to conduct acceptance
7 tests.

8 Contractor shall conduct tests during course of construction when identifiable portion of installation is
9 complete. Alternatively, testing can be conducted after entire installation is complete if this does not delay
10 the project schedule or affect system functionality.

11 If tests fail to meet stated specifications, make such adjustments, replacements and changes as are necessary
12 and then repeat tests that disclosed faulty or defective material, equipment or installation method. Provide
13 labor and materials for testing at no additional cost to Owner. The system must complete a successful
14 performance period. The performance period will begin on the day following the completed installation
15 and must continue for 30 consecutive days during which time the system will operate at an average
16 effectiveness level of 99 percent or more. If for any reason this level cannot be maintained, a new 30-day
17 performance period will be initiated. It is not necessary that one 30-day period expire before another
18 performance period begins.

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SECTION 28 31 00
FIRE DETECTION AND ALARM

PART 1 - GENERAL

SCOPE

The work covered by this section of the specifications includes the furnishing of all labor, equipment, materials, and performance of all operations associated with the installation of the new Fire Alarm System as shown on the drawings and as herein specified. Included are the following topics:

PART 1 - GENERAL

- Scope
- Related Work
- Description of Work
- Regulatory Requirements
- Manufacturer Provided Services
- Quality Assurance
- Qualifications
- Submittals
- Project Record Drawings
- Operation and Maintenance Manuals
- Product Delivery, Storage and Handling
- Spare Parts
- Supervision
- Power Requirements

PART 2 - PRODUCTS

- Enclosures
- Multiplex/Intelligent Fire Alarm Control Panel
- Operation - Multiplex/Intelligent Fire Alarm System
- Building connection
- Multiplex/Intelligent Peripheral devices
- Fault Isolator Module (FIM)
- Conventional Peripheral Devices
- Audio Visual Notification Appliances
- Smoke Detectors within Resident Units/Dorm Rooms
- Printers and Terminals
- Special Devices

PART 3 - EXECUTION

- General
- Raceways
- Conductors
- Device Mounting
- Identifications
- Manufacturer's Services
- Testing
- Warranty
- Training
- Maintenance Contract
- Special Considerations

RELATED WORK

The work covered by this section of the specifications shall be coordinated with the related work as specified elsewhere under the following project sections:

- Section 26 05 00 - Common Work Results for Electrical
- 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 – Identifications for Electrical Systems
- Section 26 27 26 – Wiring Devices

DESCRIPTION OF WORK

1 Furnish and install a complete Multiplex/Intelligent Fire Alarm System, with One Way Voice
2 Communications within the 911 Center in the City-County Building as described herein and as shown on
3 the plans; to be wired, connected, and left in first class operating condition.
4

5 The complete installation shall be done in a neat, workmanlike manner in accordance with the applicable
6 requirements of NFPA 70 - Article 760 and the manufacturer's recommendations.
7

8 The New Fire Alarm System shall consist of a single Main Fire Alarm Control Panel (FACP), unless a
9 different design is submitted and approved. New system for 911 Center shall be interconnected to existing
10 City County Building fire alarm system. General building alarm tone from existing City County Building
11 shall not sound to new system in 911 Center. All voice messages from existing City County Building shall
12 broadcast to 911 Center system. Strobe light indicating general alarm in City County Building shall be
13 provided in 911 Center.
14

15 The New Fire Alarm System shall be configured as a local protective signaling system, as defined in
16 NFPA-72, and shall use/incorporate the following features, as a minimum:
17

18 The latest intelligent analog, addressable technology (detectors/sensors and modular panel equipment)
19 currently available from the manufacturer
20

21 Non-Coded, Speaker-type Audible Notification Appliances
22

23 The existing City County Building fire alarm system is manufactured by Simplex/Grinnell equipment is
24 used only to establish quality and performance. Equipment by other Manufacturers is equally acceptable
25 provided it meets or exceeds the listed requirements of this specification. The 911 Center in City-County
26 Building fire alarm system shall consist of a new multiplex/intelligent fire alarm control panel (FACP).
27 Interface the new FACP via both existing and new multimode fiber routed to the existing. Accomplish
28 these functions by interfacing to the existing building system.
29

30 Manufacturers other than Simplex/Grinnell shall provide a fire alarm network command center panel
31 capable of, but not limited to, the following:
32

33 Annunciation of each device and location.
34 Annunciation of tornado warning from this location.
35 Allow temporary sensitivity adjustment of devices.

36 UL and NFPA listed for use with and be manufactured by the same manufacturer of the
37 fire alarm system being provided in the City-County Building.”
38

39 Signaling Line Circuits (SLCs), connecting addressable field points to the associated Fire Alarm
40 Control Panel, shall be configured as NFPA style 4 (Class B), with point supervision.
41

42 Areas with more than 25 Addressable Devices shall be split into isolated SLC sub-circuits
43 where each circuit shall not have more 25 devices. Where this is done, the floor shall be
44 “split” along a logical, physical boundary.
45

46 Network Connections, Data, Audio, and Signaling Line Circuits, which functionally link together
47 multiple panels or Transponders shall be wired in an NFPA Style 6 (Class A) arrangement.
48

49 Initiating Device Circuits (IDCs) shall be limited to short runs from Monitor Modules to the
50 connected device, unless specifically stated otherwise herein, and shall be configured as NFPA Style
51 B (Class B), with individual zone supervision.
52

53 Notification Appliance Circuits (NACs) shall be configured as NFPA Style Y (Class “B”). Audible
54 NACs serving Speakers shall be installed using shielded cable, such that the speakers do not generate
55 unwanted noises, due to cross-talk with other circuits.
56

57 Data Circuits to Annunciators shall be configured as NFPA Style 4 (Class “B”). All annunciators
58 shall be fully supervised.
59

60 The system shall be an intelligent/analog type, and shall consist of the following panels:
61

PANEL NAME:	PANEL TYPE:	PANEL LOCATION:
FACP	Main Fire Alarm Control Unit	Comm Supervisors Office

1
2 **REGULATORY REQUIREMENTS**

3 The complete installation shall conform to the applicable sections of the latest edition of the following
4 Codes and Standards:

5
6 **NATIONAL FIRE PROTECTION ASSOCIATION (NFPA):**

7 NFPA-70	National Electrical Code (NEC) Generally, and Article 760 in particular
8 NFPA-72	National Fire Alarm Code
9 NFPA 101	Life Safety Code
10 IBC	International Building Code
11 IFC	International Fire Code
12 IMC	International Mechanical Code

13
14 **STATE OF WISCONSIN – DEPARTMENT OF COMMERCE (COMM):**
15 COMM 16

16
17 **NATIONAL ELECTRICAL MANUFACTURER’S ASSOCIATION (NEMA)**

18
19 **UNDERWRITERS’ LABORATORIES, INC. (UL)**

20 UL-864	Control Units for Fire Protective Signaling Systems
21 UL-268	Smoke Detector for Fire Protective Signaling Systems
22 UL-217	Smoke Detectors for Single and Multiple Station
23 UL-521	Heat Detectors for Fire Protective Signaling Systems
24 UL-464	Audible Signaling Appliances
25 UL-1971	Visual Signaling Appliances
26 UL-38	Manually Actuated Signaling Boxes
27 UL-1481	Power Supplies for Fire Protective Signaling Systems

28
29 **MANUFACTURER PROVIDED SERVICES**

30 A manufacturer-trained service technician shall provide the following installation supervision. This
31 Technician shall be certified by the equipment manufacturer, and shall have had a minimum of two (2)
32 years of service experience in the fire alarm industry.

33
34 The technician's name shall appear on equipment submittals and a letter of certification from the fire alarm
35 manufacturer shall be sent to the project engineer. The manufacturer's service technician shall be
36 responsible for the following items:

37 Pre-installation visit to the job site to review equipment submittals and verify method by which the
38 system should be wired.

39
40 Periodic job site visits to verify installation and wiring of system, and to perform any partial system
41 programming – required to permit portions of the existing system to be removed.

42
43 Upon completion of wiring, final connections shall be made under the supervision of this technician,
44 and final checkout and certification of the system.

45
46 At the time of final checkout, technician shall give operational instructions to the Owner and/or his
47 representative on the system.

48
49 All job site visits shall be dated and documented in writing and signed by the Electrical Contractor.
50 Any discrepancy shall be noted on this document and a copy kept in the system job folder that shall
51 be available to the Project Engineer any time during the project.

52
53 **QUALITY ASSURANCE**

54 Unless specifically stated otherwise, each and all items of the fire alarm system shall be listed as a product
55 of a SINGLE fire alarm system manufacturer under the appropriate category by Underwriters'
56 Laboratories, Inc. (UL), and shall bear the UL label.

1 Notification Appliances may be products of a single, different manufacturer – provided that the Primary
2 Equipment Provider or Manufacturer provides written documentation of compatibility, and agrees to
3 assume any and all responsibility for compatibility with the Control Equipment.
4

5 In addition to previously listed UL standards, all control equipment shall be listed under the following UL
6 Standards:

7 UOJZ UL category UOJZ as a single control unit. Partial listing shall NOT be acceptable.
8 UL 864 Transient protection
9 UL 497B Isolated Loop Circuit Protectors. Where fire alarm circuits leave the building, additional
10 Transient protection must be provided for each circuit.
11 UL 1481 Power Limited Applications.
12

13 **QUALIFICATIONS**

14 All equipment shall be supplied by a firm, which specializes in fire alarm and smoke detection systems
15 with a minimum of five (5) years-documented experience. The company shall be an authorized distributor
16 of the proposed equipment
17

18 All work shall be performed by a licensed contractor, who is regularly engaged in the installation and
19 servicing of fire alarm systems. Proof of five (5) years documented experience and of factory
20 authorization to furnish and install the equipment proposed shall be furnished prior to contract award, if
21 required by Division of State Facilities.
22

23 Contractor shall be located within three (3) hours of travel time or less from the site of this project.
24

25 **SUBMITTALS**

26 Under the provisions of Section 26 05 00 and Division 1, submit the following for approval prior to
27 ordering any equipment in accordance with requirements of Division 1, General Conditions. Submit a total
28 of ten (10) sets.
29

30 Copies of CAD Files (AutoCAD, latest version, or DXF Format) for the Fire Alarm floor plans will be
31 made available to the successful bidder upon request to A/E for preparation of the required shop drawings
32 and as-builts
33

34 **REQUIRED SUBMITTAL MATERIALS**

35 The following items, and any additional items required per Section 26 05 00, shall be included within the
36 submittal package:
37

38 Although they may be submitted under separate cover, Submittal Brochures / Booklets / Binders and
39 Shop Drawings shall be submitted together, and shall be treated as a complete set.
40

41 **COVER SHEET:**

42 The submittals shall contain a cover sheet, which shall include the following information:
43

44 Submittal Date
45 Specification Section(s)
46 Fire Alarm Contractor (Contact Name, name, address, and telephone number)
47 Electrical Contractor (Contact Name, name, address, and telephone number)
48 Project Name, Project City, Project State, and Project Address.
49

50 **TABS AND TABLE OF CONTENTS:**

51 The Table of Contents shall appear immediately behind the Cover Sheet, and shall contain a complete
52 listing of all of the tabs contained within the binder / booklet.
53

54 Tabbed index sheets shall be inserted into each of the binders, such that each binder is clearly sub-
55 divided into sections. Tabbed sections shall be provided, at minimum, for the following:
56

57 One section for each building – ALL submittal data, which applies to any particular building,
58 shall be located within the tabbed section for the corresponding building. All submittal data
59 within each “building” section shall appear in the same order.
60

61 One section for manufacturer’s data sheets – divided into sub-sections for the following:
62

1 Panel Equipment (Panels, Panel Components / Modules, Printers, Annunciators, etc.)
2 Addressable Field Devices (Initiating and Control / Monitoring / Isolation)
3 Non-Addressable Field Devices (Initiating Devices, relays, etc.)
4 Notification Appliances
5 Fire-Fighter Communications Equipment if applicable
6

7 **EQUIPMENT LIST:**

8 A complete equipment list of all components, including the following: Quantity, Manufacturer, Part
9 Number, and Description. If the supplier uses different part numbers from those of the actual
10 manufacturer, the actual manufacturer and part numbers as they appear – marked on the shipping box /
11 packages, shall also be identified on this list.
12

13 Each Equipment List shall include a complete listing of the modules, components, and software
14 included for each modular Fire Alarm Control Panel, Network Panel, Transponder, Outboard
15 Gear Panel or Annunciator. Such items shall be listed in a manner that clearly indicates that such
16 items are parts of / components of a larger unit. Simply stating a single part number and
17 description for such panels shall be unacceptable.
18

19 A separate list shall be included for each section, with items grouped by system.
20

21 For projects involving multiple systems, separate equipment lists shall be provided - one for each
22 system.
23

24 Spare Parts shall also be listed separately, and shall be identified clearly as “Spare Equipment”.
25

26 **PRODUCT DATA:**

27 Manufacturer's product data sheets, and equipment description of all system components. These data
28 sheets shall be highlighted or suitably marked, so that included items and options are indicated. On
29 data sheets that include multiple products, products that are not used shall be crossed out.
30

31 Product Data Sheets shall be organized, in order, corresponding to the FIRST occurrence of the
32 corresponding item on the equipment list
33

34 **SEQUENCE OF OPERATION:**

35 Complete sequence of operations of all functions of the system. This sequence of operation shall be
36 custom-created for this particular job.
37

38 In order to satisfy this submittal requirement, it shall be acceptable to include copies of the
39 “Operation” portions of the specifications, including any applicable schedules / other
40 supplementary information. Copied specification pages shall be marked and highlighted, where
41 the programmed operation will differ from the specified operation. Copied specification pages
42 shall be marked “no changes”, where no significant deviation will occur. Other acceptable
43 alternatives shall include written narratives, organized in a logical manner, and Matrix Charts.
44

45 Where Matrix Charts are provided, such charts shall be organized and labeled clearly, and shall
46 incorporate suitable levels of detail (refer to NFPA-72 (1999) A-7-5-2.2(9) for an example of an
47 acceptable matrix chart). The Leftmost column of the Matrix Chart shall include groupings of
48 initiating devices and other function switches. The Topmost Row shall include groupings of
49 notification appliances and output devices.
50

51 **BATTERY CALCULATIONS:**

52 These calculations shall clearly illustrate both the Standby and Alarm loads, due to the various field
53 devices and panel components / modules. It is generally recommended to submit such calculations in
54 a “spreadsheet” format. These calculations shall include any reserve / additional capacity, as required
55 elsewhere within these specifications. Final results shall indicate both the minimum battery capacity
56 required and the capacity actually provided.
57

58 It shall be acceptable to provide Maximum / Full-Load calculations for items such as NAC
59 Booster Panels. Where this is done, the calculation sheet shall be marked as, “typical of nnnx,
60 nnnz, nnnz” (where nnnx, nnnz ... = panel names).
61

62 **AMPLIFIER CAPACITY CALCULATIONS**

1 For all speakers plus all required spare capacity.
2

3 **ADDRESSABLE DEVICE / DESCRIPTOR LIST** - Prior to programming the system, submit a chart
4 or printout, listing every system address provided for purposes of alarm initiation, status monitoring,
5 supervised signaling, and auxiliary controls. This printout shall include the corresponding device type
6 and field programmable "custom labels", as they will be displayed on the New System – at the FACP
7 and Local Annunciator. The addresses listed within this document shall directly correspond to the
8 addresses marked on the submitted floor plan drawings. This list will be modified as needed by the
9 Owner and returned to the contractor for final programming in to the system.
10

11 **NAC WIRE DROP CALCULATIONS:**

12 Calculations shall be provided for at least one Notification Appliance Circuit (NAC) per building.
13 This calculation should cover the "worst case" (longest and / or most heavily loaded) NAC(s) as
14 installed within the facility. It is recommended that this calculation should follow a "spreadsheet"
15 format, and should clearly indicate the following:
16

- 17 The name of the circuit
 - 18 Point of origin of the circuit
 - 19 Complete list of all devices served by the circuit, including location and type of each device
 - 20 Alarm Current Draw for each device, at the applied voltage
 - 21 Applied Voltage (Based on anticipated battery voltage after specified stand-by & alarm operation)
 - 22 Acceptable Operating Voltage for each type of device on circuit
 - 23 Calculated Voltage at each device on circuit
- 24

25 These calculations should mathematically prove that all Notification Appliances on the circuit will
26 receive acceptable power for proper operation, under "worst-case-scenario" conditions.
27

28 **SHOP DRAWINGS:**

29 All submitted drawings shall be created using CAD, and shall be coordinated so that terminal
30 numbering, circuit designation and equipment or device designations are the same on all drawings.
31 All drawings must be submitted and approved by the engineer before ordering or fabrication starts, but
32 such approval will not waive any specification requirements unless specifically stated. DSF shall
33 provide copies of the floor plan drawings, in AutoCAD or DXF format, to the successful bidder.
34

35 Each and every sheet of the Shop Drawings shall be clearly and prominently identified as "SHOP
36 DRAWINGS – PREPARED BY: (insert name of contractor firm preparing the shop drawings)", and
37 shall be clearly and visibly different from the Contract Documents / Bidding Drawings. As a
38 minimum, the name and company logo for the Electrical Contractor and the Fire Alarm Equipment
39 Vendor should be added to each sheet, and a revision date shall be inserted on each sheet.
40

41 The submitted Shop Drawings shall include the following types of drawings:
42

43 **PROJECT-SPECIFIC DRAWINGS:**

44 Project-Specific Drawings. These drawings shall include the following:
45

46 **SYSTEM RISER DRAWING:**

47 A separate riser drawing shall be furnished for each system. Each System Riser shall
48 illustrate all fire alarm circuits, which serve the facility, and shall incorporate the following
49 information, in a clear, concise format:
50

- 51 Point of origin of each circuit (usually a Panel, or a Module within a panel)
 - 52 Circuit type and labeling
 - 53 Area served by each circuit
 - 54 Wire / cable type and size
 - 55 Locations of Panelboards where primary system power is obtained
 - 56 The following information for each Field Device:
 - 57 Device Type
 - 58 Circuit(s) to which device is connected
 - 59 Locations of any End-Of-Line Resistor (EOLR)
 - 60 (and the circuit terminated by any such EOLR)
- 61

62 **BLOCK DIAGRAMS:**

1 Showing layout and operation of the entire system.

2
3 **FLOOR PLANS:**

4 These drawings shall consist of edited versions of the Contract Documents, which shall
5 include the following information:

6
7 Fire Department Response Location(s)

8 Annunciator Location(s)

9 Panel Location(s)

10 Device Addresses - The addresses shown on these drawings shall directly correspond to
11 the chart or printout, as specified previously, which spells out specific information about
12 each device, including the field programmable "custom label".

13
14 **TYPICAL DEVICE / MODULE WIRING DETAILS:**

15 Component and module wiring diagrams – intended to illustrate terminations and wiring
16 connections to each typical Field Device (Detectors, Notification Appliances, etc.), and each
17 typical panel component / module utilized within the system. This set of drawings shall only
18 include diagrams for modules and components, which are actually used in the provided
19 system(s).

20
21 These drawings shall incorporate clear labeling / nomenclature, which shall clearly indicate
22 the corresponding field device or module, to which it corresponds.

23
24 **OMISSION OF ANY OF THE ABOVE MATERIALS FROM THE SUBMITTALS SHALL RESULT IN**
25 **AN IMMEDIATE REJECTION OF THE SUBMITTALS FOR THIS PROJECT.** If the EC / FAC has any
26 questions concerning the preparation of these materials, please contact the Engineer.

27
28 **DEPARTMENT OF COMMERCE PLAN REVIEW**

29 **REQUIRED DOCUMENTS** (per building)

30 This project requires a submittal to the Department of Commerce for review and approval. The following
31 details the requirements of the contractor and the A/E with regard to the fire alarm Department of
32 Commerce submittal.

33
34 **CONTRACTOR'S RESPONSIBILITY**

- 35 a) Department of Commerce approval is required prior to the start of construction. The contractor
36 shall prepare and submit the required documents in a timely fashion to meet this requirement. If
37 the contractor starts construction before approval is given by the Department of Commerce, the
38 contractor is responsible for all additional fees required by the Department of Commerce.
- 39 b) Submit five copies of the fire alarm shop drawings, cut sheets and calculations to the A/E for
40 review. These items must be approved by the A/E prior to proceeding with assembling the
41 Department of Commerce submittal materials.
- 42 c) After obtaining A/E approval, prepare four sets of the required fire alarm shop drawings that will
43 ultimately go to the Department of Commerce. These shop drawings shall be signed and dated by
44 the contractor or manufacturer taking responsibility for the shop drawings. Note that each shop
45 drawing must be signed and dated unless there is a cover sheet, in which case only the four cover
46 sheets need to be signed and dated. If the contractor did not modify the fire alarm device layout
47 from the A/E prepared construction documents, a note may be placed on the shop drawings stating
48 that the fire alarm device layout was by others. In this case the contractor is taking responsibility
49 for the initiating and indicating circuit design, not the device layout. If the device layout is
50 changed, such as additional NAC panels and associated smoke detectors, the shop drawings may
51 not contain a note stating that the fire alarm device layout was by others, and the contractor takes
52 full responsibility for the information on the shop drawings.
- 53 d) Prepare one bound booklet of the fire alarm system device cut sheets and all calculations
54 (indicating device power calculations, voltage drop calculations and battery calculations). These
55 booklets do not need to be signed and dated.
- 56 e) Send the documents described in items (c) and (d) above to the A/E.

- f) If requested by A/E, Department of Commerce or its authorized representative, additional data pertaining to the construction, materials and equipment shall be submitted to the A/E to substantiate conformance to Comm 61 code.
- g) Complete the SBD-118 form, including signing the form as the Fire Alarm Designer.
- h) Print four sets of the fire alarm construction documents and apply the engineer or designer seal with signature and date.
- i) Calculate and prepare the SDB-118 submittal fee. Fee to be paid by Contractor.
- j) Request a review date with Department of Commerce, Division of Safety and Buildings by emailing the completed first page of the review application, SBD-118, to planschedule@commerce.state.wi.us, or, fax it to 877-840-9172.
- k) Assemble the submittal and send to the Department of Commerce, Division of Safety and Buildings.

WHERE TO SEND DOCUMENTS

The following municipalities are delegated agents of Department of Commerce, Division of Safety and Buildings to perform plan review and inspection of fire alarm systems as prescribed under Comm 61.30(3):

- a) City of Madison

FORMS AND INSTRUCTIONS

SBD-118 (R03/08) can be downloaded from: <http://commerce.wi.gov/SBdocs/SB-Form118App.doc> (word) or <http://www.commerce.wi.gov/SB/docs/SB-Form118App.pdf> (PDF)

Instructions for SBD-118 can be downloaded from: <http://www.commerce.state.wi.us/SB/SB-Form118AppInstructs.doc> (word) or <http://www.commerce.state.wi.us/SB/SB-Form118AppInstructs.pdf> (PDF).

Visit Department of Commerce, Division of Safety and Buildings Commercial Buildings Plan Review info website for additional information: <http://www.commerce.state.wi.us/SB/SB-CommBldgPlanRevMoreInfo.html#7>.

Email plan Review Submittal Questions to: planschedule@commerce.state.wi.us

Email Fire Alarm Questions to: fireprotech@commerce.state.wi.us

Once approved, Safety and Buildings will retain one of the sets, and will return three sets, which shall be distributed as follows:

- (1) copy shall be retained by the fire alarm contractor on-site, and shall be used as a reference / made available to any Department of Commerce inspectors, who may make periodic inspection visits to the site.
- (1) copy shall be forwarded to the Owner for their records.
- (1) copy shall be retained by the Division 26 electrical contractor, for their records. If the Division 26 electrical contractor and the fire alarm contractor are the same firm, this copy shall be kept on site, at or near to the Fire Alarm Control Panel.

CITY OF MADISON – FIRE DEPARTMENT INSPECTION / FIRE ALARM WORK PERMIT:

PER A LOCAL ORDINANCE (City of Madison General Ordinance 34 – Fire Prevention Code) EFFECTIVE AS OF JULY 2, 2002 - THE FIRE ALARM AND FIRE PROTECTION SYSTEMS, AS INSTALLED WITHIN THIS FACILITY ARE SUBJECT TO PERMIT REQUIREMENTS AND INSPECTIONS OF THE INSTALLATION BY THE CITY OF MADISON – FIRE DEPARTMENT / FIRE PREVENTION BUREAU:

1 THE FAC SHALL BE RESPONSIBLE FOR SCHEDULING, COORDINATING, AND ATTENDING
2 THIS INSPECTION, AND FOR PAYMENT OF ALL ASSOCIATED INSPECTION / PERMIT FEES.

3
4 This process normally involves both a plan review and inspections; however, for State-Owned Buildings,
5 the City of Madison only performs the inspections, with the Plan Review being performed by COMM /
6 Safety & Buildings as specified previously under “Submittals”.

7
8 Copies of the applicable Code can be obtained on-line, via the following link:

9
10 <http://www.madisonfire.org/prevention/pdf/mgo34.pdf>

11
12 Because of this Permit / Inspection process, the following procedure shall be followed by the Division 26
13 Electrical Contractor, (and by their sub-contractors, where particular arrangements have been made
14 between the EC and their sub-contractor(s)):

15
16 First, the Electrical Contractor shall obtain State-Approval of the Installation Drawings, per the
17 process previously described under “Submittals – Plan Review Process”, as found within this
18 specification.

19
20 Once the State-Approved Drawings are received by the contractor, and PRIOR TO STARTING ANY
21 CONSTRUCTION, the Electrical Contractor shall completely fill-out submit the proper “City of
22 Madison Fire Department – Fire Protection System Work Permit Application” form. If required,
23 suitable fee payment shall accompany the form. Copies of this form may be obtained via the following
24 link:

25
26 [http://www.madisonfire.org/prevention/fire_protection_engineering/pdf_files/master_plan_review
27 permit_application.pdf](http://www.madisonfire.org/prevention/fire_protection_engineering/pdf_files/master_plan_review_permit_application.pdf)

28
29 Once the form has been received, processed, and accepted by the Madison Fire Department (MFD),
30 MFD will issue the proper permit, and construction may begin.

31
32 The inspection program involves at least two inspections, as follows:

33
34 A Rough-In Inspection shall be scheduled and performed, prior to installation of any new devices.
35 In certain buildings (high-rises), multiple rough-in inspections may be required, as subsequent
36 areas are completed. It is highly recommended that these inspections should be carefully
37 scheduled and adhered to, since potentially costly mistakes can be prevented before the associated
38 devices are completely installed.

39
40 Final Inspection of the System – prior to this inspection, the Electrical Contractor shall have
41 conducted all necessary pre-testing.

42
43 Questions regarding this inspection program may be directed to:

44
45 City of Madison – Fire Department – Fire Prevention Bureau
46 325 West Johnson Street
47 Madison, WI 53703
48 Phone: (608) 266 – 4420 (Non-Emergency Number)

49
50 **PROJECT RECORD DRAWINGS**

51 Contractor shall submit to the A/E the as-built drawings for the entire work done under this project prior to
52 final payment.

53
54 Work shall be done on Auto CAD using the contract drawings provided to the Contractor by A/E in the
55 form of Auto CAD files. A hard copy of same shall also be submitted.

56
57 These drawings shall show:

58 Locations and addresses of Initiation Devices, Notification Appliances, isolation devices, status-
59 monitoring devices, supervised signaling devices, and auxiliary control devices.
60 Circuit and Address information for each field device listed above.
61 Conduit layout and size
62 Number/size/type/Color-Code of conductors in each conduit run

- 1 Riser diagrams
- 2 Location of end-of-line devices
- 3 List of custom labels as installed for each address

4
5 Riser diagrams shall include location of emergency 120VAC panel, panel designation and circuit number
6 used to feed each fire alarm panel. Also, indicate if panel is backed up by an emergency generator.

7
8 Riser diagrams shall include locations (room or area number) of notification, initiating, end-of-line devices
9 and addresses for all addressable field devices.

10
11 Also see requirements in Division 1, General Conditions.

12
13 **OPERATION AND MAINTENANCE DATA**

14 All operations and maintenance data shall comply with the submission and content requirements specified
15 under section GENERAL REQUIREMENTS.

16
17 In addition to the general content specified under GENERAL REQUIREMENTS supply the following
18 additional documentation:

- 19 1. A material guide, which shall contain the replacement part numbers and description of all
20 components used. If this information is included in an instruction section for any of the
21 equipment, it will not be necessary to duplicate the list. In either case, the parts list shall be
22 associated with its respective chassis, modules or kit wherein it is found. A total listing of parts
23 without such grouping will not be acceptable.
- 24 2. Catalog data or literature
- 25 3. Manufacturer's operating instructions.
- 26 4. Manufacturer's maintenance instructions
- 27 5. Installation instructions
- 28 6. Name, address and telephone number of source for parts (i.e. keys, guards, etc) not supplied by
29 the Fire Alarm Manufacturer
- 30 7. Copies of all approved shop drawings
- 31 8. An updated copy of the submitted sequence of operation, revised to reflect any implemented
32 changes

33
34 **PRODUCT DELIVERY, STORAGE AND HANDLING**

35 Receive equipment at job site; verify applicable components and quantity delivered.

36
37 Handle equipment to prevent internal components' damage and breakage, as well as denting and scoring of
38 enclosure finish.

39
40 Do not install damaged equipment.

41
42 Store equipment in a clean, dry space and protect from dirt, fumes, water, and construction debris and
43 physical damage. Make arrangements with the Owner at the pre-construction meeting for storage of
44 equipment on the premises

45
46 **SPARE PARTS**

47 Contractor shall provide the following spare parts in quantities shown:

48
49 Quantity: Type of Device

50 1	Photoelectric smoke detectors
51 1	Heat detectors
52 1	Smoke and heat detector bases – “standard” 2-Wire Type
53 1	Monitor Module (of each type utilized in this project)
54 1	Control Modules
55 1	Duct detectors with housing, head, remote test station, and sample tubes
56 1	Ceiling-Mount Speaker Units.
57 1	Ceiling-Mount Speaker/strobe Units.
58 1	Speaker/strobe Units, with (#) cd Strobe
59 1	Strobe-Only Unit, of each intensity used on the project. (If devices with field-selectable 60 candela are used, then a total of (#) such units shall be provided
61 1	Pull Stations

62

1 **SUPERVISION**

2 The system shall report a TROUBLE condition when any supervised circuit becomes disarranged,
3 disconnected, or is manually disabled or overridden. Each supervised circuit shall be independently
4 protected for short-circuit conditions, and shall be arranged so that faults on any one circuit do not prevent
5 the proper operation of any other circuit in the system.
6

7 The following devices/circuits shall be supervised, as a minimum:

- 8 ALL communications links.
- 9 ALL Signaling Line Circuits
- 10 ALL Initiating Device Circuits.
- 11 All sprinkler flow and tamper switches..
- 12 ALL Notification Appliance Circuits.
- 13 Auxiliary manual control circuits.
- 14 Remote Control Relays / Control Modules.
- 15 Primary, AC Incoming power to the system.
- 16 The system's batteries.
- 17 System Expansion Modules
- 18 Auxiliary module LED's.
- 19

20 The system shall have provisions for disabling and enabling all circuits individually for maintenance or
21 testing purposes.
22

23 Each independently supervised circuit shall include a discrete LCD readout, to indicate disarrangement
24 conditions per circuit.
25

26 **POWER REQUIREMENTS**

27 Primary 120 VAC power, to all Fire Alarm equipment shall consist of dedicated branch circuits. These
28 circuits shall be of a 3-conductor type, including a suitably sized green ground wire – SHARED
29 NEUTRALS AND CONDUIT GROUNDS SHALL BE UNACCEPTABLE.
30

31 Each control panel shall receive 120 VAC power via a branch circuit in one of the building's emergency
32 load panels. Each such branch circuit shall have a "breaker lock" to prevent accidentally de-energizing of
33 the power to the fire alarm panel. Circuit breakers shall be painted red and labeled "FIRE ALARM". If
34 more than one power circuit is used, each circuit shall be properly labeled as "FIRE ALARM", and shall
35 also be labeled with additional information – in order to indicate which fire alarm equipment is powered
36 from each such circuit.
37

38 All fire alarm power supplies, as well as any other supplemental power supplies, shall be installed in
39 compliance with NFPA-70 – National Electrical Code (Latest Edition).
40

41 The panel shall include a disconnect switch for the AC power inside a locked enclosure near the panel or
42 within the panel itself. This switch shall be labeled "Fire Alarm Power Disconnect".
43

44 Where the new control panel is to remain at same location as the existing panel, the contractor may re-use
45 the existing branch circuit, if it meets the previously stated requirements stated above.
46

47 The control panel shall include electrical power surge and transient protection. If problems are anticipated,
48 due to electrical transients associated with periodic generator testing, then the fire alarm equipment
49 supplier shall provide suitable power filtering / suppression equipment, as recommended by the equipment
50 manufacturer.
51

52 The system shall include sufficient back-up battery capacity to operate the entire system as follows, upon
53 loss of normal 120 VAC power:

54 For panels connected to Dedicated Emergency Power (Generator) Branch Circuits:

55 The Panel and associated devices shall operated in a normal (non-Alarm) mode for a
56 period of 12 Hours. After the 12-Hour normal period has expired, sufficient capacity
57 shall remain, such that the panel and associated devices shall operate in an Alarm mode
58 (All Speakers EVAC) for a period of 15 minutes.
59

60 The panel shall include a power-limited, filtered and regulated battery charger. The charger shall be an
61 automatic dual-rate (high rate/float maintenance) type. The charger shall charge a fully discharged battery
62 to 70% in 12 hours. The charger shall monitor for AC fail/disconnect, low/no battery, and high battery

1 level. The charger shall include switches and associated LEDs for high rate and AC disconnect. The
2 charger shall provide a minimum of 5 AMPS regulated 24VDC for peripheral devices requiring +/-5%
3 regulation and 8 AMPS at 24VDC for standard peripheral devices. The charger shall be designed
4 specifically for, or shall be properly configured for the provided batteries, which shall be of one of the
5 following types:

- 6 Sealed, Immobilized Electrolyte Lead-Acid type (“Gel-Cells”) – Types which require fluid level
7 maintenance, or which vent significant amounts of Hydrogen shall be unacceptable.
- 8 Nickel-Cadmium (Ni-Cad) batteries.

9
10 All batteries used in conjunction with the fire alarm system shall be installed in accordance with NFPA-70
11 – National Electrical Code (Latest Edition).

12
13 If these batteries are not located within or immediately adjacent to the fire alarm equipment, the location of
14 such batteries shall be clearly indicated within the fire alarm equipment served by them, and the batteries
15 and their enclosure shall be clearly marked as “FIRE ALARM”

16
17 All external circuits requiring system-operating power shall be 24VDC and shall be individually
18 supervised and fused at the control panel.

20 21 **PART 2 - PRODUCTS**

22 23 **ENCLOSURES**

24 All panels and peripheral devices shall be the standard product of a single manufacturer and shall display
25 the manufacturer's name on each component.

26
27 Cabinet shall be equipped with locks and transparent door panel providing tamper proof enclosure yet
28 allowing full view of the various lights and controls as required above.

29 30 **MULTIPLEX/INTELLIGENT FIRE ALARM CONTROL PANEL (FACP):**

31 A Multiplex intelligent fire alarm system shall be installed within the 911 Center in City-County Building.
32 This building shall be provided with a minimum of one Fire Alarm Control Panel (FACP), as shown on the
33 project drawings.

34
35 The control Panel shall be modular, expandable with solid state, microprocessor based electronics. It shall
36 display through the front viewing window only those primary controls and displays essential to operation
37 during a fire alarm condition.

38
39 The fire alarm system shall allow for loading and editing special instructions and operating sequences as
40 required. Software programming shall allow for full flexibility for selective input/output control functions
41 based on the Boolean programming functions AND, OR, NOT, as well as, timing, and special coded
42 operations. The system shall be able to use all of the above programming functions in combination with
43 any number of inputs and outputs. The systems shall be capable of on-site programming to accommodate
44 system expansion and facilitate changes in operation. All software operations shall be stored in a non-
45 volatile programmable memory within the fire alarm control panel. Loss of primary and secondary power
46 shall not erase the instructions stored in memory.

47
48 Simple Addressable systems, which do not support Analog Addressable or Intelligent Addressable
49 detection technology shall also be unacceptable.

50
51 The control panel shall provide the following as standards:

52 Analog Addressable or Intelligent Addressable Detection, supporting the following:

- 53 Drift compensation
- 54 Sensitivity display in %
- 55 Sensitivity adjustment
- 56 Day/night sensitivity adjustment
- 57 Auto Detector test to meet NFPA 72
- 58 Alarm verification with tally counter
- 59 Maintenance alerts

1 The number of Signaling Line Circuits (SLCs) required for the specified quantity of addressable
2 field devices and peripherals, plus one (1) spare loop (SLC) for each five (5) active loops. Each
3 active loop shall include 10% spare capacity or a minimum of 10 additional devices.
4

5 The number of Audible Notification Appliance Circuits (Speaker NACs) required for the
6 specified quantity of speakers plus one (1) spare circuit for each ten (10) active circuits. Each
7 active circuit shall include 25% spare capacity
8

9 The number of Visual Notification Appliance Circuits (Strobe NACs) required for the specified
10 quantity of strobes plus one (1) spare circuit for each ten (10) active circuits. Each active circuit
11 shall include 25% spare capacity or a minimum of 4 additional 110 cd devices
12

13 80-character liquid crystal display.
14 Printer interface
15 History log file with a minimum of 800 events
16 Field programmability
17 Silent walk test
18

19 The multiplex/intelligent system shall provide the ability to recall alarms and trouble conditions in
20 chronological order for the purpose of recreating an event history.
21

22 The LCD shall display the following information relative to the abnormal condition of a point in the system
23 prior to acknowledgement:
24

25 40 characters for:
26 Point address and loop number (i.e. 555-L5)
27 Type of device (i.e. smoke sensor, pull station, water-flow)
28 Point status (i.e. alarm, trouble)
29

30 40 characters for:
31 Custom location label (i.e. 4th Floor - Room 444)
32

33 Keyboards or keypads shall not be required to operate the system during fire alarm conditions.
34

35 The following software functions shall be provided, from the built-in system keyboard / display:

36 Setting of time and date
37 LED testing
38 Alarm, trouble, and abnormal condition listing
39 Enabling and disabling of each monitor point separately
40 Activation and deactivation of each control point separately
41 Changing operator access levels
42 Walk Test enable / disable
43 Running diagnostic functions
44 Displaying historical logs
45 Point listing
46

47 The following hardware switches/functions shall be provided:

48 Acknowledge alarm or trouble
49 Silence alarm or trouble
50 Reset system after alarm
51 Connect/disconnect Central Monitoring tie
52 Provide manual evacuation (drill)
53 Bypass elevator interface
54 Bypass AHU / Fan Interface
55 Bypass door holders
56

57 STATUS INDICATORS AND DISPLAYS

58 A local audible device shall sound during Alarm, Trouble or Supervisory conditions. This audible device
59 shall also sound during each key-press to provide an audible feedback to ensure that the key has been
60 pressed properly.
61

62 The 2-line by 40-character liquid crystal display shall be backlit for enhanced readability.

1
2 A cursor shall be visible on the LCD when entering information.

3
4 Scrolling through menu options or lists shall be accomplished in a self-directing manner in which
5 prompting messages shall direct the user
6

7 CONTROLS

8 The following controls shall be accessible with the front door open.

9 Manual evacuation (drill)
10 EVAC Microphone, and associated Audio Controls and Indicators
11 LED / LCD Test Switch
12 Key pad for data input and microprocessor control
13 Bypass Function Switches and LEDs for the following:
14 Central Monitoring Bypass
15 Elevator Interface bypass
16 HVAC / Fan Interface bypass
17 Door holder release bypass
18

19 LED SUPERVISION

20 All slave modules LEDs shall be supervised for burnout or disarrangement
21

22 ACKNOWLEDGMENT

23 Two methods of acknowledgment for each abnormal condition shall be provided. One may be chosen
24 depending on the NFPA requirements.
25

26 First method - Acknowledge one event at a time from an unacknowledged list of events:
27

28 Pressing the appropriate acknowledge button shall display the first unacknowledged condition in the
29 appropriate list (either alarm, supervisory or trouble), and require another acknowledge button. Press to
30 acknowledge only the displayed point.
31

32 After all points have been acknowledged, the LEDs shall glow steadily and the Sonalert will be silenced.
33 The total number of alarms, supervisory and trouble conditions shall be displayed along with a prompt to
34 review each list chronologically. The end of the list shall be indicated by an end of list message "END of
35 LIST".
36

37 Second method- Pressing the appropriate acknowledge button shall globally acknowledge all points.
38

39 SILENCING

40 If an alarm condition exists and the "Alarm Silence" button is pressed, all alarm audio [and visual]
41 notifications appliances shall cease operation. [The strobes shall remain active until the system is reset.]
42

43 If trouble conditions exist in the system and the "Trouble Silence" button has been pressed, the aural
44 trouble signal shall cease, but shall resound at time intervals to act as a reminder that the fire alarm system
45 is not in a normal operating mode. Both the time interval and the trouble reminder signal shall be
46 programmable to suit the Owner's application.
47

48 RESET

49 The SYSTEM RESET button shall be used to return the system to its normal state after an alarm condition
50 has been remedied.
51

52 Should the Alarm Silence Inhibit function be active, the system shall ignore all key presses. An indication
53 of enabling and disabling the inhibit state shall be provided as a feedback to the operator.
54

55 BYPASS FUNCTIONS

56 Bypass Switches shall be configured such that whenever any bypass function is active, a Trouble status
57 condition shall be reported by the system, per the Trouble Sequence. The trouble message shall indicate
58 the active function(s). Bypass LEDs shall be configured such that LEDs corresponding to the active
59 function(s) shall illuminate, and shall remain lit until the associated bypass function is de-activated (until
60 the system is restored to normal operating status). Switches and LEDs shall be provided for the following
61 functions

1 Central Monitoring Bypass - When this bypass function is active; reporting of various status
2 conditions to the reporting system shall be disabled.

3
4 HVAC / Fan Interface bypass - When this bypass function is active; actuation of the Control
5 Modules or Supervised Relays, which interface to the AHU / Fan starters / Temperature Controls,
6 and to any Smoke Dampers shall be prevented. (Smoke Control System bypass shall be
7 accomplished via the separate, previously specified manual controls).
8

9 **ACCESS TO OPERATOR FUNCTIONS:**

10 The following Operator Function Access Restrictions shall be adhered to as closely as possible. Where
11 system limitations do not allow for the restrictions to be configured exactly as listed, alternate methods will
12 be considered, and shall be brought to the attention of the Engineer prior to bidding:

13 **ACCESS LEVEL 1 - BASIC OPERATOR FUNCTIONS:**

14 ACKNOWLEDGE – allows Basic Operators to acknowledge ALARM, TROUBLE, and
15 SUPERVISORY conditions, and to view the lists / logs associated with these functions.

16
17 SIGNAL SILENCE – allows Basic Operators to silence the audible signals. The system
18 shall not permit signals to be silenced during “alarm silence inhibit mode” (if “Inhibit
19 Mode” is utilized).

20
21 SYSTEM RESET – allows Basic Operators to Reset the Fire Alarm System. The
22 "System Reset" button shall be used to return the system to its normal state after an alarm
23 condition has been remedied. The LCD display shall step the user through the reset
24 process with simple English language messages.

25
26 **ACCESS LEVEL 2 - HIGH SECURITY FUNCTIONS:**

27 Changes to the linkage of Operator Functions to Access Level / Pass-Code Profiles may affect the
28 ability of individuals to access required functions. Because of this, access to this linking function
29 shall also be appropriately secured.

30
31 **ACCESS LEVEL 3 - OTHER FUNCTIONS:**

32 These functions shall include, but shall not be limited to:

- 33 Enable / Disable Points
- 34 Perform “Override” Functions / Features
- 35 Generate Hard-Copy, Printed Reports
- 36 Add / Delete / Change Pass codes, and associated links to system features
- 37 Set / Change System Clock
- 38 Set / Change Sensitivity of Detectors
- 39 Clear History Logs

40
41 **POINT LISTING**

- 42 All points list by address
- 43 Monitor point list
- 44 Signal/speaker list
- 45 Auxiliary control list
- 46 Feedback point list

47
48 **HISTORY LOGGING**

49 The system shall be capable of logging and storing the last 800 events (alarm & trouble) in a history log.
50 These events shall be stored in a battery protected random access memory.

51
52 The following historical alarm/trouble log events shall be stored:

- 53 Alarms
- 54 Alarm Acknowledgment
- 55 Alarm Silence
- 56 System Reset
- 57 Alarm Historical log cleared
- 58 Trouble conditions
- 59 Supervisory alarms
- 60 Trouble acknowledgment
- 61 Supervisory acknowledgment
- 62 Alarm Verification tallies

1 Walk Test results
2 Trouble Historical log cleared

3
4 **SILENT WALK TEST WITH HISTORY LOGGING**

5 The system shall be capable of being tested by one person. While in testing mode the alarm activation of
6 an alarm-initiating device shall be silently logged as an alarm condition in the historical data file. The
7 panel shall automatically reset itself after the logging of the alarm.

8
9 The momentary disconnection of an initiating or indicating device circuit shall be silently logged as a
10 trouble condition in the historical data file. The panel shall automatically reset itself after logging of the
11 trouble condition.

12
13 Should the silent walk-test feature be on for an inappropriate amount of time (30 minutes max.) it shall
14 revert to the normal mode automatically.

15
16 The panel shall have the capability of dividing the system into distinctive walk test groups, a minimum of 8
17 groups.

18
19 Should an alarm condition occur from an active point, not in walk test mode, it shall perform operations
20 described above.

21
22 After testing is considered complete, testing data may be retrieved from the system in chronological order
23 to ensure device/circuit activation.

24
25 **WATCH-DOG TIMERS**

26 The system shall include independent "Watch-Dog" timers to detect and report failure of any
27 microprocessor circuit, memory, or software.

28
29 **FIELD PROGRAMMING**

30 The system shall be fully programmable, configurable, and expandable in the field without the need for
31 special tools or PROM programmers and shall not require replacement of memory IC's. All programming
32 may be accomplished through the standard control panel keyboard or a keyboard at the printer, or the use
33 of a PC. All programs shall be stored in non-volatile memory.

34
35 All programming or reprogramming shall be done by the supplier at no charge until the owner accepts the
36 system.

37
38 **SOFTWARE MODIFICATIONS**

39 The system shall be capable of being programmed by means of a Field Configuration Program (FCP)
40 allowing programming to be downloaded via portable computer from any node on the network.

41
42 Provide the services of a factory trained and authorized Technician to perform all system software
43 modifications, upgrades, or changes. Response time of the Technician to the site shall not exceed 4 hours.

44
45 Provide all hardware, software, programming tools, access codes, and documentation necessary to modify
46 the fire alarm system on site. Modification includes addition and deletion of devices, circuits, zones, and
47 changes to system operation and custom label changes for devices or zones. The system structure and
48 software shall place no limit on the type or extent of software modifications on-site. Modification of
49 software shall not require power-down of the system or loss of system fire protection while modifications
50 are being made.

51
52 If the system access code is either a hardware key or a software key, the Contractor/Vendor shall provide
53 the proper key to meet the above requirements."

54
55 **SIGNALING LINE CIRCUITS:**

56 The system must provide communications with intelligent addressable initiating and control devices
57 individually. These devices shall be individually annunciated at the control panel. Annunciation shall
58 include the following conditions for each point:

- 59 Alarm
- 60 Trouble
- 61 Open

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Short
Device missing/failed

All intelligent addressable initiation and control devices shall have the capability of being disabled or enabled individually.

Systems that require factory pre-programming or EPROMs to add or delete devices shall be unacceptable.

The communication format must be a completely digital poll/response protocol to allow t-tapping of the Signaling Line Circuit wiring. Systems that do not utilize full digital transmission protocol are not acceptable.

Special-purpose Isolator devices shall be used to provide further isolation / protection of sections of the Signaling Line Circuits. Areas served by Signaling Line Circuits shall be isolated as specified within the "scope" portion of this specification. The following Isolation devices shall be acceptable for use in performing this function:

Isolator Modules – Field Mounted.

OPERATION: MULTIPLEX/INTELLIGENT FIRE ALARM SYSTEM

PRIORITY:

Fire Alarm status conditions shall have the highest priority.

Supervisory status conditions shall have the second highest priority.

Trouble status conditions shall have the lowest priority.

STAND-BY MODE:

Under normal condition the front panel shall display a "System is Normal" message and the current time and date

SYSTEM RESPONSE

The time delay between the Alarm activation of an initiating device, and the automatic activation of the Notification Appliances and the annunciation of the Alarm status condition at the FACP and annunciators shall not exceed 5 seconds.

For response-time purposes, the manual actuation of an Audio Control Switch - associated with the one-way voice communications system - shall be instantaneous and shall be treated as if it were manual alarm activation.

ALARM SEQUENCE:

The following events are not required to occur in the stated order. However, ALL automatic responses must be initiated within the time interval allotted by UL and NFPA codes and standards.

This "Fire Alarm Sequence" shall be initiated upon receipt of one of the following, valid Fire Alarm status conditions:

- Actuation of any Manual Pull Station, any Fire Protective Sprinkler System, any other Automatic Fire Suppression System, from any Smoke Detector, any addressable Heat Detector, any beam-type Smoke Detectors, any non-addressable Heat Detector

The system alarm operation, subsequent to the activation of any of the conditions listed above, shall be as follows:

The EVAC System shall automatically initiate "EVAC" Mode. All audible notification appliances (Speakers) [within the building] [within the affected Notification Area(s)] shall sound, using a sequence that is compliant with NFPA-72 – including an Alert Tone and a Digital Voice Message. The Alert Tone and Digital Message shall be repeated a minimum of three times, and shall continue to be repeated until the Audible Notification Appliances are Silenced, until a Manual Announcement is Made, or until the system is Reset.

All visual notification appliances [within the building] [or within the affected Notification Area(s)] shall flash continuously until the system is [acknowledged] [reset].

1 Any subsequent alarm shall reactivate the alarm audible [and visual] notification appliances [within
2 the building] [within the affected Notification Area(s)].

3
4 All doors normally held open by door control devices [within the building] [within the affected
5 Notification Area(s)] shall release.

6
7 [Alarm outputs connected to the facility reporting system shall be activated.]

8
9 The system Alarm LED shall flash on the FACP [and the FAAP] [and at the RFCC], until the alarm
10 has been acknowledged. Once acknowledged, this same LED shall latch on.

11
12 A subsequent alarm received from another device shall flash the system alarm LED on the FACP [and
13 the FAAP] [and at the RFCC]. The LCD display shall show the new alarm information.

14
15 A pulsing alarm tone shall occur within the FACP [and the FAAP] [and at the RFCC] until the event
16 has been acknowledged.

17
18 The system shall have a single key that will allow the operator to display all alarms, troubles, and
19 supervisory service conditions including the time and date of each occurrence.

20
21 A programmed Alarm Message shall appear on the FACP [and the FAAP] [and at the RFCC] LCD
22 displays. These field programmable messages shall be revised, as directed by the Owner, during shop
23 drawing review. The alarm shall be displayed on an 80-character LCD display as follows:

24 40 characters for:
25 Point address and loop number
26 Type of device
27 Point status

28
29 40 characters for:
30 Custom location label

31
32 **AUTOMATIC ALARM VERIFICATION:**

33 The initial Alarm activation of any system smoke detector shall initiate an alarm verification operation
34 whereby the panel will reset the activated detector and wait for a second alarm activation. If, after (20)
35 seconds and within (30) seconds after resetting, a second alarm is reported from the same or any other
36 smoke detector, the system shall process the alarm as described previously. If no second alarm occurs
37 within (30) seconds, the system shall resume normal operation. The alarm verification shall operate only
38 on single smoke detector alarm. Other activated initiating devices or multiple smoke detector alarms shall
39 be processed and reported immediately.

40
41 The alarm verification operation shall be selectable by device or by group for addressable detectors and by
42 IDC for non-addressable smoke detectors. Automatic Alarm Verification shall be enabled for all smoke
43 detectors [including resident room smoke detectors if they are connected to the fire alarm system].

44
45 **SELF-TEST AND AUTOMATIC DRIFT COMPENSATION:**

46 The control panel shall continuously perform an automatic self-test routine on each Smoke Detector, which
47 will functionally check detector electronics and ensure the accuracy of the values being transmitted to the
48 control panel. Any detector that fails this test shall indicate a "*SELF TEST FAILED*" trouble condition
49 with the detector location at the control panel.

50
51 All Intelligent Addressable Smoke Detectors used on this project shall incorporate automatic drift
52 compensation / automatic sensitivity monitoring and adjustment, as described within the "definitions"
53 portion of this specification section.

54
55 **OPERATOR INTERFACE / MAINTENANCE FEATURES FOR AUTOMATIC SMOKE DETECTION:**

56 An operator at the control panel shall have the capability to manually access the following information for
57 each detector:

58 Primary status
59 Device type
60 Present average value
61 Present sensitivity value selected
62 Peak detection values

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Detector range (normal, dirty, etc.)

Values shall be in "percent of smoke obscuration" format so that no interpretation is required by the operator.

An operator at the control panel shall have the capability to manually control the following for each detector:

- Clear peak detection values
- Enable or disable the detector
- Clear verification tally
- Establish alarm sensitivity
- Control a detector's relay driver output

It shall be possible to program the control panel to automatically change the sensitivity settings of each detector based on time-of-day and day-of-week.

The control panel shall clear a "Detector dirty" trouble after a detector has been removed from its base cleaned and replaced.

AHU SYSTEM INTERFACE

Duct Smoke Detectors and Addressable Control Modules, or Supervised Remote Relays shall be provided as specified below. Duct Smoke Detectors shall be installed in compliance with the manufacturer's recommendations. Each Addressable Control Module or Supervised Remote Relay for AHU and / or Fan shutdown shall be installed within 3 feet of the Temperature Control Panel to which it is connected. The Division 26 EC shall provide all wiring and terminations required for shutdown of the specified AHUs / Fans.

The Addressable Control Modules or Supervised Remote Relays provided for this purpose shall be provided with DPDT output contacts. One SPDT set of the DPDT contacts shall be utilized for the specified shutdown function. The second SPDT set of the DPDT contacts shall be available for connection to the temperature controls, to indicate that unit shutdown – due to Duct Smoke – has occurred.

The control panel shall provide an output alarm interface to the air handling/energy management system controllers, which in turns shall perform automatic function as specified in the applicable sections of Division 23.

An override feature / control switch shall be provided which shall prevent shutdown of AHUs when this function is active.

PROGRAMMING: The associated Fan shall be shut down only upon actuation of the Duct Smoke Detector associated with the particular unit.

SPRINKLER SYSTEM SUPERVISORY SERVICE

The control panel shall have a dedicated supervisory service LED and a dedicated supervisory service acknowledge switch.

The activation of any standpipe or sprinkler valve supervisory (tamper) switch shall activate the system supervisory service audible signal and illuminate the LED at the control panel. The panel shall provide differentiation between valve tamper activation and opens and/or grounds on the initiation circuit wiring.

Pressing the supervisory service acknowledge key will silence the supervisory audible signal while maintaining the supervisory service LED "on" indicating the off-normal condition.

Restoring the valve to the normal position shall automatically reset the tamper indication.

TROUBLE SEQUENCE:

Disarrangement, disconnection, Power Failure, or malfunction of any supervised feature(s) / components of the System shall cause actuation of the following sequence of events:

- A SYSTEM TROUBLE or POINT TROUBLE status condition shall be both audibly and visually indicated at the Fire Alarm Control Panel (FACP) and FAAP in a way which differentiates the TROUBLE status clearly from an ALARM. Audible indication shall cease, once the TROUBLE has been acknowledged.

1
2 In addition, a programmed message, similar in nature to the ALARM "Custom Labels", shall appear
3 on the FACP and FAAP. (Default messages, if TROUBLE Detector / Sensor / Module Point
4 Messages are associated with ALARM messages, shall be acceptable.)
5

6 The Trouble status condition shall also be Visually and Audibly indicated at all appropriate Network
7 Annunciators and at the Fire Alarm Network Computer. This indication shall be essentially identical
8 to the Audible, Visual, and Alphanumeric display at the FACP [and FAAP] [and the RFCC] except
9 that additional information shall be incorporated, to indicate the building of origin.

10
11 A "Trouble Reminder" Feature, which causes the FACP to re-sound the TROUBLE indicators when
12 System / Point TROUBLE conditions remain on the system, shall be enabled, and shall be set to re-
13 sound every twelve (12) hours.

14
15 Subsequent Troubles shall cause the FACP TROUBLE LEDs and sounders to re-sound, along with
16 the "Custom Label" and other information related to the "new" TROUBLE condition.
17

18 **MANUAL DRILL**

19 A manual evacuation (drill) switch shall be provided to operate the alarm indicating appliances without
20 causing other control circuits to be activated.
21

22 **LED AND LCD TEST**

23 Activation of the Lamp Test switch shall turn on all LED indicators, LCD display, and the local sounder
24 and then return to the previous condition.
25

26 **SYSTEM DIAGNOSIS**

27 The system shall include special software to detect, diagnose and report failures and isolate such failures to
28 a printed circuit board level.
29

30 **SILENT WALK TEST WITH HISTORY LOGGING**

31 The actuation of the "Walk Test" switch/program at the control panel shall activate the "Walk Test" mode
32 of the system, which shall cause the following to occur:

33 The Output Contacts, which provide the interface to the Fire Alarm System Reporting shall be
34 bypassed.

35 Control relay functions shall be bypassed, such as door holders, elevator capture, fan shut down,
36 etc.

37 The audio and visual circuits shall be bypassed.

38 The control panel shall show a trouble condition.

39 The alarm activation of any initiation device shall be silently logged as an alarm condition in the
40 historical data file. The panel shall automatically reset itself after the logging of the alarm.

41 Any momentary opening of an initiating or indicating appliance circuit shall be silently logged as
42 a trouble condition in the historical data file.

43 The panel shall automatically reset itself after logging of the trouble condition.

44 If the system becomes inactive for a period of longer than 10 minutes the panel shall default to
45 normal fire alarm functions.
46

47 It shall not be required to manually restart or reboot the fire alarm panel after a silent walk fire alarm test is
48 completed.
49

50 **BUILDING CONNECTION**

51 The new Fire Alarm System shall be interfaced to the Simplex Grinnell system utilizing direct copper
52 connection, for remote reporting of various conditions:
53

54 The interface between the reporting system(s) listed above and the new Fire Alarm System shall be
55 configured as follows:

56 The Fire Alarm System shall provide contact closure outputs for the following conditions:

57 Fire Alarm: This contact shall actuate in response to any Fire Alarm status condition,
58 other than Sprinkler Water Flow.
59

60 Water Flow Alarm: This contact shall actuate only in response to Fire Alarm status
61 Conditions, which are due to Sprinkler Water Flow.
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Sprinkler Supervisory: This contact shall actuate in response to actuation of any Valve Tamper Switch associated with the Fire Protective Sprinkler System.

System Trouble: This contact shall actuate in response to the occurrence of any Trouble status condition on the Fire Alarm System.

The Contractor installing the new Fire Alarm Systems shall be responsible for coordination of the Fire Alarm System connections to these system(s), for all wiring and conduit between these system(s), and for all terminations at the Fire Alarm end of such interface wiring. All such wiring, raceway, and terminations shall be included per the Base Bid.

MULTIPLEX/INTELLIGENT PERIPHERAL DEVICES

All devices shall be supervised for trouble conditions. The system control panel shall be capable of displaying the type of trouble condition (open, short, device missing/failed). Failure of a device shall not hinder the operation of other system devices.

DEVICE IDENTIFICATION

Each intelligent device must be uniquely identified by an address code entered on each device at time of installation. The use of jumpers to set address shall not be acceptable.

Device addressing schemes which use permanently-imbedded, electronically-identifiable "serial number" which is similar to the address imbedded within Personal Computer Network Interface Cards shall be acceptable.

Fire Alarm Systems utilizing hand-held or briefcase-style programming tools. Which are used to electronically assign addresses and/or programming parameters to devices shall be acceptable. However one such programmer tool shall be provided to the Owner at no additional cost.

The address along with the loop number and end-of-line device if present shall be indicated, and be visible from the ground, on the device in the field using machine generated marking. Contractor shall provide a sample of such labeling scheme before using it.

End-of Line devices shall also be identified by means of permanent, machine generated label, affixed to the device.

Device identification schemes that do not use uniquely set addresses but rely on electrical position along the communication channel are unacceptable. These systems cannot accommodate tapping and the addition of an intelligent device between existing devices requires re-programming all existing devices beyond added device.

The system must verify that proper type device is in place and matches the desired software configuration.

INTELLIGENT DETECTORS - GENERAL

Smoke and heat detectors must be approved by the State Engineer prior to installation.

Each detector shall incorporate the following features:

- LED(s), which shall flash to indicate communication with the Fire Alarm System, and which also illuminate in a steady manner when the detector is in an alarm status
- A means to allow field function testing of the detector
- A low-profile design / shape
- An insect screen
- Voltage and RF transient suppression techniques, in order to minimize false alarms

Smoke detectors shall communicate the actual smoke chamber values to the system control panel.

Smoke detectors shall be listed for sensitivity testing from the control panel. Sensitivity test results shall be logged and downloaded to a printer.

The detectors shall be plug-in units, which mount to a common base, and shall be UL 268 approved.

Each detector shall be compatible with the fire alarm panel and shall obtain its operating power from the SLC, to which it is connected. (Where relay or sounder-equipped bases are used, it shall be acceptable to

1 require a separate 24 VDC or NAC connection.) Each detector shall be reset by actuating the control panel
2 reset switch.

3
4 If field conditions so require the smoke detection devices shall not be installed until the construction is
5 completed.

6 7 INTELLIGENT DETECTOR BASES

8 Bases shall be suitable for either smoke or heat detector mounting.

9
10 Either the base or the head shall contain electronic circuits that communicate the detector's status (normal,
11 alarm, sensitivity status, trouble, etc.) to the control panel over two wires. The same two wires shall also
12 provide power to the base and detector. Contacts between the base and head shall be of the bifurcated type
13 using spring-type, self-wiping contacts.

14
15 The base shall be lockable. The locking feature must be field-removable when not required.

16
17 Upon removal of the detector's head, a trouble signal shall be transmitted to the control panel.

18
19 The detector base shall be sealed against rear airflow entry.

20
21 Each detector's base or head shall contain LED(s), which shall flash when the detector is being scanned by
22 the control panel. The LED(s) shall turn on steady when the detector is in an alarm condition.

23 24 INTELLIGENT PHOTOELECTRIC SMOKE DETECTORS

25 The detectors shall contain no radioactive material.

26
27 Detectors shall be of the solid state photoelectric type and shall operate on the light scattering photodiode
28 principle using a pulsed infrared LED light.

29 30 INTELLIGENT THERMAL DETECTORS

31 The detectors shall be a combination rate-of-rise and fixed temperature 135 F unless noted.

32
33 Detectors shall sense within a temperature range of 32 F to 158 F. The control panel shall be capable of
34 sensing either a set point of 135 F, or a rate-of-rise of [15] or [20] degrees F per minute for fire sensing.

35 36 INTELLIGENT DUCT SMOKE DETECTORS

37 Duct detectors shall be of the photoelectric type specified above. It shall be possible to alarm the duct
38 detector by using a remote or local test switch.

39
40 For maintenance purposes, it shall be possible to clean the duct housing sampling tubes by accessing them
41 through the duct housings front cover.

42
43 Detector shall include remote keyed test switch and alarm LED indicator.

44
45 In mechanical rooms, alarm LED indicators for duct detectors shall be grouped on a stainless steel cover
46 plate mounted adjacent to the main mechanical room door. Each LED shall be labeled with the detectors
47 loop and address. A floor plan of the room showing the detectors and addresses shall be located adjacent
48 to the cover plate. Provide Plexiglas cover over the plan.

49 50 ADDRESSABLE PULL STATIONS

51 Pull stations shall contain circuits that communicate the station's status (alarm, normal or trouble) to the
52 control panel over two wires, which also provide power to the pull station. The address shall be field
53 programmable on the station.

54
55 Manual stations shall be [single-action] [double-action] type, constructed of metal or of high impact, red
56 Lexan with raised white lettering and a smooth high gloss finish.

57
58 Station shall mechanically latch upon operation and remain so until manually reset by means of a key
59 common to all system locks. Stations that require Allen wrenches or special tools to reset them shall not be
60 accepted.

61
62 Manual stations shall be fitted with screw terminals or wire leads for field wire attachment.

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INTERFACE MODULES - GENERAL

If external power to Addressable Interface Modules is required, such power shall be 24VDC, and shall be derived from a supervised fire alarm power supply.

Addressable Interface Modules may be provided in either a Class B or Class A supervision version.

In the Class B version the wiring shall be supervised by an end-of-line device.

In the Class A version the wiring shall be looped back and connected to the module to allow continual operation of the controlled devices even if the wiring sustains a single break.

The interface modules shall be supervised and uniquely identified by the control panel. Device identification shall be transmitted to the control panel for processing according to the program instructions.

INTERFACE MODULES - SUPERVISED CONTROL

Supervised Control Modules shall be utilized where needed, for control of Notification Appliances.

For Notification Appliances, speakers, and other device control with Class B or Class A wiring supervision, the interface module shall provide a double-pole/double-throw relay output, with supervision.

These interface modules shall communicate the supervised wiring status (normal, trouble) to the fire alarm control panel and shall receive from the fire alarm control panel a command to transfer the relay.

INTERFACE MODULES - SUPERVISED MONITORING

Addressable Monitor Modules shall be suited for monitoring of water-flow, valve tamper, Fire Suppression Control Panels, and other non-intelligent detectors and systems.

Addressable Monitor Modules shall be provided in any needed configuration, and may be used to interface any of the following initiation devices to a Signaling Line Circuit, as follows:

Conventional 2-wire smoke detectors, including providing suitable power to the IDC.

Normally Open, dry contact type devices - with class B or class A wiring supervision:

These interface modules shall communicate the Initiating Device Circuit status (normal, alarm, trouble) to the control panel.

INTERFACE MODULES - NON-SUPERVISED CONTROL

This interface module shall provide double-pole/double-throw relay switching for loads up to 120VAC. It shall contain easily replaceable 2 amp fuses, one on each common leg of the relay.

FAULT ISOLATOR MODULE (FIM)

The system shall employ Fault Isolator Modules (FIM) on the Signaling Line Circuits. These FIM units shall be utilized in order to isolate portions of SLCs, in the event of short circuit conditions. The SLC segment protected by each FIM shall be separated from the SLC in a manner such that a single short-circuit condition may not affect more than 25 Addressable Field Devices / Detectors, which are served by the isolated SLC segment.

The FIM shall be located as close as practical to the point where the isolated SLC sub-circuit branches, and shall also be located at an accessible location.

CONVENTIONAL PERIPHERAL DEVICES

NON-ADDRESSABLE HEAT DETECTORS

Non-Addressable Heat Detectors shall of the fixed temp type and only to be used at locations where the ambient conditions are unsuitable for Analog Addressable units, or where the required operation (set point / response index, etc.) cannot be achieved with Analog Addressable units. Where used, these devices shall be UL listed for their intended purpose. These heat detectors do not have to be made by the same manufacturer supplying the other fire alarm equipment for the project.

SPRINKLER WATERFLOW SWITCHES – WET SYSTEMS

Waterflow switches shall be individually monitored, via individual IDCs, Monitor Modules, or Mini Monitor Modules. The point corresponding to each Waterflow switch shall be programmed such that when activated, the suitable Fire Alarm sequence shall be initiated.

1
2 If the flow switch incorporates an internal “cover tamper switch”, which actuates whenever the flow switch
3 assembly cover is removed, the Trouble sequence shall be initiated in response to the removal of this cover.
4

5 **AUDIO VISUAL NOTIFICATION APPLIANCES**

6 **SPEAKERS**

7 Speakers shall have a metal or Lexan housing with field adjustable output taps ranging from 1/8 watt to 2
8 watts. Speakers selected for this project shall produce a Sound Pressure Level, at the 1 watt tap of at least
9 87 dBA at 10 feet – as tested per UL Standard 1480. Speakers shall have vandal resistant Lexan or metal
10 grilles and shall be have sealed backs to protect the phenolic impregnated cone.
11

12 **STROBES**

13 ALL strobes, and the strobe portion of audible/strobe combination units, shall be of the Xenon type.
14

15 All strobes shall be designed for synchronized flash operation at one flash per second (1 Hz) minimum
16 over the device's listed input voltage range. Strobes shall be synchronized such that all strobe units
17 within the building shall flash simultaneously (As a minimum, all devices on each floor shall flash
18 simultaneously, with flash timing within the limits established by current UL standards.).
19

20 **SPECIAL DEVICES**

21 **TOOLS/KEYS**

22 Contractor shall provide two (2) keys per pull station. Keys shall be identical and usable in all keyways
23 associated with this project – including, but not limited to Manual Pull Stations, the FACP, [and FAAP]
24 [and RFCC] Panel(s).
25

26 Provide one device programmer tool for fire alarm systems utilizing hand-held or briefcase-style
27 programming tools used to electronically assign addressees and/or programming parameters.
28
29

30 **PART 3 - EXECUTION**

31 **GENERAL**

32 The complete installation shall be done in a neat, workmanlike manner in accordance with the applicable
33 requirements of NFPA 70 - Article 760 and the manufacturer's recommendations.
34
35

36 Smoke detectors shall not be mounted until the construction is completed, unless they are covered with
37 plastic bags or fitted covers immediately after installation to maintain cleanliness.
38

39 **RACEWAYS**

40 **NOTE: ALL FIRE ALARM SYSTEM WIRING SHALL BE INSTALLED WITHIN METALLIC**
41 **CONDUIT UNLESS SPECIFIED.**
42

43 All wiring shall be in a conduit system separate from other building wiring. See Section 26 05 33 –
44 Raceway and Boxes for Electrical Systems for specifications.
45

46 All wiring shall be in minimum ½" steel raceway.
47

48 40% fill factor shall be applied to all conduit sizes.
49

50 The contractor shall size conduit and boxes by circular mil size of each cable in each conduit or box. The
51 circular mil sizing can be found on the manufacture's spec sheet, then use the NEC codebook to make
52 calculation to follow NEC Table 370-16(a) for box fill and Chapter 9 for conduit fill.
53

54 There shall be no sharp edges with installed materials.
55

56 Use only identified conduit entries or request approval for other penetrations in cabinets; (certain areas
57 require clear space for interior components / batteries). Cabinet shall be grounded to either a cold water
58 pipe or grounding rod.
59

60 Existing conduit and surface metal raceway that is ½” in size or larger may be reused if found to have
61 adequate space provided that it only serves the Fire Alarm system and doesn’t contain any AC wiring. All

1 existing conduit that is reused MUST be brought up to the current State of Wisconsin Electrical Code and
2 Approved for usage by the Engineer prior to work being done.

3 4 **CONDUCTORS**

5 All wire and cable associated with this system shall be as required by the equipment manufacturer. The
6 following information is intended for estimating purposes only. However, the minimum wire gauges and
7 colors specified shall be strictly adhered to. All cable shall be installed as per NEC Article 760.

8
9 Type FPL wiring is required if the system is run in conduit or 'free-air.

10
11 All initiation and notification circuit cabling shall be listed Type FPL (300V) in accordance with NEC
12 article 760."

13
14 All cables and wires #14 AWG and larger shall be stranded.

15
16 Fire alarm wiring shall be held in place at the device box, by means of a two-screw connector, (do not use
17 squeeze or crimp type connectors).

18
19 All wiring shall be completely supervised. In the event of a primary power failure, disconnected standby
20 battery, disarrangement of any components, any open circuits or grounds in the system, an audible and
21 visual trouble signal shall be activated until the system is restored to normal.

22
23 All conductors shall be color-coded. Coding shall be consistent through out the facility. Green wire shall
24 be used only for equipment ground.

25
26 Each Fire Alarm Control Panel shall be connected to separate dedicated branch circuit from the building
27 emergency panel, maximum 20 amperes. Circuit shall be labeled as "FIRE ALARM". The breaker shall
28 be painted red and cap-locked.

29
30 Power wiring for Fire Alarm Control Panel shall be #12 AWG.

31
32 Fire Alarm Control Panel shall have #6 AWG green equipment ground wire.

33
34 Fire alarm risers, notification appliance circuits and interconnections to remote panels (per NFPA 72) shall
35 have a minimum 2Hr fire alarm rating. All notification appliance circuits shall be protected from the fire
36 alarm panel of origination to the signaling zone they serve.

37
38 Where fire alarm circuits enter or leave a building, additional transient 75 to 90 volt gas tube protection
39 shall be provided for each conductor.

40
41 Leave 8-inch wire tails at each device box and 36-inch wire tails at the Fire Alarm Control Panel.

42
43 Cable for Intelligent detector Loops shall be 18 to 12 AWG twisted pair with a shield jacket installed in 1/2"
44 conduit. Shield continuity must be maintained and connected to earth ground only at the control panel.

45
46 SLC wiring must not be in the same conduit with AC power wiring or other high current circuits. T-taps or
47 branch circuit connections are allowed for all class B SLCs.

48
49 Cable for RS 232-c devices (CRT, PRINTER) shall be dual pair twisted- shielded.

50
51 Cable for RS 485 devices (Remote Annunciators) shall be twisted-shielded pair (Belden 9841 or
52 equivalent) for the data signal. Power wiring shall be 12 AWG.

53
54 All splices or connections shall be made within approved junction boxes and with approved fittings. Boxes
55 shall be red and labeled "FIRE ALARM SYSTEM" or "FA" by decal or other approved markings.

56
57 Speaker and strobe circuits shall have separate conductors, and shall operate independently of each other.

58
59 Speaker wiring shall be #18 AWG twisted-shielded cable.

60
61 Strobe wiring shall be #14 AWG minimum.

1 Tray cable is not acceptable for use as fire alarm system wiring installed in conduit.

2
3 **DEVICE MOUNTING**

4 Unless otherwise noted on the drawings, plans, specifications or by the Architect or Engineer; the
5 recommended mounting heights, and requirements are as follows:

6
7 **FIRE ALARM CONTROL PANELS**

8 Mount control panels such that all visual indicators and controls are located at 60 inches above floor level.

9
10 **ANNUNCIATOR/REMOTE FIRE COMMAND CENTER PANELS**

11 Mount FAAP/RFCC panels such that all visual indicators and controls are located at 60 inches above floor
12 level.

13
14 **VISUAL AND AUDIO / VISUAL NOTIFICATION APPLIANCES**

15 In Public-Mode Areas, as defined within NFPA-72, install flush, semi-flush or surface between 80 inches
16 and 96 inches or 6 inches below finished ceiling or at 80 inches from the bottom of the device to the
17 highest level of the finished floor. No devices protruding 4 inches or more shall be installed lower than 80
18 inches. If these requirements are not achievable, consult with the Engineer before installation.

19
20 Audio/visual devices may be installed on the ceilings only where indicated, or where approved in writing
21 by the Engineer. (In such cases, these devices shall be installed in accordance with current NFPA 72
22 standards).

23
24 Except as noted in the previous paragraph, all audio/visual devices shall be installed at the same height
25 through out the facility.

26
27 For surface mounting, use manufacture-supplied backboxes and trim plates, which shall be painted Red or
28 off White, and shall contain no visible conduit knock-outs. Mark each device with its circuit number.

29
30 **MANUAL STATIONS**

31 The operable part of the manual stations shall be installed not less than 3 ½ ft. (42") and not more than 4 ft.
32 (48") above finished floor. All Manual Stations shall be in unobstructed locations. Mark the unit's address
33 on the inside and outside of housing.

34
35 All manual pull stations shall be installed at the same height throughout the facility.

36
37 For surface mounting, use manufacture-supplied backboxes and trim plates. Backboxes shall be painted
38 Red or off White, and shall contain no visible conduit knock-outs. Mark each device with its loop and
39 address.

40
41 During the installation of the new fire alarm systems, new pull stations should be covered or identified as
42 not being operable so building occupants will not be confused as to which fire alarm pull station should be
43 pulled during an alarm condition. Likewise, after the new system is installed, tested and accepted, the
44 existing pull stations should be identified as not being operable (or permanently removed as soon as
45 possible).

46
47 **HEAT AND SMOKE DETECTORS**

48 The location of detectors shown on the plans is schematic only. The detectors must be located according to
49 code requirements.

50
51 Surface mounted detectors shall be installed using back boxes equal to the base's size. Standard octagon
52 and square boxes are not acceptable.

53
54 Detectors should be located on the highest part of a smooth ceiling so that the edge of the detector is no
55 closer than 4 inches from a sidewall. Ceilings with beams, joists or soffits that exceed 8 inches in depth
56 require special planning and closer spacing.

57
58 If it is necessary to mount a detector upon a sidewall, the top of the detector (the sensing chamber portion
59 of the device) shall be located no closer than 4 inches from the ceiling and no further away than 12 inches.

1 Smoke detectors should be installed to favor the air flow towards return openings and not located closer
2 than 3 feet from air supply diffusers which could dilute smoke before it reaches the detector. No detectors
3 shall be installed in direct airflow.
4

5 Duct smoke detector installation to be by this contractor and should be installed in the locations shown on
6 the mechanical and electrical plans. Ensure that the duct smoke detectors are in serviceable locations.
7 Consult with the mechanical designer for alternate locations if these are shown in non-serviceable
8 locations. When locations on mechanical plans are not available, install in locations called for that provide
9 accessibility for service. Do not install within four feet of a fan discharge
10

11 Heat and smoke detectors should be located near the center of the open area which they are protecting, thus
12 providing coverage generally for 15-foot radius for heat and smoke detectors. Questionable locations shall
13 be verified with Architect or Engineer before installation takes place.
14

15 Heat and smoke detectors / Sensors – both Intelligent and non-addressable, shall be installed in accordance
16 with their UL Listed Spacing. The quantity of Heat and smoke detectors / Sensors depicted on the
17 drawings is based on the 900 square foot per detector rule. If detectors with significantly different spacing
18 requirements are selected by the Fire Alarm equipment provider / EC, then additional detectors / sensors, if
19 required, shall be provided at no additional cost to the project.
20

21 IDENTIFICATION

22 Attach the label containing the address and SLC designation to:

23 Each addressable detector. Label shall be visible and readable from the floor, 3/16” minimum
24 character size (1/4” is recommended).

25 Each manual pull station. Label shall be placed on the top part

26 Each Addressable Module. Label shall be attached to the faceplate
27

28 Label shall consist of black writing on white or clear background.
29

30 All junction boxes shall be painted red and labeled "Fire Alarm" or "FA".
31

32 All circuits must be labeled with the name of circuit and the area being served by the circuit.
33

34 Wire/cable splices in junction boxes shall be labeled indicating where the wire/cable is coming from and
35 where it is going.
36

37 All conductors terminated in control panels, annunciator panels and extension panels shall be labeled.
38

39 All audio visual devices shall be labeled by each circuit and the order of the device on that circuit such as
40 "Circuit No. 2, strobe No. 05 of 10".
41

42 All labels shall be permanent, and be machine generated. NO HANDWRITTEN OR NON-PERMANENT
43 LABELS SHALL BE ALLOWED. Submit a sample for approval before using any labeling schemes.
44

45 Label size shall be appropriate for the conductor or cable size(s) and design. All labels to be used shall be
46 self-laminating, white/transparent vinyl and be wrapped around the cable (sheath). Flag type labels are not
47 allowed. The labels shall be of adequate size to accommodate the circumference of the cable being labeled
48 and properly self-laminate over the full extent of the printed area of the label.
49

50 Adhesive type labels not permitted except for phase and wire identification.
51

52 TESTING

53 Before proceeding with any testing, all persons, facilities and building occupants whom receive alarms or
54 trouble signals shall be notified by the contractor to prevent unnecessary response or building occupant
55 distress. At the conclusion of testing, those previously notified shall be notified that testing has been
56 concluded.
57

58 The manufacturer's authorized representative shall provide on-site supervision of installation of the
59 complete fire alarm system installation, perform a complete functional test of the system, and submit a
60 written report to the Contractor attesting to the proper operation of the completed system prior to final
61 inspection.
62

1 Contractor shall pre-test each and every device in the system before the system is considered ready for final
2 inspection.

3
4 The completed and pre-tested fire alarm system shall be fully tested in accordance with NFPA-72 by the
5 Contractor in the presence of the Engineer, DSF representative, Owner's representative and the local Fire
6 Marshal.

7
8 The Engineer or his authorized representative may suspend or discontinue the tests at any time
9 performance is considered unsatisfactory. Resumption of testing will cover untested elements and any
10 replaced elements. The contractor shall furnish all test personnel, test instruments and equipment of the
11 accuracy necessary to perform the test. Arrangements for testing must be made with the DSF
12 representative and the Engineer at least two weeks before the proposed testing date.

13
14 Upon the completion of a successful test, and prior to the final request for payment the Contractor shall:
15 Certify the system to the Owner in writing
16 Complete the NFPA 72 record of completion form
17 Provide as built and O&M manuals.
18 Provide a signed statement that the Owner had received the specified system operation and
19 maintenance training

20
21 The final payment will not be processed unless these documents are complete and are on hand.

22 **WARRANTY**

23
24 The Contractor shall warrant the completed fire alarm system wiring and equipment to be free from
25 inherent mechanical and electrical defects for a period of two (2) years from the date of substantial
26 completion of the project.

27
28 At the end of the project, the Contractor shall post the warranty period along with the company's name and
29 telephone number inside the fire alarm panel.

30
31 Any occupied facility shall not be without a UL and an NFPA approved and fully operational fire alarm
32 system for a period longer than two (2) hours. Emergency response shall be provided within two (2) hours
33 of the notification, to the contractor, of the failure of the system to perform operationally per UL and
34 NFPA standards. Non-emergency service calls shall be responded to within twenty-four (24) hours of the
35 notification to the contractor.

36
37 Emergency situations may include, but not limited to
38 System can't be acknowledged or reset
39 System is non-responsive to commands
40 System in non-responsive to actuated alarm devices
41 Malfunction of notification/initiating circuit(s)
42 System going into alarm/trouble without indicating the source
43 System is dead (no power), etc.

44
45 Repairs and/or replacement arising from emergency situations shall be completed within twenty-four (24)
46 hours of the time of notification. Other than emergency, actual repairs and /or replacement shall be
47 provided within seventy two (72) hours of the time of notification during normal working hours, Monday
48 through Friday, excluding holidays. If the repairs involve parts that are not shelve items and require lead
49 time, the contractor shall inform the Owner within twenty-four (24) hours from the time of notification of
50 the exact time when the repairs will be completed.

51
52 If repair and/or replacement cannot be made within the prescribed time, then other means and methods of
53 protection shall be provided to insure the safety of the building's occupants during which time the system
54 is not in compliance with the standards. This may involve up to and include hiring Owner approved
55 qualified personnel to stand a fire watch, all at the contractor's expense.

56
57 Warranty service for the equipment shall be provided by the system supplier's factory trained
58 representative. Further, Warranty shall include all parts, labor and necessary travel.

59 **TRAINING**

60
61 All training provided for agency shall comply with the format, general content requirements and
62 submission guidelines specified under Section 01 91 01, or 01 91 02. The Contractor through his/her

1 supplier shall provide, as part of this contract, a minimum of (##) hours system operation training for
2 owner, the Architect/Engineer, and fire department personnel. The training session shall consist of the
3 following sessions:

4 Two (?) -hour sessions for the purpose of training personnel who will need to operate the system –
5 primarily, Level 1 and Level 2 system operators / users.
6

7 A single (?) -hour session for the purpose of training personnel who will need to administrate and
8 maintain the system. This training session shall familiarize these “power-users” with High-Level
9 functions, and shall also familiarize Electrical Department personnel with an overview of the as-
10 built drawings and equipment configuration / basic troubleshooting.

11
12 All training sessions shall be coordinated and scheduled by the EC, and shall be conducted at a time to be
13 stipulated by the owner. All training and other indoctrination shall be completed prior to final inspection.
14

15 The contractor shall videotape all training and instructional sessions on VHS format tape. Provide a
16 separate tape for each system and label for the system demonstrated and turnover to the Owner.
17

18 Training shall not take place until all systems are 100% operational as determined by the Owner. The
19 purpose of training is to fully prepare the facility maintenance staff for complete operational responsibility
20 of the fire alarm system.
21

22 The facility maintenance staff shall be fully trained and be given the capability by the product Vendor and
23 installing Contractor to modify, to program, to fully repair, to service, and to maintain the system after (and
24 if desired, during) the warranty period.
25

26 The above training shall include, but not be limited to, providing and reviewing all programming software,
27 access codes, and licenses that allow the Owner to add or to delete any points (i.e.: The mapping of
28 devices), and to change a heat detector to a smoke detector. To meet this requirement, provide the
29 necessary configuration and/or access code (hardware and/or software key). If the Vendor can not meet
30 this requirement, the product is not acceptable
31

32 **SPECIAL CONSIDERATIONS**

33 Contractor shall refer to Division 1, General Requirements, “SPECIAL SITE CONDITIONS”.
34

35 The contractor must maintain the existing fire alarm system operational during the construction period.
36 During periods of construction where dust or dirt may contaminate the existing detectors, the contractor
37 shall cover the detectors to avoid nuisance alarms and trouble-calls.
38

39 Individual zones and/or devices of the existing fire alarm system can be bypassed by the contractor during
40 construction under the following requirements:
41

42 The Superintendent of Buildings and Grounds is notified of which zones and/or devices are
43 inoperative and for how long in writing, hand delivered.
44

45 The contractor covers all manual-pull stations that are not active and post temporary fire alarm
46 notification procedures next to each inactive manual-pull station.
47

48 Ensure the fire alarm system is fully operational before leaving the job site.
49

50 Ancillary signals are acceptable during the construction period.
51
52

53 **END OF SECTION**