



CONSTRUCTION DOCUMENTS PROJECT MANUAL

DANE COUNTY DEPARTMENT OF PUBLIC WORKS,
HIGHWAY AND TRANSPORTATION

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

REQUEST FOR BIDS NO. 109001 DANE COUNTY JOB CENTER REMODEL DANE COUNTY JOB CENTER 1819 ABERG AVENUE MADISON, WISCONSIN

Opening Date / Time: **THURSDAY, FEBRUARY 19, 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:

TOM SRACIC, PROJECT MANAGER
TELEPHONE NO.: 608/266-4475
FAX NO.: 608/267-1533
E-MAIL: SRACIC@CO.DANE.WI.US

DOCUMENT INDEX FOR RFB NO. 109001

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
Prevailing Wage Rates

DIVISION 1 - GENERAL REQUIREMENTS

01 10 00 - Basic Requirements
01 23 00 - Alternates
01 50 80 - Recycling

DIVISION 2 - EXISTING CONDITIONS

02 41 19 - Selective Demolition

DIVISION 3 - CONCRETE

03 30 00 - Cast-In-Place Concrete

DIVISION 4 - MASONRY

Not Used.

DIVISION 5 - METALS

05 30 00 - Metal Decking
05 50 00 - Metal Fabrications

DIVISION 6 - WOOD AND PLASTICS

06 10 00 - Rough Carpentry

DIVISION 7 - THERMAL AND MOISTURE PROTECTION

07 54 00 - Thermoplastic Membrane Roofing
07 62 00 - Flashing And Sheet Metal

DIVISION 8 - DOORS AND WINDOWS

08 31 13 - Access Doors

DIVISION 9 - FINISHES

09 29 00 - Gypsum Board
09 51 00 - Acoustical Ceilings
09 68 13 - Tile Carpeting

DIVISION 10 - SPECIALTIES

Not Used.

DIVISION 11 - EQUIPMENT

Not Used.

DIVISION 12 - FURNISHINGS

Not Used.

DIVISION 13 - SPECIAL CONSTRUCTION

Not Used.

DIVISION 14 - CONVEYING SYSTEMS

Not Used.

DIVISION 21 – FIRE SUPPRESSION

Not Used.

DIVISION 22 - PLUMBING

Not Used.

DIVISION 23 – HVAC

- 23 05 00 - Common Work Results for HVAC
- 23 05 13 - Common Motor Requirements for HVAC
- 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 93 - Testing, Adjusting and Balancing for HVAC
- 23 07 00 - HVAC Insulation
- 23 09 23 - Direct Digital Control System for HVAC
- 23 21 13 - 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 34 00 - HVAC Fans
- 23 36 00 - Air Terminal Units
- 23 37 13 - Diffusers, Registers and Grilles
- 23 41 00 - Particulate Air Filtration
- 23 51 00 - Breechings, Chimneys and Stacks
- 23 52 00 - Condensing Boilers
- 23 73 13 - Packaged Roof Top Units
- 23 82 00 - Heating and Cooling Terminal Units

DIVISION 26 – ELECTRICAL

- 26 00 00 - Electrical General Provisions
- 26 05 00 - Common Work Results for Electrical
- 26 05 19 - Low-Voltage Electrical Power Conductors and Cables
- 26 05 26 - Grounding and Bonding for Electrical Systems
- 26 05 33 - Raceways and Boxes for Electrical Systems
- 26 24 13 - Switchboards
- 26 24 16 - Panelboards
- 26 28 13 - Fuses

26 29 13 - Enclosed Controllers

26 51 00 - Interior Lighting

DIVISIONS 27 – 33

Not Used.

DRAWINGS

TS1	Title Sheet
C201	Site Plan
LS201	Life Safety Plan
PS201	Overall Floor, Phasing, and Partial Floor Demolition Plan
A102A	Demolition Reflected Ceiling Plan – Area “A”
A102B	Demolition Reflected Ceiling Plan – Area “B”
A102C	Demolition Reflected Ceiling Plan – Area “C”
A102D	Demolition Reflected Ceiling Plan – Area “D”
A103	Roof Demolition Plan
A202	Roof Plan
A301A	Reflected Ceiling Plan – Area “A”
A301B	Reflected Ceiling Plan – Area “B”
A301C	Reflected Ceiling Plan – Area “C”
A301D	Reflected Ceiling Plan – Area “D”
M101A	Floor Plan – Area “A” – HVAC Demolition
M101B	Floor Plan – Area “B” – HVAC Demolition
M101C	Floor Plan – Area “C” – HVAC Demolition
M101D	Floor Plan – Area “D” – HVAC Demolition
M102	Roof Plan – HVAC Demolition
M201A	Floor Plan – Area “A” – HVAC New Work Ductwork
M201B	Floor Plan – Area “B” – HVAC New Work Ductwork
M201C	Floor Plan – Area “C” – HVAC New Work Ductwork
M201D	Floor Plan – Area “D” – HVAC New Work Ductwork
M202	Roof Plan – HVAC New Work
M203	Mechanical Room – HVAC Demolition and New Work
M301A	Floor Plan – Area “A” – HVAC New Work Piping
M301B	Floor Plan – Area “B” – HVAC New Work Piping
M301C	Floor Plan – Area “C” – HVAC New Work Piping
M301D	Floor Plan – Area “D” – HVAC New Work Piping
M401	HVAC Details
M501	HVAC Schedules
M502	HVAC Schedules
M601	HVAC Control Sequences
E201A	Floor Plan Area A – Electrical
E201B	Floor Plan Area B – Electrical
E201C	Floor Plan Area C – Electrical
E201D	Floor Plan Area D – Electrical
E301	Symbols, Diagrams, and Abbreviations

DANE COUNTY VENDOR REGISTRATION PROGRAM

All bidders / proposers wishing to submit a bid / proposal should be registered with Dane County Purchasing before bid / proposal opening & must be registered before award of contract. Complete a Vendor Registration Form at www.danepurchasing.com, or obtain one by calling 608/266-4131.

LEGAL NOTICE

INVITATION TO BID

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

2:00 P.M., THURSDAY, FEBRUARY 19, 2009

REQUEST FOR BIDS NO. 109001

JOB CENTER REMODEL

MADISON, WISCONSIN

Dane County is inviting Bids for construction services for the interior remodel of the Dane County Job Center. This will include HVAC, electrical, and carpeting. Only Bidders with capabilities, experience & expertise with similar projects should request this packet & submit Bids.

Request for Bids package may be obtained after **2:00 p.m. on Thursday, January 29, 2009** 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 Tom Sracic, Project Manager, at 608/266-4475, for any questions or additional information.

Refundable fee of \$75.00 per Request for Bids package (drawings & specifications) is required for each hard copy; downloaded copies are free. Non-refundable fee of \$15.00 per set is required for mailing. We require separate checks for mailing. Combined checks will not be accepted. Make checks payable to Dane County.

All Bidders wishing to submit Bids should be a registered vendor with Dane County Purchasing & prequalified as Best Value Contractor before bid opening & must be registered & prequalified before award of contract. 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.

Bidders facility tour will be held on Thursday, February 12, 2009 at 9:00 a.m. at Dane County Job Center, 1819 Aberg Ave, Madison, WI, starting in Main Entrance Lobby. This is a mandatory tour and Bidders are required to attend in order to Bid on the Work.

PUBLISH: JANUARY 29 & FEBRUARY 5, 2009 - WISCONSIN STATE JOURNAL
FEBRUARY 2 & 9, 2009 - WESTERN BUILDER

INSTRUCTIONS TO BIDDERS

TABLE OF CONTENTS

1. GENERAL	1
2. DRAWINGS AND SPECIFICATIONS	1
3. INTERPRETATION.....	2
4. QUALIFICATIONS OF BIDDER (CONTRACTOR AND SUBCONTRACTOR)	2
5. BID GUARANTEE	3
6. WITHDRAWAL OF BIDS	3
7. CONTRACT FORM.....	3
8. CONTRACT INTERESTS BY COUNTY PUBLIC OFFICIALS	3
9. EMERGING SMALL BUSINESS PROVISIONS	4
10. METHOD OF AWARD - RESERVATIONS	6
11. SECURITY FOR PERFORMANCE AND PAYMENTS.....	6
12. TAXES.....	6
13. SUBMISSION OF BIDS	7
14. SUBCONTRACTOR LISTING	7
15. ALTERNATE BIDS	8
16. INFORMATIONAL BIDS	8
17. UNIT PRICES	8
18. COMMENCEMENT AND COMPLETION.....	8
19. WORK BY COUNTY.....	9
20. SPECIAL HAZARDS COVERAGE	9
FORM A	10
FORM B.....	11
FORM C.....	12
FORM D	13

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 Thursday, February 12, 2009 at 9:00 AM at Dane County Job Center, Madison , Wi., in the main Entrance Lobby. Attendance by all bidders is mandatory. Other subcontractors to bidders are encouraged to attend.
- D. Failure to visit site or failure to examine any and all Construction Documents will in no way relieve successful Bidder from necessity of furnishing any necessary materials or equipment, or performing any work, that may be required to complete the Work in accordance with Drawings and Specifications. Neglect of above requirements will not be accepted as reason for delay in the Work or additional compensation.

2. DRAWINGS AND SPECIFICATIONS

- A. Drawings and Specifications that form part of this Contract, as stated in Article 1 of General Conditions of Contract, are enumerated in Document Index of these Construction Documents.

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 County 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. County 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, County 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 and supplies list of 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 Manager within three (3) days after Bid Opening]. 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 County 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. County reserves right to reject Bid if evidence submitted by, or investigation of, bidder fails to satisfy County 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 County 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. County 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. All bidders are encouraged to submit their bids in special printed bid envelope available at Dane County Public Works, Highway & Transportation Department - Public Works Engineering Division. Bids submitted in any other type of envelope run risk of not being identified as bid and County shall not be liable therefore in any respect. Bids shall be signed, sealed and delivered at place and before time of closing 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.
- H. 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. County reserves right to accept or reject any unit prices as given in Bid.
- C. Bidder shall refer to Bid Form and applicable specification section to determine basis of unit measure and detailed information related to each unit price item requested.

18. COMMENCEMENT AND COMPLETION

- A. Successful Bidder shall commence work when schedule and weather permit, but no later than stated in Bid Form. Contractor shall pursue the Work regularly and continuously at reasonable rate to insure completion of the Work within time stated in Bid.

- B. Should it be found impossible to complete the Work on or before time specified for completion, written request may be submitted for extension of time setting forth reasons believed to justify granting of such request. Refer to Article 20 of General Conditions of Contract, titled "Time for Completion".

19. WORK BY COUNTY

- A. This work will be accomplished by County or will be let under separate contracts and will not be included under this Contract:
 - 1. County will perform the roofing work. New Roof Top Units will be flashed. Open penetrations resulting from removal of existing roof top units will be patched. Any damage to existing roofing shall be the responsibility of the General Contractor.
 - 2. New Electrical Switchboard shall be provided by the County. The Switchboard shall be completely installed by the contractor. The switchboard will be manufactured by Square D Company and will be a Power Style QED-2, rated at 2,000 amps, shipped in three (3) sections with a total weight 2,705 lbs. Switchboard will be 126" long, 24" deep and 91.5" high. Breakers are indicated on the drawings.
 - 3. County will remediate or protect any hazardous material on site.

20. SPECIAL HAZARDS COVERAGE

- A. Contractor shall be responsible to inform Project Manager of any hazardous material encountered

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. 109001

PROJECT: DANE COUNTY JOB CENTER REMODEL

DANE COUNTY JOB CENTER

**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 electrical, carpeting, and for the replacement of the HVAC system and controls, 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

ALTERNATE BID 1 - UNIT PRICING:

Base bid requires that all existing light fixtures have new ballasts and lamps installed to replace existing. Provide a unit cost per fixture for **not replacing** existing ballasts and lamps in fixtures that have been recently re-ballasted and re-lamped by Owner.

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

_____ and _____ /100 Dollars
Written Price

ALTERNATE BID 2 – LUMP SUM:

Add for the removal of the 3 existing parking area post lights and the complete installation of the 3 new post lights as indicated on sheet numbers E1 and E2, Sheet Note 6.

\$ _____

Numeric Price (circle: Add or Deduct)

_____ and _____ /100 Dollars
Written Price

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

Addendum No(s). _____ through _____

Dated _____

Dane County Human Services Department must have this project completed by June 1, 2011. Assuming this Work can be started by April, 1, 2009, what dates can you commence and complete this job?

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

Name of Bidder: _____

Address: _____

Telephone No.: _____ Fax No.: _____

Contact Person: _____

SIGNATURE: _____
(Bid is invalid without signature)

BID CHECK LIST:			
These items must be included with Bid or completed before bidding			
<input type="checkbox"/> Bid Form	<input type="checkbox"/> Bid Bond	<input type="checkbox"/> Fair Labor Practices Certification	
<input type="checkbox"/> Best Value Qualified Contractor		<input type="checkbox"/> Vendor Registration	

FAIR LABOR PRACTICES CERTIFICATION

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

- A. That he or she is an officer or duly authorized agent of the above-referenced BIDDER, APPLICANT or PROPOSER, which has a submitted a 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.nlrb.gov and werc.wi.gov.

For reference, Dane County Ordinance 25.11(28)(a) is as follows:
(28) BIDDER RESPONSIBILITY. (a) Any bid, application or proposal for any contract with the county, including public works contracts regulated under chapter 40, shall include a certification indicating whether the bidder has been found by the National Labor Relations Board (NLRB) or the Wisconsin Employment Relations Committee (WERC) to have violated any statute or regulation regarding labor standards or relations within the last seven years. The purchasing manager shall investigate any such finding and make a recommendation to the committee, which shall determine whether the conduct resulting in the finding affects the bidder’s responsibility to perform the contract.

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



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 bidders to be prequalified with the County prior to bid opening. In addition, the County reviews potential contractors and sub-contractors who wish to work on County contracts. This document shall be completed, properly executed, along with the necessary attachments regarding information relating to financial ability, equipment, experience in the work prescribed in the public contract, and other matters that the County requires for the protection and welfare of the public in the performance of a County contract.

The Contractor shall notify the County within 15 days of any information regarding any material 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 or other sanctions available under the law.

Contractors or subcontractors of any tier who attain prequalification status will retain that status for a period of two years from the date of qualification. Subcontractors must become prequalified ten days prior to commencing work under any Dane County Public Works Contract. Potential subcontractors are urged to become prequalified as early as possible.

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 www.wisconsinapprenticeship.org.

EXEMPTIONS

- Contractors or subcontractors of any tier automatically attain prequalification status with Dane County if the contractor has current Executive Order 108 precertification status with the State of Wisconsin or prequalification status with the City of Madison.
- Contractors who employ less than five (5) craft 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 the project or obtain the same through the use of responsible, prequalified subcontractors?	Yes: <input type="checkbox"/> No: <input type="checkbox"/>
2	Does 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	Does your firm meet all bonding requirements as required by applicable law or contract specifications?	Yes: <input type="checkbox"/> No: <input type="checkbox"/>
4	Does 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	Does 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	Does 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 prequalified with the City of Madison?	Yes: <input type="checkbox"/> No: <input type="checkbox"/>
16	Is your firm an active Wisconsin Trade Trainer as determined by the Wisconsin Bureau of Apprenticeship Standards?	Yes: <input type="checkbox"/> No: <input type="checkbox"/>
17	Is your firm exempt from being prequalified with Dane County?	Yes: <input type="checkbox"/> No: <input type="checkbox"/> If Yes, attach reason for exemption.
18	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. 109001

Authority: Res. _____, 2008-09

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 Dane County Job Center Remodel at 1819 Aberg Ave, Madison, Wisconsin [including Alternate Bid[s] X, Y & Z (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 Strang, Inc. (hereinafter referred to as "the Architect / Engineer"), and as enumerated in the Project Manual Document Index, all of which are made a part hereof and collectively evidence and constitute the Contract.
2. COUNTY agrees to pay the CONTRACTOR in current funds for the performance of the Contract subject to additions and deductions, as provided in the General Conditions of Contract, and to make payments on account thereof as provided in Article entitled, "Payments to Contractor" of the General Conditions of Contract.
3. During the term of this Contract, CONTRACTOR agrees to take affirmative action to ensure equal employment opportunities. The CONTRACTOR agrees in accordance with Wisconsin Statute 111.321 and Chapter 19 of the Dane County Code of Ordinances not to discriminate on the basis of age, race, ethnicity, religion, color, gender, disability, marital status, sexual orientation,

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

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

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

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

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

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

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

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

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

TABLE OF CONTENTS

GENERAL CONDITIONS OF CONTRACT	1
1. CONSTRUCTION DOCUMENTS	2
2. DEFINITIONS	2
3. ADDITIONAL INSTRUCTIONS AND DRAWINGS	2
4. SHOP DRAWINGS, PRODUCT DATA AND SAMPLES	2
5. CUTTING AND PATCHING	3
6. CLEANING UP	4
7. USE OF SITE	4
8. MATERIALS AND WORKMANSHIP	5
9. CONTRACTOR'S TITLE TO MATERIALS	5
10. "OR EQUAL" CLAUSE	5
11. PATENTS AND ROYALTIES	6
12. SURVEYS, PERMITS, REGULATIONS AND TAXES	6
13. CONTRACTOR'S OBLIGATIONS AND SUPERINTENDENCE	7
14. WEATHER CONDITIONS	8
15. PROTECTION OF WORK AND PROPERTY	8
16. INSPECTION AND TESTING OF MATERIALS	8
17. REPORTS, RECORDS AND DATA	9
18. CHANGES IN THE WORK	9
19. EXTRAS	10
20. TIME FOR COMPLETION	10
21. CORRECTION OF WORK	10
22. SUBSURFACE CONDITIONS FOUND DIFFERENT	11
23. RIGHT OF DEPARTMENT TO TERMINATE CONTRACT	11
24. CONSTRUCTION SCHEDULE AND PERIODIC ESTIMATES	11
25. PAYMENTS TO CONTRACTOR	12
26. WITHHOLDING OF PAYMENTS	13
27. ACCEPTANCE OF FINAL PAYMENT AS RELEASE	14
28. PAYMENTS BY CONTRACTOR	14
29. CONTRACT SECURITY	14
30. ASSIGNMENTS	15
31. MUTUAL RESPONSIBILITY OF CONTRACTORS	15
32. SEPARATE CONTRACTS	15
33. SUBCONTRACTS	15
34. PUBLIC WORKS PROJECT ENGINEER'S AUTHORITY	16
35. ARCHITECT / ENGINEER'S AUTHORITY	16
36. STATED ALLOWANCES	17
37. ESTIMATES OF QUANTITIES	17
38. LANDS AND RIGHTS-OF-WAY	17
39. GENERAL GUARANTEE	17
40. CONFLICTING CONDITIONS	18
41. NOTICE AND SERVICE THEREOF	18
42. PROTECTION OF LIVES AND HEALTH	18
43. AFFIRMATIVE ACTION PROVISION AND MINORITY / WOMEN / DISADVANTAGED BUSINESS ENTERPRISES	18
44. COMPLIANCE WITH FAIR LABOR STANDARDS	19
45. DOMESTIC PARTNERSHIP BENEFITS	19
46. USE AND OCCUPANCY PRIOR TO ACCEPTANCE	20
47. MINIMUM WAGES	20
48. CLAIMS	21
49. ANTITRUST AGREEMENT	21
50. INSURANCE	21
51. WISCONSIN LAW CONTROLLING	23

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 no 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 Statue 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.

SUPPLEMENTARY CONDITIONS

1. APPLICATION & CERTIFICATE FOR PAYMENT

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


AIA Document G702™ – 1992

Application and Certificate for Payment

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

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

1. ORIGINAL CONTRACT SUM \$ _____

2. Net change by Change Orders \$ _____

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

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

5. RETAINAGE:

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

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

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

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

7. LESS PREVIOUS CERTIFICATES FOR PAYMENT (Line 6 from prior Certificates) \$ _____

8. CURRENT PAYMENT DUE \$ _____

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

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

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

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

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

ARCHITECT:
 By: _____ Date: _____

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

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

AIA Document G702™ – 1992 Copyright © 1953, 1963, 1965, 1971, 1976, 1983 and 1992 by The American Institute of Architects. All rights reserved. **WARNING:** This AIA™ Document is protected by U.S. Copyright Law and International Treaties. Unauthorized reproduction or distribution of this AIA™ Document, or any portion of it, may result in severe civil and criminal penalties, and will be prosecuted to the maximum extent possible under the law. Purchasers are permitted to reproduce ten (10) copies of this document when completed. To report copyright violations of AIA Contract Documents, e-mail The American Institute of Architects' legal counsel, copyright@aia.org.

Continuation Sheet

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

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

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

CAUTION: You should sign an original AIA Contract Document, on which this text appears in RED. An original assures that changes will not be obscured.
 AIA Document G703™ – 1992. Copyright © 1993, 1995, 1996, 1997, 1970, 1976, 1982 and 1992 by The American Institute of Architects. All rights reserved. (AIA/INHO) This AIA® Document is protected by U.S. Copyright Law and International Treaties. Unauthorized reproduction or distribution of this AIA® Document, or any portion of it, may result in severe civil and criminal penalties, and will be prosecuted to the maximum extent possible under the law. Purchasers are permitted to reproduce (1) copies of this document when completed. For reprint/copyright violations of AIA Contract Documents, e-mail: The American Institute of Architects legal counsel, copyright@aia.org.

2. PREVAILING WAGE RATE DETERMINATION

- A. These supplements shall modify, delete, and / or add to General Conditions of Contract. Where any article, paragraph, or subparagraph in General Conditions of Contract is supplemented by one of these paragraphs, provisions of such article, paragraph, or subparagraph shall remain in effect and supplementary provisions shall be considered as added thereto. Where any article, paragraph, or subparagraph in General Conditions of Contract is amended, voided, or superseded by any of these paragraphs, provisions of such article, paragraph, or subparagraph not so amended, voided, or superseded shall remain in effect.
 - 1. General Conditions of Contract Article 45, “Minimum Wages”, paragraph B. Following Prevailing Wage Rate Determination No. 200801435 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)

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

TOM SRACIC, PROJ MGR
DANE CO PUBLIC WORKS
1919 ALLIANT ENERGY CTR WAY
MADISON, WI 53713

RE: DANE COUNTY JOB CENTER REMODEL
CITY OF MADISON, DANE COUNTY, WI
Determination No. 200801435 Project No. 109001

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

11/26/2008

Enclosures

FOR THE DEPARTMENT

A handwritten signature in black ink, appearing to read 'Terry Moser', written over a horizontal line.

Terry Moser, Investigator
Labor Standards Bureau
Construction Wage Standards Section
(608) 266-0028

PREVAILING WAGE RATE DETERMINATION

Issued by the State of Wisconsin
Department of Workforce Development
Pursuant to s. 66.0903, Stats.
Issued On: 11/26/2008

DETERMINATION NUMBER: 200801435

EXPIRATION DATE: Prime Contracts MUST Be Awarded Or Negotiated On Or Before 5/24/2009. If NOT, You MUST Reapply.

DESCRIPTION OF PROJECT: DANE COUNTY JOB CENTER REMODEL
PROJECT NO: 109001

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

CONTRACTING AGENCY: DANE CO 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 All Hours Worked

<u>TRADE OR OCCUPATION</u>	<u>HOURLY BASIC RATE OF PAY</u>	<u>HOURLY FRINGE BENEFITS</u>	<u>TOTAL</u>
	\$	\$	\$
Acoustic Ceiling Tile Installer	25.51	12.11	37.62
Boilermaker	29.44	16.37	45.81
Bricklayer, Blocklayer or Stonemason	29.46	13.41	42.87
Cabinet Installer	48.00	0.00	48.00
Carpenter	26.11	12.86	38.97
Carpet Layer or Soft Floor Coverer	25.51	12.11	37.62
Cement Finisher	28.43	12.94	41.37
Drywall Taper or Finisher	24.30	11.60	35.90

Future Increase(s): Add \$1.55/hr on 6/1/08; Add \$1.60/hr on 6/1/09

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>
	\$	\$	\$
Electrician	30.00	16.05	46.05
Elevator Constructor	40.94	18.34	59.28
Fence Erector	21.50	3.00	24.50
Fire Sprinkler Fitter	35.69	13.35	49.04
Glazier	33.68	6.47	40.15
Heat or Frost Insulator	30.63	16.60	47.23
Future Increase(s): Add \$2.60/hr on 6/1/08; Add \$2.85/hr on 6/1/09; Add \$3.05/hr on 6/1/2010.			
Insulator (Batt or Blown)	21.97	10.65	32.62
Ironworker	29.30	14.71	44.01
Lather	25.51	12.11	37.62
Line Constructor (Electrical)	31.99	13.94	45.93
Marble Finisher	24.60	13.00	37.60
Marble Mason	30.75	13.00	43.75
Metal Building Erector	19.23	1.61	20.84
Millwright	27.11	12.07	39.18
Overhead Door Installer	24.60	11.99	36.59
Painter	24.00	11.60	35.60
Future Increase(s): Add \$1.55 on 6/1/08; 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	23.46	9.45	32.91
Piledriver	26.61	12.86	39.47
Pipeline Fuser or Welder (Gas or Utility)	27.11	12.19	39.30
Plasterer	25.28	12.95	38.23
Plumber	33.50	11.84	45.34
Future Increase(s): Add \$2.20/hr on 6/1/08			
Refrigeration Mechanic	33.11	14.84	47.95
Future Increase(s): Add \$2.60 6/2/2008; Add \$2.85 6/1/2009			
Roofer or Waterproofer	26.70	3.62	30.32
Sheet Metal Worker	30.68	16.62	47.30
Future Increase(s): Add \$2.50 6/1/2008			
Steamfitter	35.25	12.11	47.36
Future Increase(s): Add \$2.60 6/02/2008; Add \$2.85 6/01/2009			
Teledata Technician or Installer	20.69	10.23	30.92
Future Increase(s): Add \$.85 on 6/1/08; Add \$.90 on 6/1/09			
Temperature Control Installer	34.10	10.89	44.99
Terrazzo Finisher	26.62	10.63	37.25
Terrazzo Mechanic	26.62	10.63	37.25
Tile Finisher	14.00	1.35	15.35
Tile Setter	26.62	10.63	37.25
Tuckpointer, Caulker or Cleaner	20.98	6.02	27.00
Underwater Diver (Except on Great Lakes)	31.90	11.44	43.34
Well Driller or Pump Installer	22.52	7.14	29.66
Siding Installer	28.56	15.24	43.80
Heavy Equipment Operator - ELECTRICAL LINE CONSTRUCTION ONLY	24.06	15.52	39.58

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>
	\$	\$	\$
Light Equipment Operator -ELECTRICAL LINE CONSTRUCTION ONLY	28.12	15.40	43.52
Heavy Truck Driver - ELECTRICAL LINE CONSTRUCTION ONLY	16.00	8.00	24.00
Light Truck Driver - ELECTRICAL LINE CONSTRUCTION ONLY	20.58	10.71	31.29
Groundman - ELECTRICAL LINE CONSTRUCTION ONLY	17.41	9.80	27.21

TRUCK DRIVERS

Single Axle or Two Axle	24.55	16.08	40.63
Three or More Axle	16.40	11.17	27.57
Articulated, Euclid, Dumptor, Off Road Material Hauler	27.87	15.40	43.27
Pavement Marking Vehicle	20.85	11.10	31.95
Truck Mechanic	12.50	0.00	12.50

LABORERS

General Laborer	21.69	11.15	32.84
Premium Pay: Add \$1.00/hr for certified welder; Add \$.25/hr for mason tender			
Asbestos Abatement Worker	21.06	11.13	32.19
Landscaper	12.36	14.53	26.89
Gas or Utility Pipeline Laborer (Other Than Sewer and Water)	18.25	3.33	21.58
Fiber Optic Laborer (Outside, Other Than Concrete Encased)	40.00	1.81	41.81
Railroad Track Laborer	12.00	0.00	12.00

**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)	28.12	15.73	43.85
Farm or Industrial Type Tractor; Greaser; Compactor (Self-Propelled); Broom or Sweeper; Environmental Burner	28.59	16.00	44.59
Crusher, Screening or Wash Plant; Air Compressor (400 CFM or Over); Pump (3 Inch or Over) or Well Points; Refrigeration Plant or Freeze Machine; Skid Steer Loader (With or Without Attachments); Skid Rig; Stump Chipper; Mulcher; Vibratory Hammer or Extractor	27.59	14.88	42.47

**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	30.62	16.00	46.62
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.			

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>
	\$	\$	\$
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): Premium Pay: Add \$.25/hr for cranes with lifting capacity of 45 ton or over	29.62	16.00	45.62
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):	29.12	16.00	45.12
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	22.98	6.02	29.00
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	28.87	14.90	43.77
Oilier; Forklift	25.89	16.00	41.89
Gas or Utility Pipeline, Except Sewer and Water (Primary Equipment)	31.57	17.23	48.80
Gas or Utility Pipeline, Except Sewer and Water (Secondary Equipment)	28.12	15.40	43.52
Fiber Optic Cable Equipment	25.33	12.35	37.68

SEWER, WATER OR TUNNEL CONSTRUCTION

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

Bricklayer, Blocklayer or Stonemason	28.41	12.81	41.22
Carpenter	29.02	13.72	42.74
Cement Finisher	27.82	12.86	40.68
Electrician	30.00	16.05	46.05
Fence Erector	21.50	3.00	24.50

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>
	\$	\$	\$
Ironworker	28.96	18.14	47.10
Future Increase(s): Add \$2.00 6/2/2008; Add \$2.00 6/1/2009; Add \$ 2.00 6/7/2010.			
Line Constructor (Electrical)	31.99	13.94	45.93
Pavement Marking Operator	23.46	9.45	32.91
Piledriver	26.61	12.86	39.47
Plumber	24.00	1.52	25.52
Steamfitter	30.76	24.46	55.22
Teledata Technician or Installer	20.30	10.01	30.31
Tuckpointer, Caulker or Cleaner	20.98	6.02	27.00
Underwater Diver (Except on Great Lakes)	31.90	11.44	43.34
Well Driller or Pump Installer	22.52	7.14	29.66
Heavy Equipment Operator - ELECTRICAL LINE CONSTRUCTION ONLY	24.06	15.52	39.58
Light Equipment Operator -ELECTRICAL LINE CONSTRUCTION ONLY	28.12	15.40	43.52
Heavy Truck Driver - ELECTRICAL LINE CONSTRUCTION ONLY	16.00	8.00	24.00
Light Truck Driver - ELECTRICAL LINE CONSTRUCTION ONLY	20.58	10.71	31.29
Groundman - ELECTRICAL LINE CONSTRUCTION ONLY	17.41	9.80	27.21

TRUCK DRIVERS

Single Axle or Two Axle	24.55	16.08	40.63
Three or More Axle	17.52	7.80	25.32
Articulated, Euclid, Dumptor, Off Road Material Hauler	22.00	11.07	33.07
Pavement Marking Vehicle	20.85	11.10	31.95
Truck Mechanic	12.50	0.00	12.50

LABORERS

General Laborer	23.28	11.14	34.42
Future Increase(s): Add \$1.40 6/2/08; Add \$1.45 6/1/09; Add \$1.40 6/7/10; Add \$1.45 on 6/6/2011			
Premium Pay: Add \$.20 for blaster, bracer, manhole builder, caulker, bottomman and power tool; Add \$.55 for pipelayer; Add \$1.00 for tunnel work 0-15 lbs. compressed air; Add \$2.00 for over 15-30 lbs. compressed air; Add \$3.00 for over 30 lbs. compressed air.			
Landscaper	22.53	10.54	33.07
Flagperson or Traffic Control Person	20.33	10.57	30.90
Fiber Optic Laborer (Outside, Other Than Concrete Encased)	40.00	1.81	41.81
Railroad Track Laborer	12.00	0.00	12.00

HEAVY EQUIPMENT OPERATORS

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; Backhoe (Track Type) Having a Mfgr.'s Rated Capacity of 130,000 Lbs. or Over	30.62	16.00	46.62
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.			
Crane, Tower Crane or Derrick, With or Without Attachments, With a Lifting	29.12	16.00	45.12

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>
	\$	\$	\$
Capacity of 100 Tons or Under; Crane, Tower Crane or Derrick, With Boom, Leads and/or Jib Lengths Measuring 175 Feet or Under; Traveling Crane (Bridge Type); Caisson Rig; Pile Driver; Dredge (Not Performing Work on the Great Lakes); Backhoe (Track Type) Having a Mfr.'s Rated Capacity of Under 130,000 Lbs. Future Increase(s):			
Truck Mounted Hydraulic Crane (10 Tons or Under); Tractor or Truck Mounted Hydraulic Backhoe; Gradall (Cruz-Aire Type); Mechanic or Welder; Bulldozer or Endloader; Grader or Motor Patrol; 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; Manhoist or Elevator; Material or Stack Hoist; Trencher; Sideboom; Post Hole Digger or Driver; Tug or Launch (Not Performing Work on the Great Lakes) Future Increase(s):	28.59	16.00	44.59
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 Ton or Under); Broom or Sweeper; Hoist (Tugger); Environmental Burner	22.98	6.02	29.00
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; High Pressure Utility Locating Machine (daylighting machine). Oiler; Forklift	24.89	16.49	41.38
	24.89	15.40	40.29

LOCAL STREET OR MISCELLANEOUS PAVING CONSTRUCTION

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

Bricklayer, Blocklayer or Stonemason	30.23	6.44	36.67
Carpenter	26.11	12.86	38.97
Cement Finisher	25.87	12.28	38.15
Electrician	28.97	19.18	48.15
Fence Erector	21.50	3.00	24.50
Ironworker Future Increase(s): Add \$2.00 6/2/2008; Add \$2.00 6/1/2009; Add \$ 2.00 6/7/2010.	28.96	18.14	47.10
Line Constructor (Electrical)	31.99	13.94	45.93
Painter	19.00	9.91	28.91
Pavement Marking Operator	23.46	9.45	32.91
Piledriver	26.76	11.36	38.12
Roofer or Waterproofer	26.70	3.62	30.32

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>
	\$	\$	\$
Teledata Technician or Installer	20.30	10.01	30.31
Tuckpointer, Caulker or Cleaner	20.98	6.02	27.00
Underwater Diver (Except on Great Lakes)	31.90	11.44	43.34
Heavy Equipment Operator - ELECTRICAL LINE CONSTRUCTION ONLY	27.86	0.00	27.86
Light Equipment Operator -ELECTRICAL LINE CONSTRUCTION ONLY	25.33	12.35	37.68
Heavy Truck Driver - ELECTRICAL LINE CONSTRUCTION ONLY	22.16	11.18	33.34
Light Truck Driver - ELECTRICAL LINE CONSTRUCTION ONLY	20.58	10.71	31.29
Groundman - ELECTRICAL LINE CONSTRUCTION ONLY	17.41	9.80	27.21

TRUCK DRIVERS

Single Axle or Two Axle	15.48	6.59	22.07
Three or More Axle	17.10	8.96	26.06
Articulated, Euclid, Dumptor, Off Road Material Hauler Future Increase(s):	28.59	16.00	44.59
Pavement Marking Vehicle	19.26	10.94	30.20
Shadow or Pilot Vehicle	15.48	6.59	22.07
Truck Mechanic	12.50	0.00	12.50

LABORERS

General Laborer	22.53	10.10	32.63
Landscaper	14.50	5.53	20.03
Flagperson or Traffic Control Person	15.89	12.12	28.01
Fiber Optic Laborer (Outside, Other Than Concrete Encased)	14.25	1.20	15.45
Railroad Track Laborer	17.50	7.00	24.50

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

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 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.	30.62	16.00	46.62
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; Caisson Rig; Pile Driver; Dredge (Not Performing Work on the Great Lakes) Future Increase(s): Add \$1.65 on 6/1/08	29.47	15.95	45.42
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	28.97	15.95	44.92

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>
	\$	\$	\$
Subgrader; Concrete Spreader; Concrete Paver; Concrete Grinder or Planing Machine; Concrete Conveyor System; Concrete Slipform Placer; Curb and Gutter Machine; Air Track, Rotary or Percussion Drilling Machine; Straddle Carrier or Travel Lift; Trencher; Post Hole Digger or Driver; Tug or Launch (Not Performing Work on the Great Lakes) Future Increase(s): Add \$1.65 on 6/1/08			
Farm or Industrial Type Tractor; Greaser; Compactor (Self-Propelled); Concrete Saw (Vermeer Type); Concrete Bump Cutter or Grooving Machine; Tining or Curing Machine; Environmental Burner	27.71	15.35	43.06
Oilier; Crusher, Screening or Wash Plant; Air Compressor; Generator; Pump (3 Inch or Over) or Well Points; Forklift; Skid Steer Loader (With or Without Attachments); Skid Rig; Stump Chipper; Mulcher; Vibratory Hammer or Extractor Future Increase(s): Add \$1.65 on 6/1/08	28.71	15.95	44.66
Fiber Optic Cable Equipment	18.50	1.45	19.95

**HEAVY EQUIPMENT OPERATORS
ASPHALT PAVEMENT OR OTHER 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	29.62	15.40	45.02
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; Caisson Rig; Pile Driver; Dredge (Not Performing Work on the Great Lakes) Future Increase(s): Add \$2.05/hr on 6/1/2008 Premium Pay: Crane Operators with CCO certification add \$.35/hr. Add addn'l \$.15/hr 6/1/2007. Cranes with boom legnth over 200ft. not exceeding 300 ft. OR lifting capacity over 200 ton not exceeding 300 ton add \$.50/hr. Over 300 ton OR 300 ft. add \$.01/hr. per foot OR ton whichever is greater.	32.51	16.45	48.96
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 Breaker (Manual or Remote); Power Subgrader; Concrete Grinder or Planing Machine; Concrete Slipform Placer; Curb and Gutter Machine; Asphalt Plant; Asphalt Paver; Asphalt Screed; Asphalt Milling Machine; Roller (Over 5 Ton); Shouldering Machine; Trencher; Post Hole Digger or Driver Future Increase(s):	28.59	16.00	44.59
Farm or Industrial Type Tractor; Greaser; Compactor (Self-Propelled); Roller (5 Ton or Under); Broom or Sweeper; Environmental Burner Future Increase(s): Add \$1.65 on 6/1/2008; Add \$1.50 on 6/1/2009.	28.42	15.60	44.02
Oilier; Crusher, Screening or Wash Plant; Air Compressor; Generator; Pump (3 Inch or Over) or Well Points; Forklift; Skid Steer Loader (With or Without Attachments); Skid Rig; Stump Chipper; Mulcher; Vibratory Hammer or Extractor	25.52	16.38	41.90
Fiber Optic Cable Equipment	25.33	12.35	37.68

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) 266-0028.

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

February 1, 2007

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 subcontract 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 Mike Dixon, Equal Rights Division, P. O. Box 8928, Madison, WI 53708 or call (608) 266-0028. 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>
Bay Asphalt, Inc.	1792 Scray Hill Road De Pere, WI 54115	1/1/03	12/31/05	1, 2 and 4	1997- 1999	None
Bechitsao, Joel	See Tri-State Traffic Services, Inc.					
B.P. Phillips Construction, Inc.	1570 Fire Lane Drive Green Bay, WI 54311	9/19/01	9/18/04	1, 2 and 4	4/7/97 to 3/7/98	None
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
Haim, James	See Haim Painting, Inc.					

<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>
Haim Painting, Inc.	N15 W22120 Jerico Drive, #8 Waukesha, WI 53186	4/1/01	3/31/04	1, 2 and 4	7/6/97 to 10/30/98	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
Jacobi, Sandi	See Wisconsin Detention Systems, Inc.					
Jacobi Sr., Michael A.	See Wisconsin Detention Systems, Inc.					
Joseph Stoller Company	N8426 Hwy 42	2/1/2007	1/31/2010	1, 2	2004 and 2005	None
J. R. Electric	2391 233 rd St., P. O. Box 491, Cushing, WI 54006	1/1/03	12/31/05	1 and 2	1999	None
J. R. Electric, Inc.	2391 233 rd St., P. O. Box 491, Cushing, WI 54006	1/1/03	12/31/05	1 and 2	1999	None
Keiver, David	See Custom Heating & Air LLC	12/1/06	11/30/09	1, 2 and 4	2003 and 2004	None
Kletschka, Richard	See J. R. Electric and J. R. Electric, Inc.					
Kletschka, Tristan	See J. R. Electric, Inc.					
Kruczek Construction, Inc.	3636 Kewaunee Road, Green Bay, WI 54311	6/1/05	11/30/05	1 and 2	1998 and 1999	None
Kruczek, John	See Kruczek Construction, Inc.					
LaCosse, Todd	See Midwest Contractors, Inc.					

<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>
Maria, Steve	See Gibraltar Construction LLC					
Mellendez, Odilion	See Amigo Painting					
Midwest Contractors, Inc.	2100 Depot St., Holt, MI 48842	6/21/02	6/20/05	1	6/11/99 to 12/31/99	None
Nevels, Betty	See D. C. Nevels Truckng, Inc.					
Nevels, Donald	See D. C. Nevels Trucking, Inc.					
Phillips, Bruce P.	See B.P. Phillips Construction					
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
Scandia Heating and Air Conditioning, Inc.	P. O. Box 7 Scandia, MN. 55703	5/1/2003	4/30/2004	1 and 2	2001	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

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

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

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

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

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. As-Built 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 the remodel of The Dane County Job Center. This will include HVAC, electrical and carpeting.
- B. Work by Owner:
 - 1. County will perform the roofing work. New Roof Top Units will be flashed. Open penetrations resulting from removal of existing roof top units will be patched. Any damage to existing roofing shall be the responsibility of the General Contractor.
 - 2. New Electrical Switchboard shall be provided by the County. The Switchboard shall be completely installed by the contractor. The switchboard will be manufactured by Square D Company and will be a Power Style QED-2, rated at 2,000 amps, shipped in three (3) sections with a total weight 2,705 lbs. Switchboard will be 126" long, 24" deep and 91.5" high. Breakers are indicated on the drawings.
- 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 others and work 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: Refer to Bid Form

1.6 COORDINATION

- A. Coordinate scheduling, submittals, and work of various sections of Specifications to assure efficient and orderly sequence of installation of interdependent construction elements.
- B. Verify utility requirement characteristics of operating equipment are compatible with building utilities.
- C. Coordinate space requirements and installation of mechanical and electrical work that are indicated diagrammatically on Drawings.

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 one (1) per week.
- B. Owner 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. Arrange for temporary parking areas to accommodate construction personnel. Parking shall be available at the Work site.

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 (8:00 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.

- 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 Project Manager at 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 up to seven (7) days prior to date of Bid Opening.
- 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 manual and 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 AS-BUILT DRAWINGS AND SPECIFICATIONS

- A. Contractor-produced Drawings and Specifications shall remain property of Contractor whether Project for which they are made is executed or not. Contractor shall furnish Public Works Project Engineer with original tracings of drawings and prints of specifications in reproducible format, one set of Drawings and Specifications and one set of as-built drawings in AutoCAD 2007 (or lower) format and entire specification in Word 2000 (or lower) format on CD.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

1 **SECTION 01 23 00 - ALTERNATES**

2
3 **PART 1 - GENERAL**

4
5 1.1 RELATED DOCUMENTS:

- 6
7 A. Applicable provisions of Division 1 shall govern work under this Section.
8

9 1.2 SUMMARY:

- 10
11 A. This Section includes administrative and procedural requirements governing Alternates.
12

13 1.3 DEFINITIONS:

- 14
15 A. Sum to incorporate the Alternate into the work. No other adjustments are made to the
16 Contract Sum.
17

18 1.4 PROCEDURES:

- 19
20 A. Coordination: Modify or adjust affected adjacent work as necessary to completely and
21 fully integrate that work into the project.
22
23 B. Include as part of each alternate, miscellaneous devices, accessory objects, and similar
24 items incidental to or required for a complete installation whether or not mentioned as
25 part of the Alternate.
26
27 C. Notification: Immediately following the award of the Contract, notify each party involved,
28 in writing, of the status of each alternate. Indicate whether alternates have been
29 accepted, rejected, or deferred for later consideration. Include a complete description of
30 negotiated modifications to alternates.
31
32 D. Execute accepted alternates under the same conditions as other work of this contract.
33
34 E. Schedule: A "Schedule of Alternates" is included at the end of this section. Each
35 alternate is defined by abbreviated language, recognizing that drawings and specification
36 sections document the requirements.
37
38

39 **PART 2 - PRODUCTS**

40
41 Not applicable
42
43

44 **PART 3 - EXECUTION**

45
46 3.1 SCHEDULE OF ALTERNATES:

- 47
48 Alternate No. 1 (DEDUCT): Base bid requires that all existing light fixtures have new
49 ballasts and lamps installed to replace existing. Provide a unit cost per fixture for
50 not replacing existing ballasts and lamps in fixtures that have been recently re-
51 ballasted and re-lamped by Owner.

1
2 Alternate No. 2 (ADD): Add for the removal of the 3 existing parking area post lights and the
3 complete installation of the 3 new post lights as indicated on sheet numbers E1 and E2,
4 Sheet Note 6.
5
6
7 END SECTION 01 23 00

SECTION 01 50 80 - 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 01000 - Basic Requirements

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

1 **SECTION 02 41 19 - SELECTIVE DEMOLITION**

2
3 **PART 1 - GENERAL**

4
5 1.1 RELATED DOCUMENTS:

- 6
7 A. Applicable provisions of Division 1 shall govern work under this Section.
8

9 1.2 SUMMARY:

- 10
11 A. This Section includes the following:

- 12
13 1. Demolition and removal of selected portions of building.
14 2. Patching and repair procedures for selective demolition operations.
15

- 16 B. Related Sections including the following:

- 17
18 1. Division 1 Section "Summary of Work" for use of the premises and phasing
19 requirements.
20 2. Division 1 Section "Basic Requirements", Cutting and Patching for cutting and
21 patching procedures for selective demolition operations.
22

23 1.3 MATERIALS OWNERSHIP:

- 24
25 A. Except for items or materials indicated to be reused, salvaged, or otherwise indicated to
26 remain the Owner's property, demolished materials shall become the Contractor's
27 property and shall be removed from the site.
28

29 1.4 SUBMITTALS:

- 30
31 A. Schedule: Submit proposed methods and operations of building demolition to Architect
32 for review prior to start of work. Include in schedule coordination for shut-off, capping and
33 continuation of utility services as required.
34
35 B. Provide a detailed sequence of demolition and removal work to ensure uninterrupted
36 progress of Owner's on-site operations.
37
38 C. Inventory of items to be removed and salvaged.
39
40 D. Inventory of items to be removed by the Owner.
41

42 1.5 QUALITY ASSURANCE:

- 43
44 A. Demolition personnel qualifications: Engage an experienced person or persons that has
45 experience in demolition work similar in material and extent to that indicated for this
46 Project.
47
48 B. Regulatory Requirements: Comply with governing EPA notification regulations and State
49 requirements before starting demolition Work. Comply with hauling and disposal
50 regulations of authorities having jurisdiction.
51

1 1.6 PROJECT CONDITIONS:
2

- 3 A. Owner will occupy portions of the building immediately adjacent to selective demolition
4 area. Conduct selective demolition so that Owner's operations will not be disrupted.
5 Provide not less than seven (7) calendar days notice to Owner of activities that will affect
6 Owner's operations.
7
- 8 B. Materials and equipment to be removed and not required to be reused will be reviewed
9 by Owner for salvage. Items which Owner does not wish to retain shall be removed from
10 the site by the Contractor. Items to be retained shall be stored at job site where directed
11 by Owner.
12
- 13 C. Condition of Structures: The Owner assumes no responsibility for actual condition of
14 structures to be demolished. Conditions existing at time of inspection for bidding
15 purposes will be maintained by Owner insofar as practicable. However, variations within
16 structure may occur by Owner's removal and salvage operations prior to start of
17 demolition work.
18
- 19 D. Demolition: Items of salvable value to Contractor may be removed from structure as work
20 progresses. Salvaged items must be transported from site as they are removed. Storage
21 or sale of removed items on site will not be permitted.
22
- 23 E. Maintain access to existing walkways, corridors, and other adjacent occupied or used
24 facilities.
25
- 26 1. Do not close or obstruct walkways, corridors, or other occupied or used facilities
27 without written permission from authorities having jurisdiction.
28
- 29 F. Hazardous Materials: It is not expected that hazardous materials will be encountered in
30 the Work.
31
- 32 1. Hazardous materials will be removed by Owner before start of the Work.
33 2. If materials suspected of containing hazardous materials are encountered, do not
34 disturb; immediately notify Architect and Owner. Hazardous materials will be
35 removed by Owner under a separate contract.
36

37
38 **PART 2 - PRODUCTS**

39 Not applicable
40
41

42
43 **PART 3 - EXECUTION**

44
45 3.1 EXAMINATION:

- 46 A. Verify that utilities have been disconnected and capped.
47
48 B. Survey existing conditions and correlate with requirements indicated to determine extent
49 of demolition required.
50
51 C. Inventory and record the condition of items to be removed and reinstalled and items to be
52 removed and salvaged.
53
54 D. Survey the condition of the building to determine whether removing any element might
55

1 result in a structural deficiency or unplanned collapse of any portion of the structure or
2 adjacent structures during demolition.

- 3
4 E. Perform surveys as the Work progresses to detect hazards resulting from demolition
5 activities.
6
7 F. When unanticipated mechanical, electric, or structural elements that conflict with intended
8 function or design are encountered, investigate and measure the nature and extent of
9 conflict. Notify the Architect of the conditions prior to proceeding with demolition.

10
11 3.2 UTILITY SERVICES:

- 12
13 A. Maintain existing utilities indicated to remain, keep in service and protect against damage
14 during demolition operations.
15
16 1. Do not interrupt existing utilities serving occupied or operating facilities, except
17 when authorized in writing by the Owner and authorities having jurisdiction.
18 Provide temporary services during interruptions to existing utilities, as acceptable
19 to the Owner and to authorities having jurisdiction.
20 2. Provide at least 72 hours notice to Owner if shutdown of service is required
21 during changeovers.
22
23 B. Owner will disconnect and seal utilities serving areas to be demolished, prior to start of
24 demolition work, upon written request of Contractor.
25
26 1. Owner will shut-off utilities serving each areas to be demolished. Disconnecting
27 and sealing indicated utilities before starting demolition operations is part of this
28 work.
29
30 B. The Contractor shall disconnect and seal utilities serving each area to be demolished,
31 prior to start of demolition work. The Contractor shall arrange to shut off indicated utilities
32 with utility companies.
33
34 C. Refer to Division 21, 22, 23 and 26 Sections for shutting off, disconnecting, removing,
35 and sealing or capping utility services. Do not start demolition work until utility
36 disconnecting and sealing have been completed and verified in writing.
37

38 3.3 PREPARATION:

- 39
40 A. Traffic: Conduct demolition operations and removal of debris to ensure minimum
41 interference with roads, streets, walks and other adjacent occupied or used facilities.
42
43 B. Do not close or obstruct streets, walks or other occupied or used facilities without
44 permission from Owner and authorities having jurisdiction. Provide alternate routes
45 around closed or obstructed traffic ways if required by governing regulations.
46
47 C. Protection: Ensure safe passage of persons around area of demolition. Conduct
48 operations to prevent injury to adjacent buildings, structures, other facilities and persons.
49
50 1. Erect temporary protection, such as walks, fences, canopies, and covered
51 passageways as required by authorities having jurisdiction.
52 2. Provide interior and exterior shoring, bracing or support to prevent movement,
53 settlement or collapse of structures to be demolished and adjacent facilities to
54 remain. Strengthen or add new supports when required during progress of
55 selective demolition.

3. Provide temporary weather protection, during intervals between demolition and removal of existing construction, on exterior surfaces and new construction to ensure that no water leakage or damage occurs to structure or interior areas.
4. Protect walls, ceilings, floors, and other existing finish work that are to remain and are exposed during selective demolition operations.
5. Cover and protect furniture, furnishings, and equipment that have not been removed.
6. Erect and maintain dustproof partitions and temporary enclosures to limit dust and dirt migration and to separate areas from fumes and noise. Insulate partitions to provide noise protection to occupied areas. Seal joints and perimeter. Equip partitions with dustproof doors and security locks. Weatherstrip openings in exterior walls. Construct partitions and temporary enclosures of fire-rated construction where required to maintain existing fire-separation and enclosures between areas.

3.4 POLLUTION CONTROLS:

- A. Pollution Controls: Use water mist, temporary enclosures and other suitable methods to limit spread of dust and dirt. Comply with governing regulations pertaining to environmental protection.
 1. Do not use water when it may damage existing construction or create hazardous or objectionable conditions, such as ice, flooding, and pollution.
- B. Clean adjacent structures and improvements of dust, dirt and debris caused by demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

3.5 SELECTIVE DEMOLITION:

- A. Perform demolition and removal of existing materials shown on drawings or required to facilitate accomplishment of new work. Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete Work within limitations of governing regulations and as follows:
 1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition work above each floor or tier before disturbing supporting members on the next lower levels.
 2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. To minimize disturbance of adjacent surfaces, use hand or small power tools designed for sawing or grinding, not hammering and chopping. Temporarily cover openings to remain.
 3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
 4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct or pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations. Maintain adequate ventilation when using cutting torches.
 5. Remove decayed, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
 6. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
 7. Locate selective demolition equipment throughout the structure and remove

- 1 debris and materials so as not to impose excessive loads on supporting walls,
2 floors, or framing.
3 8. Dispose of demolished items and materials promptly. On-site storage or sale of
4 removed items is prohibited.
5 9. Return elements of construction and surfaces to remain to condition existing
6 before start of selective demolition operations.
7
8 B. Demolish concrete and masonry in small sections. Cut concrete and masonry at
9 junctures with construction to remain, using power-driven masonry saw or hand tools; do
10 not use power driven impact tools.
11
12 C. Break up and remove concrete slabs on grade indicated to be removed.
13
14 D. Remove no more existing roofing than can be covered in one day by new roofing. See
15 applicable Division 7 Section for new roofing requirements.
16

17 3.6 PATCHING AND REPAIRS:

- 18
19 A. Promptly patch and repair holes and damaged surfaces caused to adjacent construction
20 by selective demolition operations.
21
22 B. Where repairs to existing surfaces are required, patch to produce surfaces suitable for
23 new materials. Completely fill holes and depressions in existing masonry walls to remain
24 with an approved masonry patching material, applied according to manufacturer's printed
25 recommendations.
26
27 C. Restore exposed finishes of patched areas and extend finish restoration into adjoining
28 construction to remain in a manner that eliminates evidence of patching and refinishing.
29
30 D. Patch and repair floor and wall surfaces in the new spaces where demolished walls or
31 partitions extend one finish area into another. Provide a flush and even surface of
32 uniform color and appearance.
33
34 1. Closely match texture and finish of existing adjacent surface. Patch with durable
35 seams that are as invisible as possible. Comply with specified tolerances.
36 2. Where patching smooth painted surfaces, extend final paint coat over entire
37 unbroken surface containing the patch after the surface has received primer and
38 second coat.
39 3. Remove existing floor and wall coverings and replace with new materials, if
40 necessary, to achieve uniform color and appearance.
41
42 E. Patch, repair, or rehang existing ceilings as necessary to provide an even-plane surface
43 of uniform appearance.
44

45 3.7 DISPOSAL:

- 46
47 A. Remove demolition debris from project site daily. Do not allow demolished materials to
48 accumulate on-site. Transport demolished materials off Owner's property and legally
49 dispose of them.
50
51 B. Do not store or burn materials on site.
52

53 3.8 CLEANUP:

- 54
55 A. Remove tools, materials, plant, apparatus and rubbish of any sort upon completion.

- 1
- 2 B. Sweep the building broom clean on completion of selective demolition operations.
- 3
- 4 END SECTION 02 41 19

1 **SECTION 03 30 00 - CAST-IN-PLACE CONCRETE**

2
3 **PART 1 - GENERAL**

4
5 1.1 SCOPE

- 6
7 A. Concrete for interior equipment pads.

8
9 1.2 SECTION REQUIREMENTS:

- 10
11 A. Submit Concrete mix designs.
12
13 B. Comply with ASTM C 94; ACI 301, "Specifications for Structural Concrete for Buildings";
14 ACI 318, "Building Code Requirements for Structural Concrete"; and CRSI's "Manual of
15 Standard Practice."
16

17
18 **PART 2 - PRODUCTS**

19
20 2.1 MATERIALS:

- 21
22 A. Deformed Reinforcing Bars: ASTM A 615, Grade 60).
23
24 B. Welded Steel Wire Fabric: ASTM A 185, flat sheets, not rolls.
25
26 C. Portland Cement: ASTM C 150, Type 1.
27
28 D. Fly Ash: ASTM C 618, Type F.
29
30 E. Aggregates: ASTM C 33, Class 4S.
31
32 F. Fiber Reinforcement: ASTM C 1116, Type III, engineered polypropylene fibers.
33
34 G. Air-Entraining Admixture: ASTM C 260.
35
36 H. Chemical Admixtures: ASTM C 494, water reducing and retarding.
37
38 I. Water Stops: Flat dumbbell or center-bulb type, of either rubber (CRD C 513) or PVC
39 (CRD C 572).
40
41 J. Vapor Retarder: Clear 8-mil-thick polyethylene.
42
43 K. Liquid Membrane-Forming Curing Compound: ASTM C 309, clear, Type I, Class A or B,
44 solvent borne, wax free.
45
46 L. Nonslip Aggregate: Factory-produced, rustproof, nonglazing, fused aluminum-oxide
47 granules or crushed emery, unaffected by freezing, moisture, and cleaning materials.
48

49 2.2 MIXES:

- 50
51 A. Proportion normal-weight concrete mixes to provide the following properties for interior
52 equipment pads:

- 1
 - 2
 - 3
 - 4
 - 5
 - 6
 - 7
 - 8
 - 9
 - 10
 - 11
 - 12
 - 13
 - 14
 - 15
 - 16
 - 17
 - 18
 - 19
 - 20
 - 21
 - 22
 - 23
 - 24
 - 25
 - 26
 - 27
 - 28
 - 29
 - 30
 - 31
 - 32
 - 33
 - 34
 - 35
1. Compressive Strength: 3000 psi at 28 days.
 2. Aggregate size: 0.75-inch, maximum.
 3. Slump Limit: 3 inches at point of placement.
 4. Water-Cement Ratio: 0.55 maximum at point of placement.

PART 3 - EXECUTION

3.1 CONCRETING:

- A. Construct formwork and maintain tolerances and surface irregularities within ACI 117 limits of Class A for concrete exposed to view and Class C for other concrete surfaces.
- B. Accurately position, support, and secure reinforcement.
- C. Formed Surface Finish: Smooth-formed finish for concrete exposed to view, coated, or covered by waterproofing or other direct-applied material.
- D. Uniformly spread 25 lb/100 sq. ft. of dampened nonslip aggregate over float-finished paving surface, tamp, and expose nonslip aggregate.
- E. Apply dry-shake color hardener to float finished surface, repeating float finishing to embed each application. Apply final float.
- F. Cure formed surfaces by moist curing until forms are removed.
- G. Begin curing unformed concrete after finishing.
- H. Owner will engage a testing agency to perform tests and to submit test reports.
- I. Protect concrete from damage. Repair surface defects in concrete.

END OF SECTION 03 30 00

1 **SECTION 05 30 00 - METAL DECKING**

2
3 **PART 1 - GENERAL**

4
5 1.1 RELATED DOCUMENTS:

- 6
7 A. Applicable provisions of Division 1 shall govern work under this Section.
8

9 1.2 DESCRIPTION OF WORK:

- 10
11 A. The extent of metal decking is patching of roof openings as shown on the drawings,
12 including basic layout and type of deck units required.
13

14 1.3 QUALITY ASSURANCE:

- 15
16 A. Codes and Standards: Comply with provisions of the following codes and standards,
17 except as otherwise shown or specified:
18
19 1. AISI "Specification for the Design of Cold-Formed Steel Structural Members".
20 2. AWS "Structural Welding Code".
21 3. SDI "Design Manual for Floor Decks and Roof Decks".
22
23 B. Qualification of Field Welding: Qualify welding processes and welding operators in
24 accordance with AWS "Standard Qualification Procedure".
25

26 1.4 PERFORMANCE REQUIREMENTS:

- 27
28 A. Uplift Loading: Install and anchor roof deck units to resist gross uplift loading of 45
29 pounds per square feet at eave overhang and 30 pounds per square feet for other roof
30 areas.
31
32 B. Underwriters' Label: Provide metal floor deck units listed in Underwriters' Laboratories
33 "Fire Resistance Directory", with each deck unit bearing the UL label and marking for
34 specific system detailed.
35
36 C. Provide cellular floor deck units listed in UL "Electrical Construction Materials List" with
37 each cellular metal floor deck unit bearing UL labels and marking. Provide units which will
38 permit use of standard header ducts and outlets for electrical distribution systems.
39

40 1.5 SUBMITTALS:

- 41
42 A. Product Data: Submit manufacturer's specifications and installation instructions for each
43 type of decking and accessories. Include manufacturer's certification as may be required
44 to show compliance with these specifications.
45
46 B. Shop Drawings: Submit detailed drawings showing layout and types of deck panels,
47 anchorage details, and conditions requiring closure panels, supplementary framing, sump
48 pans, cant strips, cut openings, special jointing or other accessories.
49
50 C. Provide manufacturer's design calculations prepared, sealed, signed, and dated by a
51 Wisconsin registered Professional Engineer.

1
2
3 **PART 2 - PRODUCTS**
4

5 2.1 MATERIALS:
6

- 7 A. Steel for Galvanized Metal Deck Units: ASTM A 653/A 653M, Structural Steel, Grade 33,
8 G60 zinc coating. Galvanizing will conform to ASTM A 924.
9
10 B. Miscellaneous Steel Shapes: ASTM A 36.
11
12 C. Sheet Metal Accessories: ASTM A 526, commercial quality, galvanized.
13
14 D. Galvanizing: ASTM A 653/A 653M, G60.
15
16 E. Galvanizing Repair Paint: High zinc-dust content paint for repair of damaged galvanized
17 surfaces complying with Military Specifications MIL-P-21035 (Ships).
18
19 F. Paint: Manufacturer's baked-on, rust-inhibitive paint, for application to metal surfaces
20 which have been chemically cleaned and phosphate chemical treated.
21
22 G. Flexible Closure Strips: Manufacturer's standard vulcanized, closed-cell, synthetic rubber.
23
24 H. Powder-actuated Fasteners: Fasteners, appropriately sized for substrate thickness,
25 equal to Hilti, for installation with the DX 750 system.
26
27 I. Pneumatically attached Fasteners: Fasteners, appropriately sized for substrate thickness
28 (maximum 3/8"), equal to Hilti.
29

30 2.2 FABRICATION:
31

- 32 A. General: Form deck units in lengths to span 3 or more supports, with flush, telescoped or
33 nested 2 inch laps at ends and interlocking or nested side laps, unless otherwise
34 indicated.
35
36 B. Roof Deck Units: Provide deck configurations complying with SDI "Roof Deck
37 Specifications", of metal thickness, depth and width as shown.
38
39 C. Metal Cover Plates: Fabricate metal cover plates for end-abutting floor deck units of not
40 less than same thickness as decking. Form to match contour of deck units and
41 approximately 6 inches wide.
42
43 D. Metal Closure Strips: Fabricate metal closure strips, for cell raceways and openings
44 between decking and other construction, of not less than 0.045 inch min. (18 gage) sheet
45 steel. Form to provide tight-fitting closures at open ends of cells or flutes and sides of
46 decking.
47
48

49 **PART 3 - EXECUTION**
50

51 3.1 INSPECTION:
52

- 53 A. Installer must examine areas and conditions under which metal decking is to be installed
54 and notify Contractor in writing of conditions detrimental to proper and timely completion

1 of work. Do not proceed with work until unsatisfactory conditions have been corrected in
2 a manner acceptable to Installer.

3
4 3.2 INSTALLATION:

5
6 A. General:

- 7
8 1. Install deck units and accessories in accordance with manufacturer's
9 recommendations and final shop drawings, and as specified herein.
10 2. Place deck units on supporting steel framework and adjust to final position with
11 ends accurately aligned and bearing on supporting members before being
12 permanently fastened. Do not stretch or contract side lap interlocks.
13 3. Place deck units flat and square, secured to adjacent framing without warp or
14 excessive deflection.

15
16 B. Fastening Deck Units:

- 17
18 1. Fasten roof deck units to steel supporting members by not less than 5/8 inch
19 diameter fusion welds or elongated welds of equal strength, spaced not more
20 than 6 inches on center at end laps and at 12" at intermediate supports. See
21 drawings for closer spacing where required for lateral force resistance.
22 2. Roof deck may be attached using Powder-actuated or Pneumatic fasteners at
23 similar spacings to those noted in 3 above.
24 3. Comply with AWS requirements and procedures for manual shielded metal arc
25 welding, appearance and quality of welds, and methods used in correcting
26 welding work. Use welding washers where recommended by deck manufacturer.
27 4. Lock side laps of adjacent deck units between supports, at intervals not
28 exceeding 36 inches on center. Keep the interiors of cells that will be used as
29 raceways free of welds having sharp points or edges.
30 5. Cutting and Fitting: Cut and neatly fit deck units and accessories around other
31 work projecting through or adjacent to the decking, as shown.
32 6. Reinforcement at Openings: Provide additional metal reinforcement and closure
33 pieces as required for strength, continuity of decking and support of other work
34 shown.

35
36 C. Closure Strips:

- 37
38 1. Provide metal closure strips where required at open uncovered ends and edges
39 of roof decking, and in voids between decking and other construction. Weld into
40 position to provide a complete decking installation.
41 2. Provide flexible closure strips instead of metal closures, at Contractor's option,
42 wherever their use will ensure complete closure. Install with adhesive in
43 accordance with manufacturer's instructions.

44
45 D. Touch Up Painting: Cleaning and touch up painting of field welds, abraded areas and rust
46 spots, as required after erection and before proceeding with field painting, is included in
47 Division 9 under Painting.

48
49
50 END SECTION 05 30 00

1 **SECTION 05 50 00 - METAL FABRICATIONS**

2
3 **PART 1 - GENERAL**

4
5 1.1 RELATED DOCUMENTS:

- 6
7 A. Applicable provisions of Division 1 shall govern work under this Section.
8

9 1.2 DESCRIPTION OF WORK:

- 10
11 A. This section includes the following:

12 1. Miscellaneous framing and supports.

- 13
14 B. Related Sections:

15 1. Steel decking is specified in another section within Division 5.
16
17
18

19 1.3 QUALITY ASSURANCE:

- 20
21 A. Field Measurements: Take field measurements prior to preparation of shop drawings and
22 fabrication, where possible. Do not delay job progress; allow for trimming and fitting
23 where taking field measurements before fabrication might delay work.
24

- 25 B. Shop Assembly: Preassemble items in shop to greatest extent possible to minimize field
26 splicing and assembly. Disassemble units only as necessary for shipping and handling
27 limitations. Clearly mark units for reassembly and coordinated installation.
28

29 1.4 SUBMITTALS:

- 30
31 A. Shop Drawings:

32 1. Submit shop drawings for fabrication and erection of miscellaneous metal
33 fabrications. Include plans, elevations and details of sections and connections.
34 Show anchorage and accessory items. Provide templates for anchor and bolt
35 installation by others.
36

37 2. Where materials or fabrications are indicated to comply with certain requirements
38 for design loadings include structural computations, material properties and other
39 information needed for structural analysis.
40
41

42 **PART 2 - PRODUCTS**

43
44 2.1 MATERIALS:

- 45
46 A. Metals:

47
48 1. Metal Surfaces, General: For fabrication of miscellaneous metal work which will
49 be exposed to view, use only materials which are smooth and free of surface
50 blemishes including pitting, seam marks, roller marks, rolled trade names and
51 roughness.

52 2. Steel Plates, Shapes and Bars: ASTM A 36.

3. Structural Steel Sheet: Hot rolled, ASTM A 570 or cold rolled ASTM A 611, Class 1; of grade required for design loading.
4. Galvanized Structural Steel Sheet: ASTM A 653/A, of grade required for design loading.
5. Steel Pipe: ASTM A 53; Type and grade (if applicable) as selected by fabricator and as required for design loading; black finish unless galvanizing is indicated; standard weight (schedule 40), unless otherwise indicated.
6. Brackets, Flanges and Anchors' Cast or formed metal of the same type material and finish as supported rails, unless otherwise indicated.

B. Fasteners: (As Required)

1. General: Provide zinc coated fasteners for exterior use or where built into exterior walls. Selected fasteners for the type, grade and class required.
2. Bolts and Nuts: Regular hexagon head type, ASTM A 307, Grade A.
3. Lag Bolts: Square head type, FS FF-B-561.
4. Machine Screws: Cadmium plated steel, FS FF-S-92.
5. Wood Screws: Flat head carbon steel, FS FF-S-111.
6. Plain Washers: Round, carbon steel, FS FF-W-92.
7. Masonry Anchorage Devices: Expansion shields, FS FF-S-325.
8. Toggle Bolts: Tumble-wing type, FS FF-B-588, type, class and style as required.
9. Lock Washers: Helical spring type carbon steel, FS FF-W-84.

C. Primer Paint:

1. Shop Primer for Ferrous Metal: Fast-curing, lead and chromate-free, universal modified-alkyd primer complying with performance requirements in FS TT-P-664; selected for good resistance to normal atmospheric corrosion, compatibility with finish paint systems indicated, and capability to provide a sound foundation for field-applied topcoats despite prolonged exposure.
2. Do not apply primer to galvanized surfaces.
3. Galvanizing Repair Paint: High-zinc-dust-content paint for regalvanizing welds in galvanized steel, complying with SSPC-Paint 20.
4. Bituminous Paint: Cold-applied asphalt mastic complying with SSPC-Paint 12, except containing no asbestos fibers; or cold-applied asphalt emulsion complying with ASTM D 1187.

2.2 FABRICATION, GENERAL:

A. Workmanship:

1. Use materials of size and thickness shown or, if not shown, of required size and thickness to produce strength and durability in finished product. Work to dimensions shown or accepted on shop drawings, using proven details of fabrication and support. Use type of materials shown or specified for various components of work.
2. Form exposed work true to line and level with accurate angles and surfaces and straight sharp edges. Ease exposed edges to a radius of approximately 1/32 inch unless otherwise shown. Form bent metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
3. Weld corners and seams continuously, complying with AWS recommendations. At exposed connections, grind exposed welds smooth and flush to match and blend with adjoining surfaces.
4. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners wherever possible. Use exposed fasteners of type shown or, if not shown, Phillips flat-head (countersunk) screws or bolts.

- 1 5. Provide for anchorage of type shown, coordinated with supporting structure.
2 Fabricate and space anchoring devices to provide adequate support for intended
3 use.
4 6. Cut, reinforce, drill and tap miscellaneous work as indicated to receive finish
5 hardware and similar items.
6

7 B. Galvanizing:

- 8
9 1. Provide a zinc coating for those items shown or specified to be galvanized, as
10 follows:
11
12 a. ASTM A 153 for galvanizing iron and steel hardware.
13 b. ASTM A 123 for galvanizing both fabricated and unfabricated iron and
14 steel products made of uncoated rolled, pressed and forged shapes,
15 plates, bars and strip 22 gage, 0.0299 inch thick, or thicker.
16
17 2. Fabricate joints which will be exposed to weather in a manner to exclude water or
18 provide weep holes where water may accumulate.
19

20 C. Shop Painting:

- 21
22 1. Shop paint miscellaneous metal work, except members or portions of members
23 to be embedded in concrete or masonry, surfaces and edges to be field welded
24 and galvanized surfaces, unless otherwise specified.
25 2. Remove scale, rust and other deleterious materials before applying shop coat.
26 Clean off heavy rust and loose mills scale in accordance with SSPC Sp-2 "Hand
27 Tool Cleaning," or SSPC SP-3 "Power Tool Cleaning," or SSPC SP-7 "Brush-Off
28 Blast Cleaning."
29 3. Remove oil, grease and similar contaminants in accordance with SSC SP-1
30 "Solvent Cleaning."
31 4. Immediately after surface preparation, brush or spray on primer in accordance
32 with manufacturer's instructions and at a rate to provide uniform dry film
33 thickness of 2.0 mils for each coat. Use painting methods which will result in full
34 coverage of joints, corners, edges and exposed surfaces.
35 5. Apply one shop coat to fabricated metal items, except apply 2 coats of paint to
36 surfaces inaccessible after assembly or erection. Change color of second coat to
37 distinguish it from the first.
38

39 2.3 MISCELLANEOUS METAL FABRICATIONS:

40
41 A. Rough Hardware:

- 42
43 1. Furnish bent or otherwise custom bolts, plates, anchors, hangers, dowels and
44 other miscellaneous steel and iron shapes as required for framing and supporting
45 woodwork and for anchoring or securing woodwork to concrete or other
46 structures. Straight bolts and other stock rough hardware items are specified in
47 Division 6 sections.
48 2. Manufacturer or fabricate items of sizes, shapes and dimensions required.
49 Furnish malleable iron washers for heads and nuts which bear on wood structural
50 connections; elsewhere, furnish steel washers.
51

52 B. Miscellaneous Framing and Supports:

- 53
54 1. Provide miscellaneous steel framing and supports which are not a part of
55 structural steel framework, as required to complete work.
56 2. Fabricate miscellaneous units to sizes, shapes and profiles shown or, if not

- 1 shown, of required dimensions to receive adjacent work to be retained by
2 framing. Except as otherwise shown, fabricate from structural steel shapes and
3 plates and steel bars, of welded construction using mitered joints for field
4 connection. Cut, drill and tap units to receive hardware and similar items.
5 4. Galvanize miscellaneous frames and supports where indicated.
6
7

8 **PART 3 - EXECUTION**
9

10 3.1 PREPARATION:

- 11 A. Coordinate and furnish anchorages, setting drawings, diagrams, templates, instructions
12 and directions for installation of anchorages, such as concrete inserts, anchor bolts and
13 miscellaneous items having integral anchors.
14

15
16 3.2 INSTALLATION:

17 A. General:

- 18
19
20 1. Fastening to In-Place Construction: Provide anchorage devices and fasteners
21 where necessary for securing miscellaneous metal fabrications to in-place
22 construction; including, threaded fasteners for concrete and masonry inserts,
23 toggle bolts, through-bolts, lag bolts, wood screws and other connectors as
24 required.
25 2. Cutting, Fitting and Placement: Perform cutting, drilling and fitting required for
26 installation of miscellaneous metal fabrications. Set work accurately in location,
27 alignment and elevation, plumb, level, true and free of rack, measured from
28 established lines and levels. Provide temporary bracing for anchors in formwork
29 for items which are to be built into concrete, masonry or similar construction.
30 3. Fit exposed connections accurately together to form tight hairline joints. Weld
31 connections which are not to be left as exposed joints, but cannot be shop
32 welded because of shipping size limitations. Grind exposed joints smooth and
33 touch up shop paint coat. Do not weld, cut or abrade the surfaces of exterior
34 units which have been hot-dip galvanized after fabrication and are intended for
35 bolted or screwed field connections.
36 4. Field Welding: Comply with AWS Code for procedures of manual shielded metal
37 arc welding, appearance and quality of welds made and methods used in
38 correcting welding work.
39

40 3.3 ADJUST AND CLEAN:

- 41
42 A. Touch Up Painting: Immediately after erection, clean field welds, bolted connections and
43 abraded areas of shop paint and paint exposed areas with same material as used for
44 shop painting. Apply by brush or spray to provide a minimum dry film thickness of 2.0
45 mils.
46
47 B. For Galvanized Surfaces: Clean field welds, bolted connections and abraded areas and
48 apply 2 coats of galvanized repair paint, according to ASTM A 780.
49

50
51 END SECTION 05 50 00

1 **SECTION 06 10 00 - ROUGH CARPENTRY**

2
3 **PART 1 - GENERAL**

4
5 1.1 RELATED DOCUMENTS:

- 6
7 A. Applicable provisions of Division 1 shall govern work under this Section.
8

9 1.2 DESCRIPTION OF WORK:

- 10 A. This section includes the following.

- 11
12 1. Wood grounds, nailers and blocking.
13 2. Gypsum soffit panels.
14

- 15 B. Related Sections:

- 16 1. Architectural Woodwork is specified in another Division-6 section.
17

18
19
20 1.3 REFERENCES:

- 21 A. Lumber Standards: Comply with PS 20 and with applicable rules of the respective
22 grading and inspecting agencies for species and products indicated.
23

- 24 B. Plywood Product Standards: Comply with PS 1 (ANSI A 199.1) or, for products not
25 manufactured under PS 1 provisions, with applicable APA Performance Standard for type
26 of panel indicated.
27

28
29 1.4 SUBMITTALS:

- 30 A. Product Data: Submit manufacturer's specifications and installation instructions for
31 materials listed below:
32

- 33 1. Glass mat gypsum sheathing.
34

- 35 B. Material Certificates: Where dimensional lumber is provided to comply with minimum
36 allowable unit stresses, submit listing of species and grade selected for each use, and
37 submit evidence of compliance with specified requirements. Compliance may be in form
38 of assigned copy of applicable portion of lumber producer's grading rules showing design
39 values for selected species and grade. Design values shall be as approved by the Board
40 of Review of American Lumber Standards Committee.
41

- 42 C. Wood Treatment Data: Submit treatment manufacturer's instructions for proper use of
43 each type of treated material.
44

- 45 1. Pressure Treatment: For each type specified, include certification by treating
46 plant stating chemicals and process used, net amount of preservative retained
47 and conformance with applicable standards.
48 2. For waterborne preservatives include statement that moisture content of treated
49 materials was reduced to a maximum of 15 percent prior to shipment to project
50 site.
51 3. Fire-Retardant Treatment: Include certification by treating plant that treatment
52

1 material complies with governing ordinances and that treatment will not bleed
2 through finished surfaces.

3
4 1.5 PRODUCT HANDLING:

- 5
6 A. Delivery and Storage: Keep materials dry at all times. Protect against exposure to
7 weather and contact with damp or wet surfaces. Stack lumber and plywood and provide
8 air circulation within stacks.
9

10 1.6 PROJECT CONDITIONS:

- 11
12 A. Coordination: Fit carpentry work to other work; scribe and cope as required for accurate
13 fit. Correlate location of furring, nailers, blocking, grounds and similar supports to allow
14 proper attachment of other work.
15
16 B. Provide fire treated nailers, panels, blocking, grounds and sleepers in all locations
17 necessary to comply with code requirements for applicable class of construction.
18
19

20 **PART 2 - PRODUCTS**

21
22 2.1 MATERIALS:

23
24 A. Lumber, General:

- 25
26 1. Factory mark each piece of lumber with type, grade, mill and grading agency,
27 except omit marking from surfaces to be exposed with transparent finish or
28 without finish.
29 2. Nominal sizes are indicated, except as shown by detail dimensions. Provide
30 actual sizes as required by PS 20, for moisture content specified for each use.
31
32 a. Provide dressed lumber, S4S, unless otherwise indicated.
33 b. Provide seasoned lumber with 19 percent maximum moisture content at
34 time of dressing.
35 c. Provide unseasoned lumber with moisture content in excess of 19
36 percent allowed at time of dressing.
37

38 B. Miscellaneous Lumber:

- 39
40 1. Provide wood for support or attachment of other work including cant strips, buck,
41 nailers, blocking, furring, grounds, stripping and similar members. Provide lumber
42 of sizes shown or specified, worked into shapes shown and as follows:
43
44 a. Moisture content: 15 percent maximum for lumber items not specified to
45 receive wood preservative treatment.
46
47 2. Grade: Construction Grade light framing size lumber of any species or board size
48 lumber as required. Provide construction grade boards (RIS or WCLB) or No. 2
49 boards (SPIB or WWPA).
50

51 C. Plywood:

- 52
53 1. Trademark: Identify each plywood panel with appropriate APA trademark.
54 2. Plywood Backing Panels: For mounting electrical or telephone equipment, or
55 backing in walls for architectural components, provide fire-retardant treated
56 plywood panels with grade designation, APA C-D PLUGGED INT with exterior

1 glue, in thickness indicated or, if not otherwise indicated, not less than 1/2 inch.

2
3 D. Gypsum Soffit panels: Provide 1/2 inch (for 16 inches on center framing) 5/8 inch (for 24
4 inches on center framing) thick gypsum board complying with ASTM C 1177 and the
5 following:

- 6
7 1. Water-repellent treated core with water absorption of less than 10 percent by
8 weight after 2 hour immersion (ASTM C 473), and fiberglass surface on face and
9 back.
10 2. Sizes and Edges: 4 feet wide, not less than 8 feet long, with square edges on
11 sides.
12 3. Identical to Georgia Pacific "Tough Rock."

13
14 E. Miscellaneous Materials:

- 15
16 1. Fasteners and Anchorages: Provide size, type, material and finish as indicated
17 and as recommended by applicable standards, complying with applicable
18 Federal Specifications for nails, staples, screws, bolts, nuts, washers and
19 anchoring devices. Provide metal hangers and framing anchors of the size and
20 type recommended by the manufacturer for each use including recommending
21 nails. Where rough carpentry work is exposed to weather, in ground contact,
22 associated with roofing work, or in areas of high relative humidity provide
23 fasteners and anchorages with a hot-dip zinc (ASTM A 153).
24 2. Finishing Compound for Gypsum Soffits: Provide 90/45 Setting Compound for
25 finishing of heads and joints.
26 3. Weather Resistive Barriers:
27
28 a. Building Paper: Asphalt saturated felt, nonperforated, ASTM D 226, Type
29 I, 15 pound type.
30

31 2.2 WOOD TREATMENT:

32
33 A. Preservative Treatment: Where lumber or plywood is indicated as "Trt-Wd" or "Treated"
34 or is specified herein to be treated, comply with applicable requirements of AWPA
35 Standards C2 (Lumber) and C9 (Plywood). Mark each treated item with the Quality Mark
36 Requirements of and inspection agency approved by ALSC's Board of Review. Do not
37 use chemicals containing chromium or arsenic.

- 38
39 1. Pressure-treat above ground items with waterborne preservatives to a minimum
40 retention of 0.25 pound/cubic foot. After treatment, kiln dry lumber and plywood
41 to a maximum moisture content of 19 percent and 15 percent respectively. Treat
42 indicated items and the following:
43
44 a. Wood cants, nailers, curbs, blocking, stripping and similar members in
45 connection with roofing, flashing, vapor barriers and waterproofing.
46
47 2. Pressure-treat the following with waterborne preservatives to a minimum
48 retention of 0.40 pound/cubic foot:
49
50 a. Wood members in contact with fresh water.
51
52 3. Complete fabrication of treated items prior to treatment, where possible. If cut
53 after treatment, apply field treatment complying with AWPA M4 to cut surfaces.
54

55 B. Fire-Retardant Treatment: Where "FR-S" lumber or plywood is specified or otherwise
56 indicated provide materials which comply with AWPA standards for pressure

1 impregnation with fire-retardant chemicals and which have a flame spread rating of not
2 more than 25 when tested in accordance with UL Test 723 or ASTM E 84 and show no
3 increase in flame spread and significant progressive combustion upon continuation of test
4 for additional 20 minutes.

- 5
- 6 1. Where treated items are exposed on exterior or to high humidities or are to have
7 a transparent finish in form of stain or sealer, provide materials which show no
8 change in fire-hazard classification when subjected to standard rain test (UL 790
9 or ASTM B 2898).
- 10 2. Use fire-retardant treatment which will not bleed through or adversely affect type
11 of finish indicated and which does not require brush treatment of field made end
12 cuts to maintain fire-hazard classification.
- 13 3. Where transparent finish is indicated use type of treatment and species which
14 permits milling of lumber after treatment without altering indicated fire-hazard
15 classification, as determined by fire testing.
- 16 4. Kiln dry treated items to maximum moisture content of 19 percent.
- 17 5. Provide UL label on each piece of fire-retardant lumber or plywood.

- 18
- 19 C. Inspect each piece of treated lumber or plywood after drying and discard damaged or
20 defective pieces.
- 21
- 22

23 **PART 3 - EXECUTION**

24 3.1 INSTALLATION:

25 A. General:

- 26
- 27
- 28
- 29 1. Discard units of material with defects which might impair quality of work and units
30 which are too small to fabricate work with minimum joints or optimum joint
31 arrangement.
- 32 2. Set carpentry work accurately to required levels and lines, with members plumb
33 and true and accurately cut and fitted.
- 34 3. Securely attach carpentry work to substrate by anchoring and fastening as
35 shown and as required by recognized standards. Countersink nail heads on
36 exposed carpentry work and fill holes.
- 37 4. Use common wire nails, except as otherwise indicated. Use finishing nails for
38 finish work. Select fasteners of size that will not penetrate members where
39 opposite side will be exposed to view or will receive finish materials. Make tight
40 connections between members. Install fasteners without splitting of wood; predrill
41 as required.
- 42

43 B. Wood Grounds, Nailers and Blocking:

- 44
- 45 1. Provide wherever shown and where required for screeding or attachment of other
46 work. Form to shapes as shown and cut as required for true line and level of
47 work to be attached. Coordinate location with other work involved.
- 48 2. Attach to substrates as required to support applied loading. Countersink bolts
49 and nuts flush with surfaces, unless otherwise shown. Build into masonry during
50 installation of masonry work. Where possible, anchor to formwork before
51 concrete placement.
- 52 3. Provide permanent grounds of dressed, preservative treated, key-beveled lumber
53 not less than 1-1/2 inches wide and of thickness required to bring face of ground
54 to exact thickness of finish material involved.
- 55

56 K. Installation of Plywood:

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26

1. General: Comply with applicable recommendations contained in Form No. E 304, "APA Design/Construction Guide - Residential & Commercial," for types of plywood products and applications indicated.
2. Fastening Methods: Fasten panels as indicated below:
 - a. Plywood Backing Panels: Nail or screw to supports.

P. Gypsum Soffit Panels:

1. General: Provide gypsum soffit panels where shown. Fasten to exterior face of steel stud framing for exterior walls. Use manufacturers recommended fasteners not more than 4 inches on center around perimeter and 8 inches on center at intermediate supports. Keep perimeter fasteners 3/8 inch from edges and ends of board units. Fit boards tightly against each other and around openings.
2. Install 2 foot x 8 foot panels horizontally with long edges at right angles to studs with grooved edge down. Center end joints over supports and stagger in each course. Screw to each support in accordance with manufacturer's recommended spacing, but provide not less than 4 fasteners per 2 foot width per stud if framing is diagonally braced or not less than 7 fasteners per 2 foot width per stud if not braced.
4. Finish all joints in gypsum soffit panels and trowel flat. Apply sealant over every fastener to cover completely, then trowel flat.

END SECTION 06 10 00

1 **SECTION 07 54 00 - THERMOPLASTIC MEMBRANE ROOFING - Patching**

2
3 **PART 1 - GENERAL**

4
5 1.1 RELATED DOCUMENTS

- 6
7 A. Applicable provisions of the Agreement and Division 1 shall govern work of this section.
8

9 1.2 SUMMARY

- 10
11 A. This Section includes the following:

- 12
13 1. Adhered membrane roofing system.
14 2. Roof insulation.

- 15
16 B. Related Sections include the following:

- 17
18 1. Division 6 Section "Rough Carpentry" for wood nailers, curbs, and blocking.
19 2. Division 7 Section "Sheet Metal Flashing and Trim" for metal roof penetration
20 flashings, flashings, and counterflashings.
21 3. Division 7 Section "Roof Accessories."

22
23 1.2 DEFINITIONS

- 24
25 A. Roofing Terminology: Refer to ASTM D 1079 and glossary of NRCA's "The NRCA
26 Roofing and Waterproofing Manual" for definition of terms related to roofing work in this
27 Section.
28
29 B. Design Uplift Pressure: The uplift pressure, calculated according to procedures in SPRI's
30 "Wind Load Design Guide for Fully Adhered and Mechanically Fastened Roofing
31 Systems," before multiplication by a safety factor.
32
33 C. Factored Design Uplift Pressure: The uplift pressure, calculated according to procedures
34 in SPRI's "Wind Load Design Guide for Fully Adhered and Mechanically Fastened
35 Roofing Systems," after multiplication by a safety factor.
36

37 1.3 PERFORMANCE REQUIREMENTS

- 38
39 A. General: Provide installed roofing membrane and base flashings that remain watertight;
40 do not permit the passage of water; and resist specified uplift pressures, thermally
41 induced movement, and exposure to weather without failure.
42
43 B. Material Compatibility: Provide roofing materials that are compatible with one another
44 under conditions of service and application required, as demonstrated by roofing
45 membrane manufacturer based on testing and field experience.
46
47 C. FMG Listing: Provide roofing membrane, base flashings, and component materials that
48 comply with requirements in FMG 4450 and FMG 4470 as part of a membrane roofing
49 system and that are listed in FMG's "Approval Guide" for Class 1 or noncombustible
50 construction, as applicable. Identify materials with FMG markings.
51
52

1. Fire/Windstorm Classification: Class 1A-90.
2. Hail Resistance: MH.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For roofing system. Include plans, elevations, sections, details, and attachments to other Work.
 1. Base flashings and membrane terminations.
 2. Insulation fastening patterns.
- C. Samples for Verification: For the following products:
 1. 12-by-12-inch square of sheet roofing, of color specified, including T-shaped side and end lap seam.
 2. 12-by-12-inch square of roof insulation.
- D. Installer Certificates: Signed by roofing system manufacturer certifying that Installer is approved, authorized, or licensed by manufacturer to install roofing system.
- E. Manufacturer Certificates: Signed by roofing manufacturer certifying that roofing system complies with requirements specified in "Performance Requirements" Article.
 1. Submit evidence of meeting performance requirements.
- F. Qualification Data: For Installer and manufacturer.
- G. Product Test Reports: Based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, for components of roofing system.
- H. Research/Evaluation Reports: For components of membrane roofing system.
- I. Maintenance Data: For roofing system to include in maintenance manuals.
- J. Warranties: Special warranties specified in this Section.
- K. Inspection Report: Copy of roofing system manufacturer's inspection report of completed roofing installation.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified firm that is approved, authorized, or licensed by roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's warranty.
- B. Manufacturer Qualifications: A qualified manufacturer that has FMG approval for membrane roofing system identical to that used for this Project.
- C. Fire-Test-Response Characteristics: Provide membrane roofing materials with the fire-test-response characteristics indicated as determined by testing identical products per test method below by UL, FMG, or another testing and inspecting agency acceptable to authorities having jurisdiction. Materials shall be identified with appropriate markings of applicable testing and inspecting agency.

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
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

1. Exterior Fire-Test Exposure: Class A ASTM E 108, for application and roof slopes indicated.
 2. Fire-Resistance Ratings: ASTM E 119, for fire-resistance-rated roof assemblies of which roofing system is a part.
- D. Preinstallation Conference: Conduct conference at Project site. Comply with requirements in Division 1 Section "Project Management and Coordination." Review methods and procedures related to roofing system including, but not limited to, the following:
1. Meet with roofing Installer, roofing system manufacturer's representative, deck Installer, and installers whose work interfaces with or affects roofing including installers of roof accessories and roof-mounted equipment.
 2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
 3. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 4. Examine deck substrate conditions and finishes for compliance with requirements, including flatness and fastening.
 5. Review structural loading limitations of roof deck during and after roofing.
 6. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect roofing system.
 7. Review governing regulations and requirements for insurance and certificates if applicable.
 8. Review temporary protection requirements for roofing system during and after installation.
 9. Review roof observation and repair procedures after roofing installation.

1.6 DELIVERY, STORAGE, AND HANDLING

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

1.7 PROJECT CONDITIONS

- 1 A. Weather Limitations: Proceed with installation only when existing and forecasted
2 weather conditions permit roofing system to be installed according to manufacturer's
3 written instructions and warranty requirements.
4

5 1.8 WARRANTY
6

- 7 A. Special Warranty: Manufacturer's standard form, without monetary limitation, in which
8 manufacturer agrees to repair or replace components of membrane roofing system that
9 fail in materials or workmanship within specified warranty period. Failure includes roof
10 leaks.
11
12 1. Special warranty includes roofing membrane, base flashings, roofing membrane
13 accessories, roof insulation fasteners, vapor retarder and other components of
14 membrane roofing system.
15 2. Warranty Period: 20 years from date of Substantial Completion.
16
17

18 **PART 2 - PRODUCTS**
19

20 2.1 THERMOPLASTIC POLYOLEFIN ROOFING MEMBRANE
21

- 22 B. Fabric-Reinforced Thermoplastic Polyolefin Sheet: ASTM D 6878, internally fabric or
23 scrim reinforced, uniform, flexible TPO sheet.
24
25 1. Manufacturers: Subject to compliance with requirements, provide products by
26 one of the following:
27
28 a. Carlisle SynTec Incorporated.
29 b. Custom Seal Roofing.
30 c. Firestone Building Products Company.
31 d. GAF Materials Corporation.
32 e. GenFlex Roofing Systems.
33 f. Johns Manville.
34 g. Mule-Hide Products Co., Inc.
35 h. Stevens Roofing Systems; Division of JPS Elastomerics.
36 i. Versico Incorporated.
37
38 2. Physical Properties:
39
40 a. Thickness: 60 mils thickness, nominal.
41 b. Exposed Face Color: White.
42 c. Physical Properties:
43 d. Breaking Strength: 225 lbf; ASTM D 751, grab method.
44 e. Elongation at Break: 15 percent; ASTM D 751.
45 f. Tearing Strength: 55 lbf minimum; ASTM D 751, Procedure B.
46 g. Brittleness Point: Minus 22 deg F.
47 h. Ozone Resistance: No cracks after sample, wrapped around a 3-inch- di-
48 ameter mandrel, is exposed for 166 hours to a temperature of 104 deg F
49 and an ozone level of 100 pphm; ASTM D 1149.
50

51 2.2 AUXILIARY MATERIALS
52

- 53 A. General: Auxiliary materials recommended by roofing system manufacturer for intended
54 use and compatible with membrane roofing.
55

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
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

1. Liquid-type auxiliary materials shall meet VOC limits of authorities having jurisdiction.
- C. Sheet Flashing: Manufacturer's standard unreinforced thermoplastic polyolefin sheet flashing, 55 mils thick, minimum, of same color as sheet membrane.
- D. Bonding Adhesive: Manufacturer's standard water-based bonding adhesive for membrane, and solvent-based bonding adhesive for base flashings.
- E. Slip Sheet: Manufacturer's recommended slip sheet, of type required for application.
- F. Metal Termination Bars: Manufacturer's standard predrilled stainless-steel or aluminum bars, approximately 1 by 1/8 inch thick; with anchors.
- G. Metal Battens: Manufacturer's standard aluminum-zinc-alloy-coated or zinc-coated steel sheet, approximately 1 inch wide by 0.05 inch thick, prepunched.
- H. Fasteners: Factory-coated steel fasteners and metal or plastic plates meeting corrosion-resistance provisions in FMG 4470, designed for fastening membrane to substrate, and acceptable to membrane roofing system manufacturer.
- I. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, T-joint covers, termination reglets, cover strips, and other accessories.

2.3 ROOF INSULATION

- A. General: Preformed roof insulation boards manufactured or approved by TPO membrane roofing manufacturer, selected from manufacturer's standard sizes suitable for application, of thicknesses indicated.
- B. Polyisocyanurate Board (Fill) Insulation: Rigid, cellular polyisocyanurate thermal insulation with core formed by using HCFCs as blowing agents to comply with ASTM C 1289, with Type II, glass-fiber mat facers both major surfaces. Aged R value of 7.2 minimum per inch of thickness.
 1. Provide boards with parallel faces.
 2. Provide standard tapered boards for crickets and sloped features.

2.4 INSULATION ACCESSORIES

- A. General: Furnish roof insulation accessories recommended by insulation manufacturer for intended use and compatible with membrane roofing.
- B. Fasteners: Factory-coated steel fasteners and metal or plastic plates meeting corrosion-resistance provisions in FMG 4470, designed for fastening roof insulation to substrate, and acceptable to roofing system manufacturer.
- C. Cold Fluid-Applied Adhesive: Manufacturer's standard cold fluid-applied adhesive formulated to adhere roof insulation to substrate.
- D. Cover Board: ASTM C 1177/C 1177M, glass-mat, water-resistant gypsum substrate, 1/4 inch thick.
 1. Product: Subject to compliance with requirements, provided "Dens-Deck" manufactured by Georgia-Pacific Corporation.

1
2
3 **PART 3 - EXECUTION**
4

5 3.1 EXAMINATION
6

- 7 A. Examine substrates, areas, and conditions, with Installer present, for compliance with the
8 following requirements and other conditions affecting performance of roofing system:
9
- 10 1. Verify that roof openings and penetrations are in place and set and braced and
11 that roof drains are securely clamped in place.
 - 12 2. Verify that wood blocking, curbs, and nailers are securely anchored to roof deck
13 at penetrations and terminations and that nailers match thicknesses of insulation.
 - 14 3. Verify that surface plane flatness and fastening of steel roof deck comply with
15 requirements in Division 5 Section "Steel Deck."
 - 16 4. Proceed with installation only after unsatisfactory conditions have been
17 corrected.

18
19 3.2 PREPARATION
20

- 21 A. Clean substrate of dust, debris, moisture, and other substances detrimental to roofing
22 installation according to roofing system manufacturer's written instructions. Remove
23 sharp projections.
24
- 25 B. Complete terminations and base flashings and provide temporary seals to prevent water
26 from entering completed sections of roofing system at the end of the workday or when
27 rain is forecast. Remove and discard temporary seals before beginning work on
28 adjoining roofing.
29

30 3.3 INSULATION INSTALLATION
31

- 32 A. Coordinate installing membrane roofing system components so insulation is not exposed
33 to precipitation or left exposed at the end of the workday.
34
- 35 B. Comply with membrane roofing system manufacturer's written instructions for installing
36 roof insulation.
37
- 38 C. Install parallel face or tapered insulation under area of roofing to conform to slopes indi-
39 cated.
40
- 41 D. Install one or more layers of insulation under area of roofing to achieve required thick-
42 ness. Where overall insulation thickness is 2 inches or greater, install 2 or more layers
43 with joints of each succeeding layer staggered from joints of previous layer a minimum of
44 6 inches in each direction.
45
- 46 E. Trim surface of insulation where necessary at roof drains so completed surface is flush
47 and does not restrict flow of water.
48
- 49 F. Install insulation with long joints of insulation in a continuous straight line with end joints
50 staggered between rows, abutting edges and ends between boards. Fill gaps exceeding
51 1/4 inch with insulation.
52
- 53 1. Cut and fit insulation within 1/4 inch of nailers, projections, and penetrations.
54
- 55 H. Adhered Insulation: Install each layer of insulation and adhere to substrate as follows:
56

1. Prime surface of concrete deck with asphalt primer at a rate of 3/4 gallon/100 square feet and allow primer to dry.
2. Set each layer of insulation in a cold fluid-applied adhesive.

3.4 ADHERED ROOFING MEMBRANE INSTALLATION

- A. Install roofing membrane over area to receive roofing according to membrane roofing system manufacturer's written instructions. Unroll roofing membrane and allow to relax before installing.
 1. Install sheet according to ASTM D 5036.
- B. Start installation of roofing membrane in presence of membrane roofing system manufacturer's technical personnel.
- C. Accurately align roofing membrane and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.
- D. Bonding Adhesive: Apply water-based bonding adhesive to substrate at rate required by manufacturer and immediately install roofing membrane. Do not apply bonding adhesive to splice area of roofing membrane.
- E. Adhesively fasten roofing membrane securely at terminations, penetrations, and perimeter of roofing.
- F. Apply roofing membrane with side laps shingled with slope of roof deck where possible.
- G. Seams: Clean seam areas, overlap roofing membrane, and hot-air weld side and end laps of roofing membrane according to manufacturer's written instructions to ensure a watertight seam installation.
 1. Test lap edges with probe to verify seam weld continuity. Apply lap sealant to seal cut edges of roofing membrane.
 2. Verify field strength of seams a minimum of twice daily and repair seam sample areas.
 3. Repair tears, voids, and lapped seams in roofing membrane that does not meet requirements.

3.5 BASE FLASHING INSTALLATION

- A. Install sheet flashings and preformed flashing accessories and adhere to substrates according to membrane roofing system manufacturer's written instructions.
- B. Apply water-based bonding adhesive to substrate and underside of sheet flashing at required rate and allow to partially dry. Do not apply bonding adhesive to seam area of flashing.
- C. Flash penetrations and field-formed inside and outside corners with sheet flashing.
- D. Clean seam areas and overlap and firmly roll sheet flashings into the adhesive. Weld side and end laps to ensure a watertight seam installation.
- E. Terminate and seal top of sheet flashings and mechanically anchor to substrate through termination bars.

3.7 PROTECTING AND CLEANING

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16

- A. Protect membrane roofing system from damage and wear during remainder of construction period. When remaining construction will not affect or endanger roofing, inspect roofing for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.
- B. Correct deficiencies in or remove membrane roofing system that does not comply with requirements, repair substrates, and repair or reinstall membrane roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.
- C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION 07 54 00

1 **SECTION 07 62 00 - FLASHING AND SHEET METAL**

2
3 **PART 1 - GENERAL**

4
5 1.1 RELATED DOCUMENTS:

- 6
7 A. Applicable provisions of Division 1 shall govern work under this Section.
8

9 1.2 DESCRIPTION OF WORK:

- 10
11 A. This section includes the following:

- 12
13 1. Metal counter flashing; and base flashing.
14 2. Metal copings.
15 3. Radius metal coping.
16 4. Metal expansion joints.
17 5. Built-in metal scuppers, downspouts and conductor heads.
18 6. Miscellaneous sheet metal accessories.

- 19
20 B. Related sections:

- 21
22 1. Roofing accessories (excluding roof accessories) are specified in roofing system
23 sections as roofing work.
24

25 1.3 SUBMITTALS:

- 26
27 A. Product Data; Flashing, Sheet Metal, Accessories: Submit manufacturer's product
28 specifications, installation instructions and general recommendations for each specified
29 sheet material and fabricated product.
30

- 31 B. Samples; Flashing, Sheet Metal, Accessories:

- 32
33 1. Submit 2, 8 inch square samples of specified sheet materials to be exposed as
34 finished surfaces.
35

- 36 C. Shop Drawings; Flashing, Sheet Metal, Accessories: Submit shop drawings showing
37 layout, joining, profiles, and anchorages of fabricated work, including major counter
38 flashings, trim/fascia units, gutters, downspouts, scuppers and expansion joint systems;
39 layouts at 1/4 inch scale, details at 3 inch scale.
40

41 1.4 JOB CONDITIONS:

- 42
43 A. Coordinate work of this section with interfacing and adjoining work for proper sequencing
44 of each installation. Ensure best possible weather resistance and durability of the work
45 and protection of materials and finishes.
46
47

48 **PART 2 - PRODUCTS**

49
50 2.1 FLASHING AND SHEET METAL MATERIALS:

- 51
52 A. Sheet Metal Flashing/Trim:

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
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

1. Paint coated sheet steel: Shop formed, 0.028 inches thick prior to painting, hot-dipped galvanized steel, commercial quality AISI G90 extra smooth. Primed and finished on one side with Duranar 200 fluoropolymer coating system. Wash coat applied to back. Mask painted side with strippable plastic film. Colorklad by Vincent Brass and Aluminum Company and PAC-CLAD by Peterson Aluminum Corporation are approved. Custom champagne metallic color as selected by the Architect.
2. Miscellaneous Materials and Accessories: (As required by flashing manufacturer).
 - a. Solder: For use with steel or copper, provide 50 - 50 tin/lead solder (ASTM B 32), with rosin flux.
 - b. Fasteners: Same metal as flashing/sheet metal or, other noncorrosive metal as recommended by sheet manufacturer. Match finish of exposed heads with material being fastened.
 - c. Bituminous Coating: FS TT-C-494 or SSPC - Paint 12, solvent type bituminous mastic, nominally free of sulfur, compounded for 15-mil dry film thickness per coat.
 - d. Mastic Sealant: Polyisobutylene; nonhardening, nonskinning, nondrying, nonmigrating sealant.
 - e. Elastomeric Sealant: Generic type recommended by manufacturer of metal and fabricator of components being sealed; comply with FS TT-S-0027, TT-S-00230, or TT-S-001543.
 - f. Epoxy Seam Sealer: 2-part noncorrosive metal seam cementing compound, recommended by manufacturer for exterior/interior nonmoving joints including riveted joints.
 - g. Adhesives: Type recommended by flashing sheet manufacturer for waterproof/weather-resistant seaming and adhesive application of flashing sheet.
 - h. Paper Slip Sheet: 5-lb rosin-sized building paper.
 - i. Polyethylene Underlayment: 6-mil carbonated polyethylene film; FS L-P-512.
 - j. Reglets: Metal or plastic units of the type and profile indicated, compatible with flashing indicated, noncorrosive.
 - k. Metal Accessories: Provide sheet metal clips, straps, anchoring devices and similar accessory units as required for installation of work, matching or compatible with material being installed, noncorrosive, size and gage required for performance.
 - l. Elastic Flashing Filler: Closed-cell polyethylene or other soft closed-cell material recommended by elastic flashing manufacturer as filler under flashing loops to ensure movement with minimum stress on flashing sheet.
 - m. Roofing Cement: ASTM D 4586, Type I, asbestos free, asphaltic based.

2.2 FABRICATED UNITS:

- A. General Metal Fabrication: Shop fabricate work to greatest extent possible. Comply with details shown, and with applicable requirements of SMACNA "Architectural Sheet Metal Manual" and other recognized industry practices. Fabricate for waterproof and weather resistant performance; with expansion provisions for running work, sufficient to permanently prevent leakage, damage or deterioration of the work. Form work to fit substrates. Comply with material manufacturer instructions and recommendations. Form exposed sheet metal work without excessive oil-canning, buckling and tool marks, true to line and levels as indicated, with exposed edges folded back to form hems.
- B. Seams: Fabricate nonmoving seams in sheet metal with flat-lock seams. For metal

1 other than aluminum, tin edges to be seamed, form seams, and solder. Form aluminum
2 seams with epoxy seam sealer; rivet joints for additional strength where required.

- 3
4 C. Expansion Provisions: Where lapped or bayonet type expansion provisions in work
5 cannot be used, or would not be sufficiently water/weatherproof, form expansion joints of
6 intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant
7 (concealed within joints).
8
9 D. Sealant Joints: Where movable, nonexpansion type joints are indicated or required for
10 proper performance of work, form metal to provide for proper installation of elastomeric
11 sealant, in compliance with industry standards.
12
13 E. Separations: Provide for separation of metal from noncompatible metal or corrosive
14 substrates by coating concealed surfaces at locations of contact, with bituminous coating
15 or other permanent separation as recommended by manufacturer/fabricator.
16
17 F. Flashing reglets: Extruded aluminum, alloy 6063-T5, standard mill finish. Approved
18 products are as follows:
19
20 1. Cushion Lock B-2; Superior Concrete Accessories, Inc.
21 2. Temline; Tremco
22
23 G. Scuppers, Downspouts and Conductor Heads:
24
25 1. Shop fabricate metal scuppers, downspouts, conductor heads, metal flashing
26 and similar items to comply with profiles and sizes indicated and to comply with
27 standard industry details shown in the SMACNA "Architectural Sheet Metal
28 Manual." Unless otherwise indicated, provide soldered flat-lock seams and fold
29 back metal to form a hem on concealed side of exposed edges. Fabricate work
30 from paint coated sheet steel.
31
32

33 **PART 3 - EXECUTION**

34 35 3.1 **INSTALLATION REQUIREMENTS:**

- 36
37 A. General: Except as otherwise indicated, comply with manufacturer's installation
38 instructions and recommendations, and with SMACNA "Architectural Sheet Metal
39 Manual." Anchor units of work securely in place by methods indicated, providing for
40 thermal expansion of metal units; conceal fasteners where possible, and set units true to
41 line and level as indicated. Install work with laps, joints and seams which will be
42 permanently watertight and weatherproof.
43
44 B. Underlayment: Where stainless steel or aluminum is to be installed directly on
45 cementitious or wood substrates, install a course of paper slip sheet and a course of
46 polyethylene underlayment.
47
48 C. Bed flanges of work in a thick coat of bituminous roofing cement where required for
49 waterproof performance.
50
51 D. Install reglets to receive counter flashing in manner and by methods indicated. Where
52 shown in concrete, furnish reglets to trades of concrete work for installation as work of
53 Division 3 sections. Where shown in masonry, furnish reglets to trades of masonry work,
54 for installation as work of Division 4 sections.
55
56 E. Install counterflashing in reglets, either by snap-in seal arrangement, or by wedging in
57 place for anchorage and filling reglet with mastic or elastomeric sealant, as indicated and

1 depending on degree of sealant exposure.
2

3 F. Install elastic flashing without stretching. Install elastic flashing filler strips to provide for
4 movement by forming loops or bellows in width of flashing. Locate filler strips to facilitate
5 complete drainage of water from flashing. Seam flashing sheets with adhesive, and
6 anchor edges in manner indicated.
7

8 G. Nail flanges of expansion joint units to curb nailers, at maximum spacing of 6 inches.
9 Complete seams at joints between units, to form a continuous waterproof system.
10

11 H. Install continuous gutter guards on gutters, arranged as hinged units to swing open for
12 cleaning gutters. Install beehive type strainer-guard at conductor heads, removable for
13 cleaning downspouts.
14

15 3.2 CLEANING AND PROTECTION:
16

17 A. Clean exposed metal surfaces, removing substances which might cause corrosion of
18 metal or deterioration of finishes.
19

20 B. Protection: Installer shall advise Contractor of required procedures for surveillance and
21 protection of flashings and sheet metal work during construction, to ensure that work will
22 be without damage or deterioration, other than natural weathering, at time of substantial
23 completion.
24

25
26 END SECTION 07 62 00

1 **SECTION 08 31 13 - ACCESS DOORS**

2
3 **PART 1 - GENERAL**

4
5 1.1 RELATED DOCUMENTS:

- 6
7 A. Applicable provisions of Division 1 shall govern work under this Section.
8

9 1.2 DESCRIPTION OF WORK:

- 10 A. This Section includes the following types of access doors:

11
12 1. Ceiling access doors.

- 13
14 B. Related Sections:

- 15
16 1. Division 4 Section "Unit Masonry" for building in anchors and grouting frames set
17 in masonry construction.
18 2. Division 9 Section "Gypsum Board" for gypsum board walls and ceilings.
19 3. Division 9 Section "Acoustical Ceilings" for suspended acoustical ceiling systems.
20
21

22 1.3 QUALITY ASSURANCE:

- 23 A. Fire-Resistance Ratings:

- 24
25 1. Wherever a fire-resistance classification is indicated, provide access door
26 assembly with panel door, frame, hinge and latch from manufacturer listed in
27 Underwriters Laboratories, Inc.; "Classified Building Materials Index" for rating
28 shown.
29 2. Provide UL label on each fire-rated access door.
30

- 31 B. Size Variations: Obtain Architect's acceptance of manufacturer's standard size units
32 which may vary slightly from sizes indicated.
33
34

35 1.4 SUBMITTALS:

- 36 A. Product Data: Submit manufacturer's technical data and installation instructions for each
37 type of access door assembly, including setting drawings, templates, instructions and
38 directions for installation of anchorage devices.
39

- 40 B. Shop Drawings: Submit shop drawings for fabrication and installation of customized
41 access doors and frames, including details of each frame type, elevations of door design
42 types, anchorage and accessory items.
43
44

45 1.5 COORDINATION:

- 46 A. Furnish inserts and anchoring devices, which must be built into other work for installation
47 of access doors. Coordinate delivery with other work to avoid delay.
48
49

50
51 **PART 2 - PRODUCTS**

- 1 2.1 MANUFACTURERS:
2
3 A. Provide access doors by one of the following:
4
5 Cesco Products.
6 J.L. Industries.
7 Karp Associates, Inc.
8 Milcor Div.; Inryco, Inc.
9 Nystrom, Inc.
10 The Williams Bros. Corporation of America.
11
- 12 2.2 MATERIALS:
13
14 A. Steel Sheet: ASTM A 366/A 366M commercial quality, cold rolled steel sheet with baked-
15 on rust-inhibitive primer.
16
- 17 2.3 ACCESS DOORS:
18
19 A. General: Furnish each access door assembly manufactured as an integral unit, complete
20 with all parts and ready for installation.
21
22 B. Steel Access Doors and Frames: Fabricate units of continuous welded steel construction,
23 unless otherwise indicated. Grind welds smooth and flush with adjacent surfaces. Furnish
24 attachment devices and fasteners of type required to secure access panels to types of
25 support shown.
26
27 C. Flush Access Door with Exposed Trim/Frame:
28
29 1. Units consisting of frame with exposed trim, door, hardware, and complying with
30 the following requirements:
31
32 a. Frame: 0.0598-inch (16 gage) thick steel sheet.
33 b. Door: 0.0747-inch (14 gage) thick steel sheet.
34 c. Trim: Flange integral with frame, 3/4-inch wide, overlapping surrounding
35 finished surface.
36 d. Hinges: Continuous type.
37 e. Provide gasket seal around entire perimeter on inside of frame.
38 f. Locks/Latches: Provide screwdriver-operated cam latches per
39 manufacturer's standard to properly latch access door.
40
41

42 **PART 3 - EXECUTION**

- 43
44 3.1 INSPECTION:
45
46 A. Installer must examine areas and conditions under which access doors are to be installed
47 and must notify Contractor in writing of conditions detrimental to proper and timely
48 completion of work. Do not proceed with work until unsatisfactory conditions have been
49 corrected in manner acceptable to Installer.
50
- 51 3.2 INSTALLATION:
52
53 A. Comply with manufacturer's instructions for installation of access doors.
54
55 B. Set frames accurately in position and securely attach to supports with face panels plumb
56 or level in relation to adjacent finish surfaces.

1
2
3
4
5
6
7
8
9

3.3 ADJUST AND CLEAN:

- A. Adjust hardware and panels after installation for proper operation.
- B. Remove and replace panels or frames, which are warped, bowed or otherwise damaged.

END SECTION 08 31 13

1 **SECTION 09 29 00 - GYPSUM BOARD**

2
3 **PART 1 - GENERAL**

4
5 1.1 RELATED DOCUMENTS:

- 6
7 A. Applicable provisions of Division 1 shall govern work under this Section.
8

9 1.2 DESCRIPTION OF WORK:

- 10
11 A. This section includes the following:

12
13 Gypsum wallboard attached to steel framing
14 Ceiling suspension systems.
15 Accessories

- 16
17 B. Related sections:

- 18
19 1. Gypsum Sheathing: Refer to Division 6 Section- "Rough Carpentry."
20

21 1.3 JOB CONDITIONS:

- 22
23 A. Maintain temperature at 50 degrees F or more for at least 48 hours prior to installation,
24 during installation and until heating system is in operation or until building is occupied.
25
26 B. Ventilate building spaces as required to dry joint treatment materials. Avoid drafts during
27 hot, dry weather to prevent finishing materials from drying too quickly.
28
29

30 **PART 2 – PRODUCTS**

31
32 2.1 PANELS RECYCLED CONTENT:

- 33
34 A. Recycled Content: Provide gypsum panel products with recycled content such that
35 postconsumer recycled content plus one-half of preconsumer recycled content
36 constitutes a minimum of five percent by weight.
37

38 2.2 GYPSUM WALLBOARD (GWB):

- 39
40 A. Types as noted on drawings, details and schedules as follows:

- 41
42 1. Regular Gypsum Board, tapered edge, ASTM C-36.
43 2. Type "X" Gypsum Board, tapered edge, ASTM C-36.
44

45 2.3 METAL FRAMING COMPONENTS:

- 46
47 A. Hanger Wire: ASTM A641, Class 1 zinc coating, soft temper, 8 gage (0.162 inch)
48 diameter.
49
50 B. Grid Suspension System for Interior Ceilings: ASTM C645, manufacturer's standard
51 direct hung grid suspension system composed of main beams and cross-furring
52 members that interlock to form a modular supporting network.

1
2 2.4 ACCESSORIES:
3

4 A. Screws: Type S, ASTM C-1002, steel drill screws at metal framing and/or Type W at
5 wood framing. Type S-12 at 20 gauge or heavier metal framing.
6

7 B. Joint Tape: ASTM C 475.
8

9 1. Interior Gypsum Wallboard: Paper tape.
10

11 C. Joint Treatment: ASTM C 475. For each coat use formulation that is compatible with
12 other compounds applied on previous or for successive coats.
13

14 1. Interior Locations:
15

16 a. Prefilling: At open joints, open or beveled panel edges, and damaged
17 surface areas, use setting type taping compound.

18 b. Embedding and First Coat: For embedding tape and first coat on joints,
19 fasteners and trim flanges, use setting type taping compound.

20 c. Fill Coat: For second coat use drying type all purpose compound.
21

22 d. Finish Coat: For third coat use drying type all purpose compound.
23

24 D. Texture Finish: Nonasbestos type, unaggregated, for spray application to obtain medium
25 "orange peel" texture.
26

27 E. Expansion Joints: USG Control Joint No. 093, zinc with tape protected slot.
28

29 **PART 3 - EXECUTION**
30

31 3.1 CEILING SUSPENSION SYSTEM INSTALLATION:
32

33 A. Hang furring runners, with wire spaced maximum 48 inches on center vertically, from
34 structural system. Wrap hanger wires tightly with at least 3 full turns.
35

36 B. Interconnect runners with furring tees spaced 16 inches on center and 8 inches from end
37 of each gypsum board panel. Provide tee adjacent to each side of fixtures not supported
38 by a furring runner and at other ceiling penetrations requiring support.
39

40 3.2 GYPSUM WALLBOARD INSTALLATION:
41

42 A. Apply gypsum wallboard and finish in accordance with ASTM C-840 and GA-216 unless
43 otherwise specified.
44

45 B. Apply gypsum board of maximum practical length with light contact butt joints so that
46 tapered edge joints abut and mill cut or field cut joints abut.
47

48 C. Apply gypsum board and stagger end joints.
49

50 D. Parallel application to be with all edge joints centered over framing members.
51

52 E. Perpendicular application to be with wallboard of maximum practical lengths and end
53 joints occurring over framing members.
54

55 F. Fasten gypsum board to framing with screws located 3/8 inch minimum to 1/2 inch
56 maximum from edges and ends.

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
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

- G. Space screws 12 inches on center in the field and edges for perpendicular application. Space screws 12 inches on center in the field and 8 inches on center along long edges for parallel application.
- H. Space screws 12 inches on center in the field and 8 inches on center at edges of fire-rated construction.
- I. Offset joints in face layer equal to one framing member space from and parallel to joints in base layer.

3.3 ACCESSORY INSTALLATION:

- A. Apply all accessories in accordance with manufacturer's instructions.
- B. Provide ceiling control joints consisting of back to back metal trim (casing beads) spaced not more than 50 feet apart and maximum area of 2500 square feet.

3.4 FINISHING INSTALLATION:

- A. Finish all exposed joints, fastener heads, flanges of metal trim and other accessories with joint treatment in accordance with manufacturer's instructions.
- B. Levels of gypsum board finish: Provide the following levels of gypsum board finish per GA-214.
 - 1. Level 1 for ceiling plenum areas, concealed areas, and where indicated, unless a higher level of finish is required for fire-rated assemblies and sound -rated assemblies.
 - a. Embed tape in joint compound.
 - 2. Level 2 where panels form substrates for tile and where indicated.
 - a. Embed tape in joint compound and apply first coat of joint compound.
 - 3. Level 3 for gypsum board where indicated.
 - a. Embed tape in joint compound and apply first and fill (second) coats of joint compound.
 - 4. Level 4 for gypsum board surfaces, unless noted otherwise.
 - a. Embed tape in joint compound and apply first, fill (second), and finish (third) coats of joint compound over joints, angles, fastener heads, and accessories. Touch up and sand between coats and after last coat as needed to produce a surface free of visual defects and ready for decoration.

3.5 TEXTURE APPLICATION:

- A. Prepare and prime gypsum board in accordance with manufacturer's instructions.
- B. Spray-apply material to obtain an "orange peel" texture without thin spots and free of application patterns.

- 1 C. Remove over spray from adjoining materials and surfaces.
- 2
- 3
- 4 END SECTION 09 29 00

1 **SECTION 09 51 00 - ACOUSTICAL CEILINGS**

2
3 **PART 1 - GENERAL**

4
5 1.1 RELATED DOCUMENTS:

- 6
7 A. Applicable provisions of Division 1 shall govern work under this Section.

8
9 1.2 DESCRIPTION OF WORK:

- 10
11 A. This section includes the following:

- 12
13 1. Ceilings composed of salvaged acoustical panels and new exposed suspension
14 system.
15 2. New acoustical panels where indicated.

16
17 1.3 QUALITY ASSURANCE:

- 18
19 A. All acoustic materials shall have Flame Spread Rating of 0-25 when tested in accordance
20 with ASTM E-84.

21
22 1.4 SUBMITTALS:

- 23
24 A. Submit two samples of each acoustic material for approval.

25
26 1.5 JOB CONDITIONS:

- 27
28 A. Maintain temperature and humidity conditions before, during, and after installation closely
29 approximating interior conditions which will exist when building is occupied.

30
31
32 **PART 2 - PRODUCTS**

33
34 2.1 MANUFACTURER:

- 35
36 A. Provide products from the following:

37
38 Armstrong World Industries, Inc.
39 Celotex Corporation
40 USG Interiors, Inc.
41 Capaul Corporation

42
43 2.2 MINERAL FIBER ACOUSTIC PANELS (ACP):

- 44
45 A. ACP-1: 24 inches x 48 inches x 3/4 inches mineral fiber lay-in panel, square edge,
46 nondirectional fissured design, NRC 0.70, CAC 35 with washable white factory finish.
47 Product shall be identical to USG Radar Clima-Plus #22311.

48
49 2.3 SUSPENSION SYSTEMS:

- 50
51 A. Conform to all requirements of ASTM C-635 intermediate structural classification.

52

- 1 B. Provide all hanger inserts and anchors for supporting systems.
- 2
- 3 C. Color match exposed trim and accessories to suspension system.
- 4

5 2.4 EXPOSED GRID SUSPENSION SYSTEM:

- 6
- 7 A. Provide the following systems for acoustic panels as indicated.
- 8
- 9 B. 15/16 inch face, snap type of formed electro-galvanized steel main runners and cross
- 10 tees. Finish of runners, cross tees and wall moldings to be factory applied of color to
- 11 match the acoustic panel.
- 12
- 13 C. Aluminum capped snap-grid system, 15/16 inch face, formed of electro-galvanized steel
- 14 main runners and cross tees. Finish of runners, cross tees and wall moldings to be
- 15 factory applied of color to match the acoustic panel.
- 16

17 2.5 MISCELLANEOUS MATERIALS:

- 18
- 19 A. Hanging Wire: 12 gauge ASTM A-641 galvanized steel soft temper.
- 20
- 21 B. Hanging Wire for Humidity Resistant Acoustic Materials: 9 gauge aluminum or 12 gauge
- 22 stainless steel.
- 23
- 24 C. Acoustic Sealant: Heavy bodied, non-shrinking, nondrying, nonsag acoustical sealant.
- 25
- 26

27 **PART 3 - EXECUTION**

28

29 3.1 PREPARATION:

- 30
- 31 A. Verify that conditions are proper for installation of acoustic materials.
- 32

33 3.2 GENERAL INSTALLATION:

- 34
- 35 A. Conform to installation requirements of ASTM C-636 and reflected ceiling plans.
- 36
- 37 B. Suspend hang wires from building structural members. Locate hanger near each end and
- 38 spaced 4 feet-0 inches along runner or carrying channel. Level to 1/8 inch in 12 feet-0
- 39 inches.
- 40
- 41 C. Install acoustical units in a true and even plane, in straight line and courses laid out
- 42 symmetrically about center lines of ceiling or panel with border units of half width or
- 43 greater.
- 44
- 45 D. Install in accordance with the specifications and instructions of the manufacturer of the
- 46 suspension system.
- 47
- 48 E. Space hangers, runners and tees to prevent deflection in excess of 1/360 of the span of
- 49 any member.
- 50
- 51 F. Install wire hangers vertically.
- 52
- 53 G. Cut and fit all materials with straight, true, even lines.
- 54

55 3.3 EXPOSED GRID SYSTEM INSTALLATION:

- 1 A. Provide metal edge moldings where acoustical materials abut vertical surfaces or other
- 2 materials. Secure 16 inches on center and 3 inches from each end. Miter all corners.
- 3
- 4 B. Provide hold down clips at time-rated ceilings if manufacturers system requires clips.
- 5
- 6 C. Field cut reveal edge on panels at wall edge moldings.
- 7
- 8 D. Apply continuous acoustic sealant bead on back of vertical leg of wall edge molding
- 9 before installing molding.
- 10
- 11 3.4 REPLACEMENT PANELS:
- 12
- 13 A. Furnish 20 additional pieces of each type and size of lay-in panels. Store in cartons in
- 14 area where directed.
- 15
- 16 3.5 CLEANING:
- 17
- 18 A. Clean exposed surfaces of acoustical material and grid systems and touch up minor
- 19 finish damage. Replace materials which can not be repaired to new condition.
- 20
- 21
- 22 END SECTION 09 51 00

1 **SECTION 09 68 13 - TILE CARPETING**

2
3 **PART 1 - GENERAL**

4
5 1.1 RELATED DOCUMENTS

- 6
7 A. Applicable provisions of Division 1 shall govern work under this section.
8

9 1.2 SUMMARY

- 10
11 A. This section includes the following:

- 12
13 1. Removal and disposal of existing floor coverings.
14 2. Substrate preparation.
15 3. Carpet tile.
16 4. Carpet accessories except transitions to be determined at walk through.
17 5. Successful Bidder shall walk through project site with Architect to determine
18 appropriate transitions at each flooring material change location.
19 6. Installation of all materials except transitions to be determined at walk through.
20

- 21 B. Labor, material and equipment required to furnish and install transitions determined at
22 walk through shall not be part of this bid and shall be paid on a basis of time and
23 materials.
24

25 1.3 SPECIAL BID REQUIREMENTS:

- 26
27 A. Bidder shall submit with Bid, manufacturer's standard product warranties for each carpet
28 type.
29
30 B. Bidder shall submit with Bid, manufacturer's recommended maintenance plan. Plan shall
31 include:
32
33 1. Methods for maintaining carpet tile and manufacturer's recommended frequency.
34 2. Precautions for cleaning materials and methods that could be detrimental to
35 finishes and performance.
36 3. Include cleaning and stain removal products and procedures appropriate to
37 carpet tile provided.
38
39 C. Bidder shall submit with Bid, a list of three successful installations of a similar scope and
40 size. Provide contact name and telephone number for each.
41

42 1.4 QUALITY ASSURANCE

- 43
44 A. Single source responsibility: Obtain all carpet tile from one source and by a single
45 manufacturer.
46
47 B. Installer: Installer shall be certified by carpet manufacturer.
48
49 C. General Standard: "Carpet Specifier's Handbook" by the Carpet and Rug Institute;
50 comply with recommendations which can be reasonably applied to types of carpeting
51 work required. Comply with the Carpet and Rug Institute's CRI 104.
52

1 D. Fire Test Response Characteristics: Provide carpet tile with the following fire test
2 response characteristics as determined by testing products per test method indicated
3 below by UL or another testing and inspection agency acceptable to the authorities
4 having jurisdiction.

- 5
- 6 1. Surface Flammability: Passes CPSC 16 CFR, Part 1630.
- 7 2. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm per
8 ASTM E 648.
- 9 3. Flame Spread: 25 or less per ASTM E 84.
- 10 4. Smoke Developed: 450 or less per ASTM E 84.

11

12 E. Provide testing of concrete slab substrate in accordance with ASTM F-1869, "Standard
13 Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloors Using
14 Anhydrous Calcium Chloride". Test results shall be acceptable to the flooring
15 manufacturer's requirements prior to flooring installation. Test results shall be submitted
16 to the Contractor and the A/E prior to starting installation.

17

18 1.5 SUBMITTALS:

19

20 A. Product Data: In addition to complete data on each carpet and carpeting material,
21 provide manufacturer's certification or certified test laboratory reports for required
22 compliances with specified tests and provide written instructions for each type of
23 installation required.

24

25 B. Shop drawings: Provide shop drawings showing columns, doorways, enclosing walls or
26 partitions and locations where cutouts are required in the carpet. Indicate the following:

- 27
- 28 1. Carpet type, color and dye lot.
- 29 2. Seam locations, types and methods.
- 30 3. Pattern type, location and direction.
- 31 4. Pile direction.
- 32 5. Type, color and location of insets and borders.

33

34 1.6 REPLACEMENT STOCK

35

36 A. Replacement Stock: Provide 2 percent overrun on calculated yardage (carpet needed for
37 proper installation plus waste and usable scraps) for each carpet type and color. Prior to
38 installation, deliver replacement stock to Owner, packaged for protective covering for
39 storage and clearly labeled to identify contents.

40

41 1.7 PRODUCT DELIVERY AND STORAGE:

42

43 A. Deliver carpeting materials in protective wrapping and store inside, protected from
44 weather, moisture and soiling.

45

46 1.8 WARRANTY:

47

48 A. Provide a written special project warranty, signed by Contractor, Installer and
49 Manufacturer (Carpet Mill), agreeing to repair or replace defective materials and
50 workmanship of carpeting work during 10 year warranty period following substantial
51 completion. Special product warranty shall not void manufacturer's standard product
52 warranties. Attach copies of product warranties.

53

54 **PART 2 - PRODUCTS**

55

56 2.1 CARPET TILE:

1
2
3
4
5
6
7
8
9

- A. Size: Carpet tiles shall be 19.7 inches by 19.7 inches in size.
- B. Backing:
 - 1. Standard GlasBac.
- C. Product: Acceptable carpets are as follows:

Manufacturer	Carpet Type	Pattern	Yarn Weight (oz/yd.)	Gauge	Yarn Type & Percentages
InterfaceFLOR	A	Cubic 18Z	18 oz.	1/12	100% Aquafil Strutturata™

10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28

CARPET ACCESSORIES:

- D. Adhesive Pads: TacTiles for InterfaceFLOR GlasBac.
- E. Concrete slab primer: Non-staining type as recommended by carpet manufacturer.
- F. Trowelable underlayments and patching compounds: As recommended by carpet tile manufacturer.
- G. Miscellaneous Materials: As recommended by manufacturers of carpet and other carpeting products; and selected by Installer to meet project circumstance and requirements.
- H. Carpet Edge Guard, Nonmetallic: Extruded or molded vinyl or rubber carpet edge guard of size and profile indicated or if not indicated provide Johnsonite "CTA" series or equal transition of profile to suit finish thicknesses in colors selected by Architect.

PART 3 - EXECUTION

30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52

3.1 PREINSTALLATION REQUIREMENTS:

- A. Installer must examine substrates for moisture content, alkalinity range, installation tolerances and other conditions under which carpeting is to be installed and notify Contractor in writing of conditions detrimental to proper completion of the work. Do not proceed until unsatisfactory conditions have been corrected.
- B. Clear away debris and scrape up cementitious deposits from surfaces to receive carpeting; vacuum clean immediately before installation. Check concrete surfaces to ensure no "dusting" through installed carpet; apply sealer where required to prevent dusting.
- C. Sequence carpeting with other work so as to minimize possibility of damage and soiling of carpet during remainder of construction period.

3.2 PREPARATION

- A. General: Comply with carpet tile manufacturer's installation recommendations to prepare substrates indicated to receive carpet tile installation.
- B. Remove subfloor coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone.

- 1
2 C. Broom or vacuum clean subfloors to be covered with carpet tile. Following cleaning,
3 examine subfloors for moisture, alkaline salts, carbonation, or dust.
4
5 D. Level subfloor within 1/4 inch in 10 feet noncumulative, in all directions. Sand or grind
6 protrusions, bumps, and ridges. Patch and repair cracks and rough areas. Fill
7 depressions.
8
9 1. Use leveling and patching compounds to fill cracks, holes and depressions in
10 subfloor as recommended by carpet tile manufacturer.
11
12 E. Concrete-Subfloor Preparation: Apply concrete-slab primer, according to manufacturer's
13 directions, where recommended by carpet tile manufacturer and where required to
14 prevent "dusting" of concrete surfaces through installed carpet.
15

16 3.3 INSTALLATION:

- 17
18 A. General: Comply with CRI 104, Section 13: "Carpet Modules (Tiles)."
19
20 B. Installation Pattern: As recommended by manufacturer.
21
22 C. Where demountable partitions or other items are indicated for installation on top of
23 finished carpet tile floor, install carpet tile before installation of these items.
24
25 D. Cut and fit carpet tile to butt tightly to vertical surfaces, permanent fixtures, and built-in
26 furniture including cabinets, pipes, outlets, edgings, thresholds and nosings. Fit sections
27 of carpet to space prior to application of adhesive.
28
29 E. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions,
30 removable flanges, alcoves, and similar openings.
31
32 F. Provide cut-outs where required and bind cut edges properly where not concealed by
33 protective edge guards or overlapping flanges.
34
35 G. Expansion Joints: Do not bridge building expansion joints with continuous carpeting,
36 provide for movement.
37
38 H. Apply adhesive pads uniformly to substrate in accordance with manufacturer's
39 instructions. Butt carpet edges tightly together to form seams without gaps. Roll lightly to
40 eliminate air pockets and ensure uniform bond.
41

42 3.4 CLEANING AND PROTECTION:

- 43
44 A. Perform the following operations immediately after completing installation:
45
46 1. Remove visible adhesive, seam sealer, and other surface blemishes using
47 cleaner recommended by carpet tile manufacturer.
48 2. Remove protruding yarns from carpet tile surface.
49 3. Vacuum carpet using commercial machine with face-beater element. Remove
50 spots and replace carpet where spots cannot be removed.
51
52 B. Advise Contractor of protection methods and materials needed to ensure that carpeting
53 will be without deterioration or damage at time of substantial completion. Comply with
54 CRI 104, Section 15: "Protection of Indoor Installation."
55

56 END SECTION 09 68 13

1 **SECTION 23 05 00 - COMMON WORK RESULTS FOR HVAC**

2
3 **PART 1 - GENERAL**

4
5 **SCOPE**

6 This section includes information common to two or more technical specification sections or items that
7 are of a general nature, not conveniently fitting into other technical sections. Included are the following
8 topics:

9 **PART 1 - GENERAL**

10 Scope
11 Related Work
12 Reference
13 Reference Standards
14 Quality Assurance
15 Continuity of Existing Services
16 Protection of Finished Surfaces
17 Sleeves and Openings
18 Sealing and Firestopping
19 Equipment Furnished By Others
20 Provisions for Future
21 Submittals
22 Off Site Storage
23 Certificates and Inspections
24 Operating and Maintenance Data
25 Record Drawings

26 **PART 2 - PRODUCTS**

27 Access Panels and Doors
28 Identification
29 Sealing and Firestopping

30 **PART 3 - EXECUTION**

31 Demolition
32 Concrete Work
33 Cutting and Patching
34 Building Access
35 Equipment Access
36 Coordination
37 Identification
38 Lubrication
39 Sleeves
40 Sealing and Firestopping

41
42 **RELATED WORK**

43 Section 23 05 13 - Common Motor Requirements for HVAC.
44 Section 23 33 00 - Air Duct Accessories.

45
46 **REFERENCE**

47 Applicable provisions of Division 1 govern work under this Section.

48
49 **REFERENCE STANDARDS**

50 Abbreviations of standards organizations referenced in other sections are as follows:

51 AABC Associated Air Balance Council
52 ABMA American Boiler Manufacturers Association
53 ADC Air Diffusion Council
54 AGA American Gas Association
55 AMCA Air Movement and Control Association
56 ANSI American National Standards Institute
57 ARI Air-Conditioning and Refrigeration Institute
58 ASHRAE American Society of Heating, Refrigerating and Air Conditioning Engineers
59 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	MCA	Mechanical Contractors Association
7	MICA	Midwest Insulation Contractors Association
8	MSS	Manufacturer's Standardization Society of the Valve & Fitting Industry, Inc.
9	NBS	National Bureau of Standards
10	NEBB	National Environmental Balancing Bureau
11	NEC	National Electric Code
12	NEMA	National Electrical Manufacturers Association
13	NFPA	National Fire Protection Association
14	SMACNA	Sheet Metal and Air Conditioning Contractors' National Association. Inc.
15	UL	Underwriters Laboratories Inc.
16	ASTM E814	Standard Test Method for Fire Tests of Through-Penetration Fire Stops
17	ASTM E84	Standard Test Method for Surface Burning Characteristics of Building Materials
18	UL1479	Fire Tests of Through-Penetration Firestops
19	UL723	Surface Burning Characteristics of Building Materials

20
21 **QUALITY ASSURANCE**
22 Refer to Division 1, General Conditions, Equals and Substitutions.
23

24 Where equipment or accessories are used which differ in arrangement, configuration, dimensions,
25 ratings, or engineering parameters from those indicated on the contract documents, the contractor is
26 responsible for all costs involved in integrating the equipment or accessories into the system and for
27 obtaining the performance from the system into which these items are placed. This may include
28 changes found necessary during the testing, adjusting, and balancing phase of the project.
29

30 **CONTINUITY OF EXISTING SERVICES**
31 Do not interrupt or change existing services without prior written approval from the Dane County Project
32 Representative. When interruption is required, coordinate the down-time with the user agency to
33 minimize disruption to their activities. Unless specifically stated, all work involved in interrupting or
34 changing existing services is to be done during normal working hours. See plans for areas requiring
35 work on nights and weekends.
36

37 **PROTECTION OF FINISHED SURFACES**
38 Refer to Division 1, Basic Requirements, Protection of Finished Surfaces.
39

40 Furnish one can of touch-up paint for each different color factory finish which is to be the final finished
41 surface of the product. Deliver touch-up paint with other "loose and detachable parts" as covered in the
42 Basic Requirements.
43

44 **SLEEVES AND OPENINGS**
45 Refer to Division 1, Basic Requirements, Sleeves and Openings.
46

47 **SEALING AND FIRESTOPPING**
48 Sealing and firestopping of sleeves/openings between ductwork, piping, etc. and the sleeve, structural or
49 partition opening shall be the responsibility of the contractor whose work penetrates the opening. The
50 contractor responsible shall hire individuals skilled in such work to do the sealing and fireproofing. These
51 individuals hired shall normally and routinely be employed in the sealing and fireproofing occupation.
52

53 **SUBMITTALS**
54 Refer to Division 1, General Conditions, Submittals.
55

56 Submit for all equipment and systems as indicated in the respective specification sections, marking each
57 submittal with that specification section number. Mark general catalog sheets and drawings to indicate
58 specific items being submitted and proper identification of equipment by name and/or number, as
59 indicated in the contract documents.
60

61 Before submitting electrically powered equipment, verify that the electrical power and control
62 requirements for the equipment are in agreement with the motor starter schedule on the electrical
63 drawings. Include a statement on the shop drawing transmittal to the architect/engineer that the

1 equipment submitted and the motor starter schedule is in agreement or indicate any discrepancies. See
 2 related comments in Section 23 05 13 in Part 1 under Electrical Coordination.

3
 4 Include wiring diagrams of electrically powered equipment.

5
 6 Submit sufficient quantities of shop drawings to allow the following distribution:

- 7 • Operating and Maintenance Manuals 2 copies
- 8 • Testing, Adjusting and Balancing Contractor 1 copy
- 9 • Dane County 2 copies
- 10 • A/E 2 copies

11
 12 Not more than two weeks after award of contract but before any shop drawings are submittal, the
 13 contractor shall submit the following piping system data sheet for each piping service on the project.
 14 The approved piping system data sheet(s) will be made available to the Dane County Project
 15 Representative for their use on this project.

17 Item	17 Pipe Size	17 List each piping service	17 Remarks
18 Pipe	2" & smaller	Hot water supply	
19	2.5" - 4"	Hot water supply	
20	5" & larger		
21 Fittings	2" & smaller	Hot water supply	
22	2.5" & larger	Hot water supply	
23 Nipples			
24 Branch takeoffs	2" & smaller	Hot water supply	
25 D=main, d=branch	2.5" & larger	Hot water supply	
26 Gate valves	2" & smaller	Hot water supply	
27	2.5" & larger	Hot water supply	
28 Ball valves	2" & smaller	Hot water supply	
29 Butterfly	2.5" & larger	Hot water supply	
30 Balancing valves	2" & smaller	Hot water supply	
31	2.5" & larger	Hot water supply	
32 Globe valves	2" & smaller	Hot water supply	
33	2.5" & larger	Hot water supply	
34 Check valves	2" & smaller	Hot water supply	
35	2.5" & larger	Hot water supply	
36 Silent check valves	2" & smaller	Hot water supply	
37	2.5" & larger	Hot water supply	
38 Stop & check valves	2" & smaller	Hot water supply	
39	2.5" & larger	Hot water supply	
40 Triple duty valves	2" & smaller	Hot water supply	
41	2.5" & larger	Hot water supply	
42 Flowmeters	2" & smaller	Hot water supply	
43	2.5" & larger	Hot water supply	
44 Strainers	2" & smaller	Hot water supply	
45	2.5" & larger	Hot water supply	
46 Thermometers	Mfr & scale	Hot water supply	
47 Press gauges	Mfr & scale	Hot water supply	
48 Steam traps	Mfr & type	Hot water supply	
49 Insulation by pipe size	less than 1.25"	Hot water supply	
50 (Type & thickness)	1.25"-2"	Hot water supply	
51	2.5"-4"	Hot water supply	
52	5"-6"	Hot water supply	
53	over 6"	Hot water supply	
54 Hangers	Type, mfr &		
55	figure no.	Hot water supply	
56 Hanger accessories		Hot water supply	
57 Pipe identification		Hot water supply	
58 List of specialties and accessories		Hot water supply	

59
 60 **OPERATION AND MAINTENANCE DATA**

61 All operations and maintenance data shall comply with the submission and content requirements
 62 specified under section Basic Requirements.

1 **OFF SITE STORAGE**

2 Generally, ductwork, metal for making ductwork, duct lining, sleeves, pipe/pipe fittings and similar
3 rough-in material will not be accepted for off site storage. For material that can be stored off site, no
4 material will be accepted for off site storage unless shop drawings for that material have been approved.
5

6 **CERTIFICATES AND INSPECTIONS**

7 Refer also to Division 1, General Conditions.
8

9 Obtain and pay for all required State installation inspections except those provided by the
10 Architect/Engineer in accordance with Wis Adm Code Section COMM 50.12. Deliver originals of these
11 certificates to the Dane County Representative. Include copies of the certificates in the Operating and
12 Maintenance Instructions.
13

14 **OPERATING AND MAINTENANCE INSTRUCTIONS**

15 Refer to Division 1, Basic Requirements, Operating and Maintenance Instructions.
16

17 Assemble material in three-ring or post binders, using an index at the front of each volume and tabs for
18 each system or type of equipment. In addition to the data indicated in the Basic Requirements, include
19 the following information:

- 20 • Copies of all approved shop drawings
- 21 • Manufacturer's wiring diagrams for electrically powered equipment
- 22 • Records of tests performed to certify compliance with system requirements
- 23 • Certificates of inspection by regulatory agencies
- 24 • Temperature control record drawings and control sequences
- 25 • Parts lists for manufactured equipment
- 26 • Valve schedules
- 27 • Lubrication instructions, including list/frequency of lubrication done during construction
- 28 • Warranties
- 29 • Additional information as indicated in the technical specification sections
30

31 **TRAINING OF OWNER PERSONNEL**

32 Instruct Dane County personnel in the proper operation and maintenance of systems and equipment
33 provided as part of this project; video tape all training sessions by Owner or contractor. Include not less
34 than 4 hours of instruction, using the Operating and Maintenance manuals during this instruction.
35 Demonstrate startup and shutdown procedures for all equipment. All training to be during normal
36 working hours. Schedule with Owner in advance 7 days.
37

38 **RECORD DRAWINGS**

39 Refer to Division 1, Basic Requirements, Record Drawings.
40

41 In addition to the data indicated in the Basic Requirements, maintain temperature control record
42 drawings on originals prepared by the installing contractor/subcontractor. Include copies of these record
43 drawings with the Operating and Maintenance manuals.
44
45

46 **PART 2 - PRODUCTS**

47 **ACCESS PANELS AND DOORS**

48 LAY-IN CEILINGS:

49 Removable lay-in ceiling tiles in 2 X 2 foot or 2 X 4 foot configuration are sufficient; no additional access
50 provisions are required unless specifically indicated.
51
52

53 PLASTER WALLS AND CEILINGS:

54 16 gauge frame with not less than a 20 gauge hinged door panel, prime coated steel for general
55 applications, stainless steel for use in toilets, showers, and similar wet areas, concealed hinges,
56 screwdriver operated cam latch for general applications, key lock for use in public areas, UL listed for
57 use in fire rated partitions if required by the application. Use the largest size access opening possible,
58 consistent with the space and the equipment needing service; minimum size is 12" by 12".
59

60 **IDENTIFICATION**

61 STENCILS:

62 Not less than 1 inch high letters/numbers for marking pipe and equipment.
63

1 **SNAP-ON PIPE MARKERS:**

2 Cylindrical self-coiling plastic sheet that snaps over piping insulation and is held tightly in place without
3 the use of adhesive, tape or straps. Not less than 1 inch high letters/numbers and flow direction arrows
4 for piping marking. W. H. Brady, Seton, Marking Services, or equal.

5
6 **ENGRAVED NAME PLATES:**

7 White letters on a black background, 1/16 inch thick plastic laminate, beveled edges, screw mounting,
8 Setonply Style 2060 by Seton Name Plate Company or Emedolite-Style EIP by EMED Co., or equal by
9 Marking Services, or W. H. Brady.

10
11 **VALVE TAGS:**

12 Round brass tags with 1/2 inch numbers, 1/4 inch system identification abbreviation, 1-1/4 inch minimum
13 diameter, with brass jack chains or brass "S" hooks around the valve stem, available from EMED Co.,
14 Seton Name Plate Company, Marking Services, or W. H. Brady.

15
16 **SEALING AND FIRESTOPPING**

17 **FIRE AND/OR SMOKE RATED PENETRATIONS:**

18 **Manufacturers:**

19 3M, Hilti, Rectorseal, STI/SpecSeal, Tremco, or approved equal.

20
21 All firestopping systems shall be provided by the same manufacturer.

22
23 **Submittals:**

24 Contractor shall submit product data for each firestop system. Submittals shall include product
25 characteristics, performance and limitation criteria, test data, MSDS sheets, installation details and
26 procedures for each method of installation applicable to this project. For non-standard conditions where
27 no UL tested system exists, submit manufacturer's drawings for UL system with known performance for
28 which an engineering judgement can be based upon.

29
30 **Product:**

31 Fire stop systems shall be UL listed or tested by an independent testing laboratory approved by the
32 Department of Commerce.

33
34 Use a product that has a rating not less than the rating of the wall or floor being penetrated. Reference
35 architectural drawings for identification of fire and/or smoke rated walls and floors.

36
37 Contractor shall use firestop putty, caulk sealant, intumescent wrapstrips, intumescent firestop collars,
38 firestop blocks, firestop mortar or a combination of these products to provide a UL listed system for each
39 application required for this project. Provide mineral wool backing where specified in manufacturer's
40 application detail.

41
42 **NON-RATED PENETRATIONS:**

43 **Pipe Penetrations:**

44 At pipe penetrations of non-rated interior partitions, floors and exterior walls above grade, use urethane
45 caulk in annular space between pipe insulation and sleeve. For non-rated drywall, plaster or wood
46 partitions where sleeve is not required use urethane caulk in annular space between pipe insulation and
47 wall material.

48
49 **Duct Penetrations:**

50 Annular space between duct (with or without insulation) and the non-rated partition or floor opening shall
51 not be larger than 2". Where existing openings have an annular space larger than 2", the space shall be
52 patched to match existing construction to within 2" around the duct.

53
54 Where shown or specified, pack annular space with fiberglass batt insulation or mineral wool insulation.

55
56
57 **PART 3 - EXECUTION**

58
59 **DEMOLITION**

60 Perform all demolition as indicated on the drawings to accomplish new work. Where demolition work is
61 to be performed adjacent to existing work that remains in an occupied area, construct temporary dust
62 partition to minimize the amount of contamination of the occupied space. Where pipe or duct is
63 removed and not reconnected with new work, cap ends of existing services as if they were new work.

1 Coordinate work with the Dane County Project Manager to minimize disruption to the existing building
2 occupants.

3
4 All pipe, wiring and associated conduit, insulation, ductwork, and similar items demolished, abandoned,
5 or deactivated are to be removed from the site by the Contractor. All piping and ductwork specialties are
6 to be removed from the site by the Contractor unless they are dismantled and removed or stored by the
7 Owner. All designated equipment is to be turned over to the Owner for their use at a place and time so
8 designated. Maintain the condition of material and/or equipment that is indicated to be reused equal to
9 that existing before work began.

10 **CONCRETE WORK**

11 All cast-in-place concrete will be performed by the Division 3 Contractor unless otherwise noted. Provide
12 all layout drawings, anchor bolts, metal shapes, and/or templates required to be cast into concrete or
13 used to form concrete for support of mechanical equipment.

14 **CUTTING AND PATCHING**

15 Refer to Division 1, Basic Requirements, Cutting and Patching.

16 **BUILDING ACCESS**

17 Arrange for the necessary openings in the building to allow for admittance of all apparatus. When the
18 building access was not previously arranged and must be provided by this contractor, restore any
19 opening to its original condition after the apparatus has been brought into the building.

20 **EQUIPMENT ACCESS**

21 Install all piping, conduit, ductwork, and accessories to permit access to equipment for maintenance and
22 service. Coordinate the exact location of wall and ceiling access panels and doors with the General
23 Contractor, making sure that access is available for all equipment and specialties. Access doors in
24 general construction are to be furnished by the Mechanical Contractor and installed by the General
25 Contractor.

26 Provide color coded thumb tacks or screws, depending on the surface, for use in accessible ceilings
27 which do not require access panels.

28 **COORDINATION**

29 Verify that all devices are compatible for the surfaces on which they will be used. This includes, but is
30 not limited to, diffusers, register, grilles, and recessed or semi-recessed heating and/or cooling terminal
31 units installed in/on architectural surfaces.

32 Coordinate all work with other contractors prior to installation. Any installed work that is not coordinated
33 and that interferes with other contractor's work shall be removed or relocated at the installing contractor's
34 expense.

35 Cooperate with the test and balance agency in ensuring Section 23 05 93 specification compliance.
36 Verify system completion to the test and balance agency (flushing, pressure testing, chemical treatment,
37 filling of liquid systems, proper pressurization and air venting of hydronic systems, clean filters, clean
38 strainers, duct and pipe systems cleaned, controls adjusted and calibrated, controls cycled through their
39 sequences, etc.), ready for testing, adjusting and balancing work. Install dampers, shutoff and balancing
40 valves, flow measuring devices, gauges, temperature controls, etc., required for functional and balanced
41 systems. Demonstrate the starting, interlocking and control features of each system so the test and
42 balance agency can perform its work.

43 **IDENTIFICATION**

44 Identify equipment in mechanical equipment rooms by stenciling equipment number and service with one
45 coat of black enamel against a light background or white enamel against a dark background. Use a
46 primer where necessary for proper paint adhesion. Do not label equipment such as cabinet heaters and
47 ceiling fans in occupied spaces.

48 Where stenciling is not appropriate for equipment identification, engraved name plates may be used.

49 Identify piping not less than once every 30 feet, not less than once in each room, adjacent to each
50 access door or panel, and on both side of the partition where exposed piping passes through walls, floors
51 or roofs. Place flow directional arrows at each pipe identification location. Use one coat of black enamel

1 against a light background or white enamel against a dark background for stenciling, or provide snap-on
2 pipe markers as specified in Part 2 – Products.

3
4 Identify valves with brass tags bearing a system identification and a valve sequence number. Valve tags
5 are not required at a terminal device unless the valves are greater than ten feet from the device or
6 located in another room not visible from the terminal unit. Provide a typewritten valve schedule
7 indicating the valve number and the equipment or areas supplied by each valve; locate schedules in
8 each mechanical room and in each Operating and Maintenance manual. Schedules in mechanical
9 rooms to be framed under clear plastic.

10
11 Use engraved name plates to identify control equipment.

12 13 **LUBRICATION**

14 Lubricate all bearings with lubricant as recommended by the manufacturer before the equipment is
15 operated for any reason. Once the equipment has been run, maintain lubrication in accordance with the
16 manufacturer's instructions until the work is accepted by DSF. Maintain a log of all lubricants used and
17 frequency of lubrication; include this information in the Operating and Maintenance Manuals at the
18 completion of the project.

19 20 **SLEEVES**

21 **PIPE SLEEVES:**

22 Provide galvanized sheet metal sleeves for pipe penetrations through interior and exterior walls to
23 provide a backing for sealant or firestopping. Patch wall around sleeve to match adjacent wall
24 construction and finish. Grout area around sleeve in masonry construction. In finished spaces where
25 pipe penetration through wall is exposed to view, sheet metal sleeve shall be installed flush with face of
26 wall.

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 Pipe sleeves in new poured concrete construction shall be Schedule 40 steel pipe (sized to allow
32 insulated pipe to run through sleeve), cast in place.

33
34 Extend the top of sleeve 1 inch above the adjacent floor in piping floor penetrations located in the
35 mechanical rooms and wet locations listed below. In finished areas sleeves shall be flush with rough
36 floor.

37
38 For pipe penetrations through existing floors located in food service areas, core drill sleeve opening large
39 enough to insert Schedule 40 sleeve and grout area around sleeve with hydraulic setting, non-shrink
40 grout. Size sleeve to allow insulated pipe to run through sleeve and paint the sleeve.

41
42 Pipe sleeves are not required in cored floor pipe penetrations through existing floors that are not located
43 in mechanical rooms, food service areas or wet locations listed above.

44 45 **DUCT SLEEVES:**

46 Duct sleeves are not required in non-rated partitions or floors.

47
48 Provide sleeve required for fire dampers in fire-rated partitions and floors. Reference fire damper details
49 on drawings.

50 51 **SEALING AND FIRESTOPPING**

52 **FIRE AND/OR SMOKE RATED PENETRATIONS:**

53 Install approved product in accordance with the manufacturer's instructions where pipes penetrate a
54 fire/smoke rated surface. When pipe is insulated, use a product which maintains the integrity of the
55 insulation and vapor barrier.

56
57 Where firestop mortar is used to infill large fire-rated floor openings that could be required to support
58 weight, provide permanent structural forming. Firestop mortar alone is not adequate to support any
59 substantial weight.

60 61 **NON-RATED PARTITIONS:**

1 At all interior partitions and exterior walls, pipe penetrations are required to be sealed. Apply sealant to
2 both sides of the penetration in such a manner that the annular space between the pipe sleeve or cored
3 opening and the pipe or insulation is completely blocked.
4
5 Duct penetrations through non-rated partitions shall require sheet metal escutcheons with fiberglass or
6 mineral wool insulation fill for spaces that include janitor closets, toilet rooms, mechanical rooms, and
7 where noted on drawings elsewhere.
8
9
10 END SECTION 23 05 00

1 **SECTION 23 05 13 - COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT**

2
3 **PART 1 - GENERAL**

4
5 **SCOPE**

6 This section includes requirements for single and three phase motors that are used with equipment
7 specified in other sections. Included are the following topics:

8 **PART 1 - GENERAL**

- 9 Scope
- 10 Related Work
- 11 Reference
- 12 Reference Standards
- 13 Quality Assurance
- 14 Shop Drawings
- 15 Operating and Maintenance Data
- 16 Electrical Coordination
- 17 Product Criteria

18 **PART 2 - PRODUCTS**

- 19 Three Phase, Single Speed Motors
- 20 Single Phase, Single Speed Motors
- 21 Variable Frequency Drives

22 **PART 3 - EXECUTION**

- 23 Installation

24
25 **RELATED WORK**

26 Section 23 09 23 - Electric Instrumentation and Control Devices for HVAC
27 Section 23 05 14 - Variable Frequency Drives

28
29 **REFERENCE**

30 Applicable provisions of Division 1 govern work under this Section.

31
32 **REFERENCE STANDARDS**

33 ANSI/NEMA MG-1 Motors and Generators
34 ANSI/NFPA 70 National Electrical Code

35
36 **QUALITY ASSURANCE**

37 Refer to Division 1, General Conditions, Equals and Substitutions.

38
39 **SHOP DRAWINGS**

40 Refer to Division 1, General Conditions, Submittals.

41
42 Include with the equipment which the motor drives the following motor information: motor manufacturer,
43 horsepower, voltage, phase, hertz, rpm, full load efficiency. Include project wiring diagrams prepared by
44 the contractor specifically for this work.

45
46 **OPERATION AND MAINTENANCE DATA**

47 All operations and maintenance data shall comply with the submission and content requirements
48 specified under section Basic Requirements.

49
50 **ELECTRICAL COORDINATION**

51 All starters, overload relay heater coils, disconnect switches and fuses, relays, wire, conduit,
52 pushbuttons, pilot lights, and other devices required for the control of motors or electrical equipment are
53 furnished and installed by the Electrical Contractor, except as specifically noted elsewhere in this division
54 of specifications.

55
56 Electrical drawings and/or specifications show number and horsepower rating of all motors furnished by
57 this Contractor, together with their actuating devices if these devices are furnished by the Electrical
58 Contractor. Should any discrepancy in size, horsepower rating, electrical characteristics or means of

1 control be found for any motor or other electrical equipment after contracts are awarded, Contractor is to
2 immediately notify the architect/engineer of such discrepancy. Costs involved in any changes required
3 due to equipment substitutions initiated by this contractor will be the responsibility of this contractor. See
4 related comments in Section 23 05 00 - Common Work Results for HVAC, under Shop Drawings.

5
6 Electrical Contractor will provide all power wiring and control wiring, except temperature control wiring.

7
8 Furnish project specific wiring diagrams to Electrical Contractor for all equipment and devices furnished
9 by this Contractor and indicated to be wired by the Electrical Contractor.

10
11 **PRODUCT CRITERIA**

12 Motors to conform to all applicable requirements of NEMA, IEEE, ANSI, and NEC standards and shall be
13 listed by U.L. for the service specified.

14
15 Select motors for conditions in which they will be required to perform; i.e., general purpose, splashproof,
16 explosion proof, standard duty, high torque or any other special type as required by the equipment or
17 motor manufacturer's recommendations.

18
19 Furnish motors for starting in accordance with utility requirements and compatible with starters as
20 specified.

21
22
23 **PART 2 - PRODUCTS**

24
25 **THREE PHASE, SINGLE SPEED MOTORS**

26 Use NEMA rated 208 volt, three phase, 60 hertz motors for all motors 1/2 HP and larger unless
27 specifically indicated.

28
29 Use NEMA general purpose, continuous duty, Design B , normal starting torque, T-frame or U-frame
30 motors with Class B or better insulation unless the manufacturer of the equipment on which the motor is
31 being used has different requirements. Use open drip-proof motors unless totally enclosed fan-cooled,
32 totally enclosed non-ventilated, explosion-proof, or encapsulated motors are specified in the equipment
33 sections.

34
35 Use grease lubricated anti-friction ball bearings with housings equipped with plugged/capped provision
36 for relubrication, rated for minimum AFBMA 9, L-10 life of 20,000 hours. Calculate bearing load with
37 NEMA minimum V-belt pulley with belt center line at the end of NEMA standard shaft extension. Stamp
38 bearing sizes on nameplate.

39
40 All open drip-proof motors to have a 1.15 service factor. Other motor types may have minimum 1.0
41 service factors.

42
43 All motors 1 HP and larger, except specially wound motors and inline pump motors 56 frame and
44 smaller, to be high efficiency design with full load efficiencies which meet or exceed the values listed
45 below when tested in accordance with NEMA MG 1.

46
47 **FULL LOAD NOMINAL MOTOR EFFICIENCY BY MOTOR SIZE AND SPEED**

48 -----Open Drip-Proof Motors-----
49 -----Nominal Motor Speed-----

MOTOR HP	1200 rpm	1800 rpm	3600 rpm
1	82.5	85.5	77.0
1-1/2	86.5	86.5	84.0
2	87.5	86.5	85.5
3	88.5	89.5	85.5
5	89.5	89.5	86.5
7-1/2	90.2	91.0	88.5
10	91.7	91.7	89.5
15	91.7	93.0	90.2
20	92.4	93.0	91.0

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
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
62
63

MOTOR HP	----Totally Enclosed Fan-Cooled----		
	-----Nominal Motor Speed-----		
	1200 rpm	1800 rpm	3600 rpm
1	82.5	85.5	77.0
1-1/2	87.5	86.5	84.0
2	88.5	86.5	85.5
3	89.5	89.5	86.5
5	89.5	89.5	88.5
7-1/2	91.0	91.7	89.5
10	91.0	91.7	90.2
15	91.7	92.4	91.0
20	91.7	93.0	91.0
25	93.0	93.6	91.7
30	93.0	93.6	91.7
40	94.1	94.1	92.4

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 SECTION 23 05 13

1 **SECTION 23 05 14 - VARIABLE FREQUENCY DRIVES**

2
3 **PART 1 GENERAL**

4
5 Applicable provisions of Division 1 shall govern all work under this Section.

6
7 **SCOPE**

8 This section includes variable frequency drives, bypass starters, and line reactors. Included are the
9 following topics:

10 **PART 1 - GENERAL**

- 11 Scope
- 12 Related Work
- 13 Reference
- 14 Reference Standards
- 15 Submittals
- 16 Operating and Maintenance Data
- 17 Equipment Startup
- 18 Warranty

19 **PART 2 - PRODUCTS**

- 20 Manufacturers
- 21 Design and Construction
- 22 Performance Requirements
- 23 Control Features
- 24 Protection Features
- 25 Diagnostics
- 26 Quality Assurance Tests
- 27 Bypass Equipment
- 28 AC Input Line Reactors
- 29 Output Line Filters

30 **PART 3 - EXECUTION**

- 31 Variable Frequency Drives (VFD)

32
33 **RELATED WORK**

- 34 Section 23 21 23 - Hydronic Pumps
- 35 Section 23 34 00 - HVAC Fans

36
37 **REFERENCE**

38 Applicable provisions of Division 1 govern work under this Section.

39
40 **REFERENCE STANDARDS**

41 ANSI/IEEE 519 Guide for Harmonic Control and Reactive Compensation of Static Power Converters

42
43 **SUBMITTALS**

44 Submit shop drawings and product data under provisions of Division 1, General Conditions of the
45 Contract.

46
47 Include physical, electrical, and performance characteristics of each variable frequency drive and
48 associated components, including dimensions; weight; input and output performance; voltage, phase,
49 current and overcurrent characteristics; installation instructions; protective features; wiring and block
50 diagrams indicating specified options; electrical noise attenuation equipment where required to meet the

1 criteria specified; line side voltage notch wave form and line side current harmonics; certified efficiency
2 versus load and speed curves; and required operating environment.

3 4 **OPERATION AND MAINTENANCE DATA**

5 All operations and maintenance data shall comply with the submission and content requirements
6 specified under section Basic Requirements.

7 8 **EQUIPMENT STARTUP AND TRAINING**

9 Provide the services of a factory trained and certified technician to approve the installation; start-up, test,
10 and adjust for proper operation of the unit(s). Upon completion of the equipment startup, submit a
11 complete manufacturer's field report, including startup and test log, signed by the factory trained
12 technician. Coordinate with the Temperature Control Contractor and the Balancing Contractor. The
13 startup shall be coordinated with Division 26. Electrical and shall be completed within ten (10) working
14 days from the startup date as set by the Dane County Project Manager.

15 16 **WARRANTY**

17 The warranty shall be for a period of twenty-four (24) months from the date of project Substantial
18 Completion. Further, the warranty shall include all parts, labor, travel time, administrative costs,
19 overhead, travel expenses, technical support and any and all other costs to provide the warranty service.

20 21 22 **PART 2 PRODUCTS**

23 24 **DESIGN AND CONSTRUCTION**

25 The unit shall be variable torque, modular design for control of the motors as specified in Division 23 and
26 rated at the motor full load nameplate amps.

27
28 The unit shall be U.L. listed, solid state, micro processor-based with a pulse width modulated output
29 wave form (none others are acceptable).

30
31 The VFD shall employ a full wave bridge rectifier and capacitors to minimize the ripple of the rectified
32 voltage to maintain near constant DC voltage. Insulated gate bipolar transistors shall be employed as
33 the output switching device.

34
35 The VFD package shall contain the equivalent of 5% impedance to reduce harmonic distortion. The 5%
36 equivalent impedance shall be provided in the form of a DC bus choke, an input AC line reactor in each
37 phase, or a combination of the two methods.

38
39 Control circuitry shall be plug-in, plug-out modular basis with a corrosion resistant coating on printed
40 circuit boards.

41
42 Units to be suitable for an operating environment from 0°C to 40°C temperature and humidity up to 90%
43 non-condensing.

44
45 Electrically and physically isolate control circuitry and conductors from power circuitry and power
46 conductors. Control conductors and power conductors shall not be run in the same pathway.

47
48 The unit enclosure shall be NEMA 1 as required for the application minimum and all components shall be
49 fully factory assembled and tested prior to leaving the manufacturing facility.

50
51 Include the following operating and monitoring devices mounted on the front cover:

52 A disconnect switch or circuit breaker to de-energize both the drive and bypass circuit with door
53 interlocked handle and lock-open padlocking provisions.

54 Operating mode selector switch marked "hand-off-auto".

55 Manual speed adjustment via keypad, mounted on the door.

56 Manual bypass selector switch to select power through drive or bypass (if a bypass is provided).

1
2 Provide a manual bypass circuit and bypass starter to transfer from variable frequency drive operation to
3 bypass operation (if a bypass is provided).
4

5 **PERFORMANCE REQUIREMENTS**

6 Units shall be suitable for input power of electrical system as scheduled on the drawings $\pm 10\%$, 3 phase,
7 60 Hertz nominal.
8

9 Use a current limiting control device to limit output current to 110% continuous for one minute; also refer
10 to Protection Features in this Section. Full load output current available from drive shall not be less than
11 motor nameplate amperage. The full load amp rating of the VFD shall not be less than the values
12 indicated in the NEC Table 430-150.
13

14 Output power shall be suitable for driving standard NEMA B design, three phase alternating current
15 induction motors at full rated speed with capability of 6:1 turndown.
16

17 Additional performance capabilities to include the following:

- 18 Ride through a momentary power outage of 15 cycles;
- 19 Start into a rotating load without damage to drive components or motor;
- 20 Capable of automatic restart into a rotating load after a preset, adjustable time delay
21 following a power outage;
- 22 Input power factor: Min 0.95 throughout the speed range; and
- 23 Minimum efficiency: 95% at 100% speed, 85% at 50% speed.
24

25 **CONTROL FEATURES**

26 Use control circuits compatible with input signal from temperature control system in the automatic mode
27 and from manual speed control in the manual mode. Vary motor speed in response to the input control
28 signal. Include components necessary to accept the signal from the temperature control system in the
29 form that it is sent. Refer to Division 23.
30

31 Include the following additional control features:

- 32 • Hand-Off-Automatic (HOA) selector switch to select local or remote start/stop and speed control
- 33 • Analog input, selectable 0-10v or 4-20 mA, for automatic control from the temperature control
34 system
- 35 • Local speed control at the VFD
- 36 • Adjustable acceleration and deceleration rate so that the time period from start to full speed and from
37 full speed to stop can be field adjusted
- 38 • Adjustable minimum and maximum speed settings for both automatic and manual modes of
39 operation
- 40 • Manual transfer bypass circuit
- 41 • Field adjustment of minimum and maximum output frequency
- 42 • Two (2) sets of programmable form "C" contacts for remote indication of variable frequency drive
43 condition. Note: default programming to be set for "Drive Run & Fault"
- 44 • Illuminated display keypad
- 45 • External Fault indicator
- 46 • One (1) input for a N.O. dry contact type input for a 2-wire remote start/stop
- 47 • One (1) input for a N.C. dry contact type input for external faults: (freezestats, fire alarm, smokes,
48 etc.). This input shall be factory wired to prevent both the VFD and bypass starter operation when
49 external fault is present
- 50 • One (1) N.O. dry contact output for proving motor status. This output shall be programmed to detect
51 belt or coupling break that would remove the load from the motor. The dry contact will open on loss
52 of load or VFD being off
- 53 • PID control loop capable of VFD control from an external device connected to a VFD analog input
54

55 **PROTECTION FEATURES**

1 Use electronic protection circuitry in the power circuits to provide an orderly shutdown of the drive
2 without blowing fuses or tripping circuit breakers and prevent component loss under the following
3 abnormal conditions:

- 4 Activation of any safety device;
- 5 Instantaneous overcurrent and/or over voltage of output;
- 6 Power line overvoltage and undervoltage protection;
- 7 Phase loss;
- 8 Single and three phase short circuiting;
- 9 Ground faults;
- 10 Control circuit malfunction;
- 11 Overtemperature; and
- 12 Output current over limit.

13
14 Provide the following additional protective features:

- 15 • Input transient overvoltage protection up to 3000 volts per ANSI 37.90A;
- 16 • DC bus fusing or other electronic controls which limit the rate of rise of the DC bus current and de-
17 energizes the drive at a predetermined current level;
- 18 • Fusing for the control circuit transformer;
- 19 • Grounded control chassis; and
- 20 • Devices and/or control circuitry to ensure that the variable frequency drive and bypass starter are not
21 both energized and driving motor simultaneously.

22 23 **DIAGNOSTICS**

24 Provide an English character display (no error codes) with indicators for the following:

- 25 Phase loss
- 26 Ground fault
- 27 Overcurrent
- 28 Overvoltage
- 29 Undervoltage
- 30 Over temperature
- 31 Overload
- 32 DC bus status

33 34 **QUALITY ASSURANCE TESTS**

35 Use a factory heat stress test to verify proper operation of all functions and components under full load.
36

37 Field performance test of variable frequency drives to determine compliance with this specification will
38 be performed at the Dane County Project Manager's discretion and may include any specified feature,
39 including operation of protective devices through a simulated fault. Contractor will pay for initial testing.
40 Should drive be found deficient by this testing, drive manufacturer will be required to make any and all
41 changes necessary to bring unit(s) into compliance with the specified performance and demonstrate this
42 performance by retesting. Cost of changes and retest will be by this contractor.
43

44 Variable frequency drive manufacturer or designated representative to perform a field test of each drive,
45 in the presence of the Dane County's representative, for the following items:

- 46 • Provide general inspection to verify proper installation;
- 47 • Demonstrate drive reaction to simulated power interruptions of two seconds and sixty seconds; and
- 48 • Demonstrate adequate protection during switching from variable frequency drive operation to bypass
49 starter operation and back again.

50 51 **BYPASS EQUIPMENT**

52 Bypass Starters:

- 53 The bypass starters for 208 volt motors, 20 HP and less; and 480 volt motors, 40 HP and less,
54 shall be across-the-line magnetic starter type.

1 Bypass Configuration:

2 Provide one main disconnect switch or circuit breaker to de-energize both the drive and bypass
3 circuit. Provide a drive input disconnect switch or fuse block to allow the drive to be isolated
4 while the bypass circuit is energized. Provide one output drive contactor and one output bypass
5 contactor. The two output contactors shall be electrically interlocked to allow only one contactor
6 to be closed at any one time.

7
8 Provide motor overload protection in the bypass circuit.

9
10 Provide bypass equipment in a common enclosure with the VFD or, if not available, in a separate
11 enclosure.

12 **AC INPUT LINE REACTORS**

13
14 When needed to comply with the requirement for 5% equivalent impedance, furnish and factory install
15 AC input line reactors.

16
17 Line reactors shall be installed in each phase of the AC input side of the VFD and mounted within a
18 common enclosure with the VFD.

19
20 Line reactor shall be a three phase inductor, iron core, 600V, Class H insulation, 115 degree C rise,
21 copper windings with screw type terminal blocks.

22
23 **PART 3 EXECUTION**

24
25 **VARIABLE FREQUENCY DRIVES**

26
27 Install where indicated on drawings and in accordance with approved submittals and manufacturer's
28 published recommendations. Installation to be by the Division 26 Electrical Contractor.

29
30 Input power wiring shall be installed in a separate conduit, output power wiring shall be installed in a
31 separate conduit and control wiring shall be installed in a separate conduit. Do not mix input power,
32 output power, or control wiring in a common conduit. Power wiring shall be furnished and installed by the
33 Division 26 Electrical Contractor. If provided, do not mount output line filter above the drive.

34
35 Control signal for drive will be provided under Division 23.

36
37 Temperature Control Contractor will furnish and install the required temperature control wiring in metal
38 conduit and in accordance with Division 26 Electrical of these Construction Documents.

39
40
41 END SECTION 23 05 14

1 **SECTION 23 05 15 - PIPING SPECIALTIES**

2
3 **PART 1 - GENERAL**

4
5 **SCOPE**

6 This section contains specifications for HVAC piping specialties for all piping systems. Included are the
7 following topics:

8 **PART 1 - GENERAL**

- 9 Scope
- 10 Related Work
- 11 Reference
- 12 Quality Assurance
- 13 Shop Drawings
- 14 Operation and Maintenance Data
- 15 Design Criteria

16 **PART 2 - PRODUCTS**

- 17 Thermometers
- 18 Thermometer Sockets
- 19 Test Wells
- 20 P/T (Pressure/Temperature) Test Plugs
- 21 Pressure Gauges
- 22 Expansion Loops
- 23 Strainers
- 24 Expansion Tanks
- 25 Air Separators
- 26 Air Vents
- 27 Differential Pressure Gauge

28 **PART 3 - EXECUTION**

- 29 Thermometers
- 30 Thermometer Sockets
- 31 Test Wells
- 32 P/T (Pressure/Temperature) Test Plugs
- 33 Pressure Gauges
- 34 Expansion Loops
- 35 Strainers
- 36 Expansion Tanks
- 37 Air Separators
- 38 Air Vents
- 39 Differential Pressure Gauge

40
41 **RELATED WORK**

- 42 Section 23 21 13 - Hydronic Piping
- 43 Section 23 83 16 - Radiant-Heating Hydronic Piping
- 44 Section 23 05 23 - General-Duty Valves for HVAC Piping
- 45 Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment
- 46 Section 23 07 00 - HVAC Insulation

47
48 **REFERENCE**

49 Applicable provisions of Division 1 govern work under this Section.

50
51 **QUALITY ASSURANCE**

52 Refer to Division 1, General Conditions, Equals and Substitutions.

53
54 **SHOP DRAWINGS**

55 Refer to Division 1, General Conditions, Submittals.

56

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
7 specified under section Basic Requirements.

8
9 **DESIGN CRITERIA**

10 All piping specialties are to be rated for the highest pressures and temperatures in the respective system
11 in 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
21 thickness of any insulation, red indicating fluid, black lettering against a white background, with scale
22 ranges as follows:

Service	Scale Range, °F	Min. Increment, °F
Hot Water	30 - 240	2

23
24
25
26
27 **THERMOMETER SOCKETS**

28 Brass with threaded connections suitable for thermometer stems and temperature control sensing
29 elements in pipeline. Furnish with extension necks for insulated piping systems.

30
31 **TEST WELLS**

32 Similar to thermometer sockets except with a brass cap that thread into the inside of the test well to
33 prevent dirt from accumulating. Secure cap to body with a short chain. Furnish with extension necks,
34 where appropriate, to accommodate the pipeline insulation.

35
36 **P/T (PRESSURE/TEMPERATURE) TEST PLUGS**

37 Brass plug with 1/4" NPT threads, EPDM or neoprene valve core, knurled cap with cap strap. Use
38 extended length plugs to clear insulated piping. Adaptors shall have 1/4" FPT connection for standard
39 pressure gauges.

40
41 **PRESSURE GAUGES**

42 Manufacturers: Ametek/U. S. Gauge Division, Ashcroft, Marsh, Taylor, H. O. Trerice, Weiss, Weksler.

43
44 Cast aluminum case of not less than 4.5 inches in diameter, double strength glass window, black
45 lettering on a white background, phosphor bronze bourdon tube with bronze bushings, recalibration from
46 the front of the dial, 99% accuracy over the middle half of the scale, 98.5% accuracy over the remainder
47 of the scale, with scale range as follows:

Service	Scale Range, psig	Min. Increment, psig
Hot Water	0-60	1

48
49
50
51
52 **PRESSURE SNUBBERS:**

53 Bronze construction, suitable for system working pressure, 1/4" size.

54
55 **COIL SYPHONS:**

56 Bronze or steel construction, suitable for system working pressure, 1/4" size.

57
58 **GAUGE VALVES:**

59 Use valves as specified in Section 23 05 23 - General-Duty Valves for HVAC Piping. For water systems,
60 use 1/4" ball valves. For steam systems, use 1/4" gate valves suitable for system working pressure.

61
62 **EXPANSION LOOPS**

63 Provide expansion loops indicated on the drawings and details.

1
2 **STRAINERS**

3 Manufacturers: Armstrong, Hoffman, Illinois, Keckley, Metraflex, Mueller Steam, or Sarco.
4

5 **WATER SYSTEMS:**

6 Y type; cast iron body; stainless steel screens; bolted or threaded screen retainer tapped for a blowoff
7 valve; threaded body in sizes through 2 inch and rated at not less than 175 psi WOG; flanged body in
8 sizes over 2 inch and rated at not less than 125 psi WOG at 240°F. Screen to be 20 mesh for line sizes
9 2 inch and less, 0.125 inch perforations for line sizes 2-1/2 inch through 4 inch, and 0.25 inch
10 perforations for line sizes 5 inch and larger.
11

12 **EXPANSION TANKS**

13 Manufacturers: Amtrol/Thrush, Armstrong Pumps, Bell and Gossett, Taco, Wessels.
14

15 **STANDARD TYPE:**

16 Steel construction, tested and stamped in accordance with Section 8D of the ANSI/ASME Code and
17 furnished with the National Board Form U-1, red line gauge glass with guard and cocks, drain valve with
18 hose adapter, air charging device, system connection, rated for not less than 125 psi working pressure,
19 prime coated, mounting saddles for horizontal installation or base for vertical installation, size/capacity
20 as indicated on the drawings.
21

22 **AIR SEPARATORS**

23 Manufacturers: Amtrol/Thrush, Armstrong Pumps, Bell and Gossett, Taco.
24

25 1-1/2 inch and smaller: Cast iron construction, suitable for in-line installation, top and bottom
26 connections for use with expansion tanks specified above, rated at not less than 125 psig at 220°F.
27

28 2 inch and larger: Welded steel construction, ASME constructed and stamped for a working pressure not
29 less than 125 psig at 220°F, threaded or flanged connections for 2 inch size, flanged or grooved
30 connections if grooved piping is allowed for all sizes over 2 inch, suitable for use with expansion tanks
31 specified above, drain connection at the bottom of unit, vent/tank connection at the top of unit, suitable
32 for the system flow rates as indicated on the drawings. Include a galvanized or stainless steel strainer
33 with provisions in the unit shell for strainer removal. Provide a blowdown connection located so that the
34 inside surface of the strainer can be cleaned by draining the system fluid through the blowdown
35 connection.
36

37 **AIR VENTS**

38 **MANUAL KEY TYPE VENTS:**

39 Bell and Gossett Model 4V; Eaton/Dole Model 9, 9B, or 14A.
40

41 Bronze body with nonferrous internal parts, screwdriver operated, designed to relieve air from the system
42 when vent is opened, rated at not less than 125 psig at 220°F.
43

44 **MANUAL BALL VALVE VENTS:**

45 Provide 1/4" ball valves for manual venting of air handling unit coils and where indicated elsewhere on
46 drawings and details. Reference specifications section 23 05 23.
47

48 **AUTOMATIC VENTS:**

49 Thrush Model 720, Bell and Gossett Model 107, Watson McDaniel Model AV813W
50

51 Cast iron body with nonferrous internal parts, designed to vent air automatically with float principle
52 without allowing air to enter the system, rated at not less than 125 psig at 220°F.
53

54 **DIFFERENTIAL PRESSURE GAUGE**

55 Barton 247A, Midwest 809, or approved equal.
56

57 Bellows type differential pressure meter kit that includes a six inch diameter gauge with a 270° arc
58 having an accuracy of ±1% of full scale or better and suitable for the differential pressures of the flow
59 meters supplied for this project, over range protection on the meter, color coded hoses not less than ten
60 feet in length with brass connectors suitable for connection to the low and high pressure connections on
61 the balance valves, inline strainers, instrument valving so meter can be vented and drained, pressure
62 and temperature rating at least equal to that of the valves. Provide meter and all accessories in a
63 durable case with carrying handle.

1
2
3 **PART 3 - EXECUTION**
4

5 **THERMOMETERS**

6 **STEM TYPE:**

7 Install in piping systems as indicated on the drawings and/or details using a separable socket in each
8 location.
9

10 **DIAL TYPE FOR AIR TEMPERATURE MEASUREMENT:**

11 Install in ductwork where detailed or specified. Support capillary inside duct so it measures a uniform
12 sample of air. Mount readout so it is readily visible on a portion of ductwork that is not externally
13 insulated or on a sheetmetal angle support secured to a nearby structural element.
14

15 **THERMOMETER SOCKETS**

16 Install at each point where a thermometer or temperature control sensing element is located in a
17 pipeline.
18

19 **TEST WELLS**

20 Install in piping systems as indicated on the drawings and/or details wherever provisions are needed for
21 inserting a thermometer at a later date.
22

23 **P/T (PRESSURE/TEMPERATURE) TEST PLUGS**

24 Install in piping systems as indicated on the drawings and/or details. Do not insulate over test plugs.
25

26 **PRESSURE GAUGES**

27 Install in locations where indicated on the drawings and/or details, including any gauge piping, with scale
28 range appropriate to the system operating pressures.
29

30 **PRESSURE SNUBBERS:**

31 Install in gauge piping for all gauges used on water services.
32

33 **COIL SYPHONS:**

34 Install in gauge piping for all gauges used on steam services.
35

36 **GAUGE VALVES**

37 Install at each gauge location as close to the main as possible and at each location where a gauge
38 tapping is indicated.
39

40 **EXPANSION LOOPS**

41 Install where indicated on the drawings or details, locating anchors and guides as detailed.
42

43 **STRAINERS**

44 Install all strainers where indicated on the project details, allowing sufficient space for the screens to be
45 removed. Rotate screen retainer where required by the installation so blowdown can remove
46 accumulated dirt from the strainer body.
47

48 **WATER SYSTEMS:**

49 Install a ball valve for blowdown in the tapped screen retainer; valve to be the same size as the tapping.
50

51 **EXPANSION TANK**

52 Install tanks where indicated on the drawings, coordinating concrete base installation with the General
53 Contractor or fabricating steel supports to suit the application. Install all specified tank accessories.
54

55 **STANDARD TANKS:**

56 Charge tank with the proper amount of air and water during the initial fill after the system has been
57 flushed and cleaned.
58

59 **AIR SEPARATORS**

60 Mount in hot water lines as indicated on the drawings/details. Install ball valve with hose adapter in
61 bottom blowdown connection.
62

1 Open the drain valve and blowdown the strainer after system cleaning and again after 30 days of
2 operation.

3
4 **AIR VENTS**

5 **MANUAL KEY TYPE VENTS:**

6 Install at all high points where air may collect and not be carried by the system fluid. Use a soft Type L
7 copper "pigtail" so the vent can be positioned for venting and collecting any water that might escape.

8
9 **MANUAL BALL VALVE VENTS:**

10 Install on air handling coils and where indicated elsewhere as shown on drawings and details.

11
12 **AUTOMATIC VENTS:**

13 Install on the top of air separators on systems using bladder type expansion tanks. Install at other
14 locations as indicated on the drawings or details. All locations to have a ball valve installed upstream of
15 the vent for maintenance purposes.

16
17 **DIFFERENTIAL PRESSURE GAUGE**

18 Handle as a loose and detachable part as outlined in the Basic Requirements.

19
20
21 **END SECTION 23 05 15**

1 **SECTION 23 05 23 - GENERAL-DUTY VALVES FOR HVAC PIPING**

2
3 **PART 1 - GENERAL**

4
5 **SCOPE**

6 This section includes valve specifications for all HVAC systems except where indicated under Related
7 Work. Included are the following topics:

8 **PART 1 - GENERAL**

9 Scope
10 Related Work
11 Reference
12 Quality Assurance
13 Submittals
14 Operation and Maintenance Data
15 Design Criteria

16 **PART 2 - PRODUCTS**

17 Manufacturers
18 Water System Valves
19 Gate Valves
20 Ball Valves
21 Butterfly Valves
22 Globe Valves
23 Spring Loaded Check Valves
24 Balance Valves
25 Drain Valves
26 Combination Shut-off, Check, and Balancing Valves
27 Water Pressure Reducing Valves
28 Water Relief Valves
29 Natural Gas Systems
30 Shut-off Valves
31 Gas Pressure Regulators

32 **PART 3 - EXECUTION**

33 General
34 Shut-off Valves
35 Balancing Valves
36 Calibrated Balancing Valves
37 Drain Valves
38 Safety Relief Valves
39 Spring Loaded Check Valves
40 Combination Shut-off, Check, and Balancing Valves
41 Pressure Reducing Valves
42 Gas Pressure Regulators

43
44 **RELATED WORK**

45 Section 23 05 15 - Piping Specialties

46
47 **REFERENCE**

48 Applicable provisions of Division 1 govern work under this Section.

49
50 **QUALITY ASSURANCE**

51 Refer to Division 1, General Conditions, Equals and Substitutions.

52
53 **SUBMITTALS**

54 Refer to Division 1, General Conditions, Submittals.

55
56 Contractors shall submit a schedule of all valves indicating type of service, dimensions, materials of
57 construction, and pressure/temperature ratings for all valves to be used on the project. Temperature
58 ratings specified are for continuous operation.

1
2 **OPERATION AND MAINTENANCE DATA**

3 All operations and maintenance data shall comply with the submission and content requirements
4 specified under section Basic Requirements.

5
6 **DESIGN CRITERIA**

7 Where valves are specified for individual mechanical services (i.e. hot water heating, steam, etc.) all
8 valves shall be of the same manufacturer unless prior written approval is obtained from Owner.
9

10
11 **PART 2 - PRODUCTS**

12
13 **MANUFACTURERS**

14 Anvil, Armstrong, Bell & Gossett, Cash-Acme, Consolidated, Conval, Crane, Crosby, DeZurik, Durco,
15 Fisher, Grinnell, Griswald, Hammond, Hancock, Hoffman, Illinois, Jamesbury, Keystone, Kunkle, Leslie,
16 Lunkenheimer, Metraflex, Milwaukee, Mission, Mueller, Newco, Nexus, Nibco, Powell, RP&C, Sarco,
17 Spence, Stockham, Taco, Tasco, Thrush-Amtrol, Vogt, Watts, or approved equal.
18

19 **WATER SYSTEM VALVES**

20 All water system valves to be rated at not less than 125 psig water working pressure at 240°F unless
21 noted otherwise.

22
23 **GATE VALVES:**

24 2" and smaller: Use ball valves; gate valves will not be accepted in sizes 2" and smaller.

25
26 2-1/2" and larger: Use butterfly valves; gate valves will not be accepted in sizes 2-1/2" and larger.
27

28 **BALL VALVES:**

29 2" and smaller: Two piece bronze body; threaded or soldered ends, as appropriate to the pipe material;
30 stainless steel or chrome plated brass/bronze ball; conventional port; glass filled teflon seat; threaded
31 packing gland follower; blowout-proof stem; 600 psig WOG.
32

33 Valve stems shall allow operators to clear insulation without interference. Provide stem extensions when
34 valve operators interfere with pipe insulation.
35

36 Apollo 70-100/200 series, Hammond 8301/8311, Milwaukee BA100/150, Nibco T/S 585-70, Stockham
37 S206/216.
38

39 2-1/2" and over: Ball valves will not be accepted in sizes over 2 inch.
40

41 **BUTTERFLY VALVES:**

42 2" and smaller: Use ball valves; butterfly valves will not be accepted in sizes 2 inch and smaller.
43

44 2-1/2" and larger: Cast iron body; stainless steel shaft; Teflon, nylatron, or acetal bearings; EPDM
45 resilient seat. Disk to be bronze, aluminum-bronze, nickel plated ductile iron, cast iron with welded nickel
46 edge, or stainless steel. Pressure rated to 150 psig. Valve assembly to be bi-directionally bubble tight to
47 150 psig with no downstream flange/pipe attached. Polyimide or polyamide coated valves are not
48 acceptable.
49

50 Valve stems shall allow operators to clear insulation without interference. Provide stem extensions when
51 valve operators interfere with pipe insulation.
52

53 Use threaded lug type valves for installation with class 125/150 flanges.
54

55 Centerline series 200, DeZurik BGS II, Keystone Fig. 222, Nibco LD2000 (2-1/2"-12")/LD1000 (14" and
56 above), Victaulic 300 series (2-1/2"-12")/709 series (14"-24").
57

58 Provide ten-position lever actuators for valves 2" and smaller. Provide worm gear operators for valves
59 3" and larger.
60

61 Where butterfly valves are indicated or specified to be installed at the location of a flow sensing device,
62 provide the butterfly valves with a memory stop.
63

1 GLOBE VALVES:
2 Do not use globe valves for water service, except in temperature control applications.
3
4 SPRING LOADED CHECK VALVES:
5 2" and smaller: Class 125, bronze body, threaded, solder or wafer ends, bronze trim, stainless steel
6 spring, teflon seat unless only bronze available.
7
8 APCO 300 series, ConBraCo 61 series, Mueller 303BP, Nibco T-480-Y/S-480-Y, Val-Matic 1400 series.
9
10 2-1/2" and larger: Class 125, cast iron or semi-steel body, wafer or globe flanged type, bronze trim,
11 bronze or EPDM seat, stainless steel spring, stainless steel stem if stem is required. Valves with ductile
12 iron in contact with the working fluid will not be accepted.
13
14 APCO 600 series, Metraflex 900 series, Milwaukee 1800 series, Mueller Steam 101M-AP/105M-AP,
15 Nibco F910 series, Val-Matic 1800 series, Victaulic series 716.
16
17 BALANCE VALVES:
18 2" and smaller: Bronze or copper alloy body with calibrated ball, globe or venturi/valve arrangement,
19 integral pointer and calibrated scale to register degree of valve opening, memory stop, drain tapping,
20 threaded or soldered ends, with or without integral unions, P/T or Shraeder pressure taps with integral
21 check valves and seals, adjustable memory stop, suitable for 200 psig water working pressure at 250°F.
22
23 Armstrong CBV, Bell & Gossett Circuit Setter Plus, Griswald Quickset, Illinois 6000 series, Nexus Orturi,
24 Nibco 1710 Series, Taco Accu-Flo, Tour & Anderson STAS/STAD, Victaulic series 786/787.
25
26 Include one bellows type differential pressure meter kit that includes a six inch diameter gauge with 270°
27 arc readout and having an accuracy of ±1% of full scale or better and suitable for the differential
28 pressures of the valves supplied for this project, over-range protection, color coded hoses not less than
29 ten feet in length with brass connectors suitable for connection to the low and high pressure connections
30 on the balance valves, instrument valving so meter can be vented and drained, pressure and
31 temperature rating at least equal to that of the valves. Provide meter and all accessories in a durable
32 case with carrying handle.
33
34 Barton 247A, Midwest 809.
35
36 2-1/2" and larger: Use butterfly valves as specified in this section along with a flow sensing device as
37 specified in Section 23 05 15.
38
39 DRAIN VALVES:
40 Use 3/4 inch ball valve with threaded hose adapter except strainer blowdown valves to be the same size
41 as the blowdown connection.
42
43 COMBINATION SHUT-OFF, CHECK, AND BALANCE VALVES:
44 2 inch and larger: Cast or ductile iron body, threaded or flanged or grooved end connections, stainless
45 steel spring, bronze disc with EPDM seat, calibrated memory stop, backseating valve stem, inlet and
46 outlet pressure tappings, capable of being repacked under full line pressure, and suitable for a minimum
47 working pressure of 175 psig at 240°F when used in hot water heating systems.
48
49 Armstrong Flo-Trex, Bell & Gossett Triple Duty, Taco Multi Purpose Valve, Thrush-Amtrol Tri-Flow.
50
51 WATER PRESSURE REDUCING VALVES:
52 Brass or bronze body, diaphragm operated, with an integral anti-syphon check valve, inlet strainer, and
53 adjustable reduced pressure range but pre-set for the scheduled pressure, 125 psig at 225°F.
54
55 Bell & Gossett, Cash-Acme, or Watts.
56
57 WATER RELIEF VALVES:
58 Iron or bronze body, direct pressure actuated, teflon seat, stainless steel stem and spring, suitable for
59 125 psig water working pressure at 240° F and ASME stamped, with Btu capacity and set point as
60 scheduled.
61
62 Bell & Gossett, Cash-Acme, Consolidated, Kunkle, Watts.
63

1 **NATURAL GAS SYSTEMS**

2 **SHUT OFF VALVES:**

3 2" and smaller: Ball valve, bronze body, threaded ends, stainless steel ball, full or conventional port,
4 teflon seat, blowout-proof stem, two-piece construction, suitable for 150 psig working pressure, U.L. listed
5 for use as natural gas shut-off.
6

7 2-1/2" through 4": Cast iron body, flanged ends, bronze bearings, electroless nickel plated cast iron plug
8 with Hycar resilient plug seal, Buna-N stem seal packing, lever actuator, 175 psi W.O.G., U.L. listed for
9 use as natural gas shut-off.

10
11 5" and larger: Cast iron body, flanged ends, stainless steel bearings, resilient faced plugs, totally
12 enclosed hand wheel actuators, 175 psi W.O.G., U.L. listed for use as natural gas shut-off.

13
14 DeZurik, Homestead, Rockwell, Walworth.

15 **GAS PRESSURE REGULATORS:**

16 2" and smaller: Cast iron body, aluminum spring and diaphragm, Nitrile diaphragm, threaded ends, 150
17 psi W.O.G., -20°F to 150°F.
18
19

20
21 **PART 3 - EXECUTION**

22
23 **GENERAL**

24 Properly align piping before installation of valves in an upright position; operators installed below the
25 valves will not be accepted.
26

27 Install valves in strict accordance with valve manufacturer's installation recommendations. Do not
28 support weight of piping system on valve ends.
29

30 Install all temperature control valves.
31

32 Install all valves with the stem in the upright position. Valves may be installed with the stem in the
33 horizontal position only where space limitations do not allow installation in an upright position or where
34 large valves are provided with chain wheel operators. Where valves 2-1/2" and larger are located more
35 than 12'-0" above mechanical room floors, install valve with stem in the horizontal position and provide a
36 chain wheel operator. Valves installed with the stems down, will not be accepted.
37

38 Install stem extensions when shipped loose from valve.
39

40 Prior to flushing of piping systems, place all valves in the full-open position.
41

42 **SHUT-OFF VALVES**

43 Install shut-off valves at all equipment, at each branch take-off from mains, and at each automatic valve
44 for isolation or repair.
45

46 **WATER SYSTEM:**

47 Butterfly valves installed at the location of a flow sensing device are to have a memory stop.
48

49 **BALANCING VALVES**

50 Provide balancing valves for all major equipment and at each major branch takeoff and at the discharge
51 of each pump as indicated on drawings and details.
52

53 **CALIBRATED BALANCE VALVES:**

54 Install where indicated on the drawings and details for balancing of hydronic systems. Retain the
55 shipping container for use as removable insulation.
56

57 **DRAIN VALVES**

58 Provide drain valves for complete drainage of all systems. Locations of drain valves include low points
59 of piping systems, equipment locations specified or detailed including reheat coils, other locations
60 required for drainage of systems.
61

62 **SAFETY RELIEF VALVES**

63 Use air pressure to clean piping prior to installation of safety relief valves.

- 1
2 Install relief valves in locations indicated on drawings, downstream of all pressure reducing valves, and
3 on all boilers.
4
5 Install valves in the vertical position, with drain holes, including those from dip pan elbows, piped to the
6 nearest drain.
7
8 Inlet and outlet piping connecting to valves must be the same size as valve connections or larger.
9
10 Support piping and drip pan elbow independently to prevent stress at connections to safety valves.
11 Install vent pipe so that its weight does not rest on the drip pan elbow. Extend drain line from drip pan
12 elbow and relief valve to nearest drain.
13
14 Pipe discharge from water system relief valves to nearest drain.
15
16 **SPRING LOADED CHECK VALVES**
17 Install a spring loaded check valve in each pump discharge line where two pumps operate in parallel and
18 no combination shutoff, check and balancing valve is being used.
19
20 **COMBINATION SHUT-OFF, CHECK, AND BALANCING VALVES**
21 Contractor may use combination shut-off, check and balancing valves where separate shut-off valve,
22 check valve, and balancing valve are specified or detailed in pump discharge piping.
23
24 **PRESSURE REDUCING VALVES**
25 Provide gate valve and strainer at inlet. Provide gate valve at outlet.
26
27 Install pressure gauges to indicate inlet and outlet pressure at each pressure reducing valve in
28 accordance with Section 23 05 15 - Piping Specialties.
29
30 Use eccentric reducers at inlet and outlet of reducing valves where connections are not the same size as
31 adjacent piping.
32
33 **GAS PRESSURE REGULATORS**
34 When the gas pressure regulator is equipped with a vent connection, run a connection size vent to
35 outside air in accordance with codes. Use a larger size vent when required by the manufacturer's
36 installation instructions.
37
38
39 END SECTION 23 05 23

1 **SECTION 23 05 29 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT**

2
3 **PART 1 - GENERAL**

4
5 **SCOPE**

6 This section includes specifications for supports of all HVAC equipment and materials as well as piping
7 system anchors. Included are the following topics:

8 **PART 1 - GENERAL**

9 Scope

10 Related Work

11 Reference

12 Reference Standards

13 Quality Assurance

14 Description

15 Shop Drawings

16 Design Criteria

17 **PART 2 - PRODUCTS**

18 Pipe Hanger and Support Manufacturers

19 Structural Supports

20 Pipe Hangers and Supports

21 Beam Clamps

22 Anchors

23 Equipment Curbs

24 Equipment Stands

25 Pipe Penetration through Roof

26 Corrosive Atmosphere Coatings

27 **PART 3 - EXECUTION**

28 Installation

29 Hanger and Support Spacing

30 Vertical Riser Clamps

31 Anchors

32 Roof Mounted Pipe Roller Support; Equipment Rails

33 Equipment Curbs

34 Equipment Stands

35 Pipe Penetration through Roof

36
37 **RELATED WORK**

38 Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment

39 Section 23 07 00 - HVAC Insulation

40
41 **REFERENCE**

42 Applicable provisions of Division 1 shall govern work under this Section.

43
44 **REFERENCE STANDARDS**

45 MSS SP-58 Pipe Hangers and Supports - Materials, Design and Manufacture.

46 MSS SP-59 Pipe Hangers and Supports - Selection and Application.

47
48 **QUALITY ASSURANCE**

49 Refer to Division 1, General Conditions, Equals and Substitutions.

50
51 **DESCRIPTION**

52 Provide all supporting devices as required for the installation of mechanical equipment and materials.
53 All supports and installation procedures are to conform to the latest requirements of the ANSI Code for
54 pressure piping.

55
56 Do not hang any mechanical item directly from a metal deck or run piping so it rests on the bottom chord
57 of any truss or joist.
58

1 Support apparatus and material under all conditions of operation, variations in installed and operating
2 weight of equipment and piping, to prevent excess stress, and allow for proper expansion and
3 contraction.

4
5 Protect insulation at all hanger points; see Related Work above.

6 7 **SHOP DRAWINGS**

8 Refer to Division 1, General Conditions, Submittals.

9
10 Schedule of all hanger and support devices indicating shields, attachment methods, and type of device
11 for each pipe size and type of service. Reference section 23 05 00.

12 13 **DESIGN CRITERIA**

14 Materials and application of pipe hangers and supports shall be in accordance with MSS Standard
15 Practice SP-58 and SP-69 unless noted otherwise.

16
17 Piping connected to base mounted pumps, compressors, or other rotating or reciprocating equipment is
18 to have vibration isolation supports for a distance of one hundred pipe diameters or three supports away
19 from the equipment, whichever is greater. Standard pipe hangers/supports as specified in this section
20 are required beyond the 100 pipe diameter/3 support distance.

21
22 Piping flexible connections and vibration isolation supports are required for piping connected to coils that
23 are in a fan assembly where the entire assembly is mounted on vibration supports; the vibration isolation
24 supports are required for a distance of one hundred pipe diameters or three supports away from the
25 equipment, whichever is greater. Piping flexible connection and vibration isolation supports are not
26 required when the fan section is separately and independently isolated by means of vibration supports
27 and duct flexible connections. Standard pipe hangers/supports as specified in this section are required
28 when there are no vibration isolation devices in the piping and beyond the 100 pipe diameter/3 support
29 distance.

30
31 Piping supported by laying on the bottom chord of joists or trusses will not be accepted.

32
33 Fasteners depending on soft lead for holding power or requiring powder actuation will not be accepted.

34
35 Allow sufficient space between adjacent pipes and ducts for insulation, valve operation, routine
36 maintenance, etc.

37 38 39 **PART 2 - PRODUCTS**

40 41 **PIPE HANGER AND SUPPORT MANUFACTURERS**

42 B-Line, Fee and Mason, Grinnell, Kindorf, Michigan Hanger, Unistrut, or approved equal. Grinnell figure
43 numbers are listed below; equivalent material by other manufacturers is acceptable.

44 45 **STRUCTURAL SUPPORTS**

46 Provide all supporting steel required for the installation of mechanical equipment and materials, whether
47 or not it is specifically indicated or sized, including angles, channels, beams, etc. to suspend or floor
48 support tanks and equipment.

49 50 **PIPE HANGERS AND SUPPORTS**

51 **HANGERS FOR STEEL PIPE SIZES 1/2" THROUGH 2":**

52 Carbon steel, adjustable, clevis, black finish. Grinnell figure 65 or 260.

53
54 **HANGERS FOR STEEL PIPE SIZES 2-1/2" AND OVER:**

55 Carbon steel, adjustable, clevis, black finish; or adjustable steel yoke, cast iron roll, double hanger.
56 Grinnell figure 260. Use Grinnell figure 181 for steam lines.

57
58 **MULTIPLE OR TRAPEZE HANGERS:**

59 Steel channels with welded spacers and hanger rods if calculations are submitted.

60
61 **WALL SUPPORT:**

62 Welded steel bracket with hanger. B-Line 3068 Series, Grinnell 194 Series.

63

1 Perforated epoxy painted finish, 16-12 gauge min., steel channels securely anchored to wall structure
2 with interlocking, split type, bolt secured, galvanized pipe/tubing clamps. B-Line type S channel with B-
3 2000 series clamps, Grinnell type PS200 H with PS 1200 clamps. When copper piping is being
4 supported, provide flexible elastomeric/thermoplastic isolation cushion material to completely encircle
5 the piping and avoid contact with the channel or clamp, equal to B-Line B1999 Vibra Cushion or provide
6 manufacturers clamp and cushion assemblies, B-Line BVT series, Grinnell PS 1400 series.

7
8 **VERTICAL RISER SUPPORT:**

9 Carbon steel riser clamp, copper plated when used with copper pipe. Grinnell figure 261 for steel pipe,
10 figure CT121 for copper pipe.

11
12 **FLOOR SUPPORT FOR PIPE SIZES THROUGH 4":**

13 Cast iron adjustable pipe saddle, locknut nipple, floor flange, and concrete pier or steel support.

14
15 **COPPER PIPE SUPPORT:**

16 Carbon steel ring, adjustable, copper plated or polyvinylchloride coated.

17
18 **INSULATION PROTECTION SHIELDS:**

19 Galvanized carbon steel of not less than 18 gauge for use on insulated pipe 2-1/2 inch and larger.
20 Minimum shield length is 12 inches. Equal to Grinnell figure 167.

21
22 **STEEL HANGER RODS:**

23 Threaded both ends, threaded one end, or continuous threaded, black finish.

24
25 Size rods for individual hangers and trapeze support as indicated in the following schedule.

26
27 Total weight of equipment, including valves, fittings, pipe, pipe content, and insulation, are not to exceed
28 the limits indicated.

29
30

31	Maximum Load (Lbs.) (650°F Maximum Temp.)	32 Rod Diameter (inches)
33	610	3/8
34	1130	1/2
35	1810	5/8
36	2710	3/4
37	3770	7/8
38	4960	1
39	8000	1-1/4

40 Provide rods complete with adjusting and lock nuts.

41
42 **BEAM CLAMPS**

43 MSS SP-69 Type 23 malleable black iron clamp for attachment to beam flange to 0.62 inches thick for
44 single threaded rods of 3/8, 1/2, and 5/8 inch diameter, for use with pipe sizes 4 inch and less. Furnish
45 with a hardened steel cup point set screw. Grinnell figure 86.

46
47 MSS SP-69 Type 28 or Type 29 forged steel jaw type clamp with a tie rod to lock clamp in place, suitable
48 for rod sizes to 1-1/2 inch diameter but limited in application to pipe sizes 8 inch and less without prior
49 approval. Grinnell figure 228.

50
51 **ANCHORS**

52 Use welding steel shapes, plates, and bars to secure piping to the structure.

53
54 **EQUIPMENT CURBS**

55 Manufacturers: Custom Curb, Pate, Roof Products and Systems, ThyCurb, Vent Products.

56
57 Constructed of not less than 18 gauge galvanized steel reinforced so it is structurally capable of
58 supporting the intended load with no penetrations through the curb flashing, inside and outside corner
59 sections that are mitered and continuously welded, filled with 3 pound density insulation, integral deck
60 mounting flange, nominal two inch wood nailer, galvanized steel counterflashing. Do not use built-in
61 metal base flashings or cants. Use 18 inch high equipment curbs where the curb completely surrounds
62 the perimeter of the equipment and there is no roof exposed to the weather.

1 **PIPE PENETRATION THROUGH ROOF**

2 Manufacturers: Custom Curb, Pate, Roof Products and Systems, ThyCurb, Vent Products.

3
4 Curb assembly constructed of not less than 18 gauge galvanized steel reinforced so it is structurally
5 capable of supporting the intended load, inside and outside corner sections that are mitered and
6 continuously welded, filled with 3 pound density insulation, integral deck mounting flange, nominal two
7 inch wood nailer, laminated acrylic clad thermoplastic cover with graduated step boots to accommodate
8 various size pipes, fastening screws for cover, and stainless steel clamps for securing boots around the
9 pipe. Do not use built-in metal base flashings or cants. Height of assembly to be as follows:

Length of Support Rail (inches)	Min. Curb Height Above Deck
to 24	14 inches
25 - 36	18
37 - 48	24
49 - 60	30
61 and over	48

18
19 **CORROSIVE ATMOSPHERE COATINGS**

20 Factory coat supports and anchors used in corrosive atmospheres with hot dip galvanizing after
21 fabrication, ASTM A123, 1.5 ounces/square foot of surface, each side. Mechanical galvanize threaded
22 products, ASTM B695 Class 150, 2.0 mil coating. Field cuts and damaged finishes to be field covered
23 with zinc rich paint of comparable thickness to factory coating.

24
25 Corrosive atmospheres include the following locations:

- 26 • Exterior locations
- 27 • Wet wells

28
29
30 **PART 3 - EXECUTION**

31
32 **INSTALLATION**

33 Install supports to provide for free expansion of the piping and duct system. Support all piping from the
34 structure using concrete inserts, beam clamps, ceiling plates, wall brackets, or floor stands. Fasten
35 ceiling plates and wall brackets securely to the structure and test to demonstrate the adequacy of the
36 fastening.

37
38 Coordinate hanger and support installation to properly group piping of all trades.

39
40 Where piping can be conveniently grouped to allow the use of trapeze type supports, use standard
41 structural shapes or continuous insert channels for the supporting steel. Where continuous insert
42 channels are used, pipe supporting devices made specifically for use with the channels may be
43 substituted for the specified supporting devices provided that similar types are used and all data is
44 submitted for prior approval.

45
46 Perform all welding in accordance with standards of the American Welding Society. Clean surfaces of
47 loose scale, rust, paint or other foreign matter and properly align before welding. Use wire brush on
48 welds after welding. Welds shall show uniform section, smoothness of weld metal and freedom from
49 porosity and clinkers. Where necessary to achieve smooth connections, joints shall be dressed smooth.

50
51 **HANGER AND SUPPORT SPACING**

52 Place a hanger within 12 inches of each horizontal elbow, valve, strainer, or similar piping specialty item.

53
54 Where several pipes can be installed in parallel and at the same elevation, provide multiple or trapeze
55 hangers.

56
57 Support riser piping independently of connected horizontal piping.

58
59 Adjust hangers to obtain the slope specified in the piping section of this specification.

60
61 Space hangers for pipe as follows:

<u>Pipe Material</u>	<u>Pipe Size</u>	<u>Max. Spacing</u>
----------------------	------------------	---------------------

1	Steel	1/2" through 1-1/4"	6'-6"
2	Steel	1-1/2" through 6"	10'-0"
3	Steel	8" through 12"	14'-0"
4	Steel	14" and over	20'-0"
5	Thermoplastic	All sizes	6'-0"
6	Copper	1/2" through 1-1/4"	5'-0"
7	Copper	1-1/2" and larger	8'-0"

8
9 **VERTICAL RISER CLAMPS**

10 Support vertical piping with clamps secured to the piping and resting on the building structure or secured
11 to the building structure below at each floor.

12
13 Piping 5" and above, of lengths exceeding 30 feet, shall be additionally supported on base elbows
14 secured to the building structure, with flexible supporting hangers provided at top of riser to allow for pipe
15 expansion.

16
17 **ANCHORS**

18 Install where indicated on the drawings and details. Where not specifically indicated, install anchors at
19 ends of principal pipe runs and at intermediate points in pipe runs between expansion loops. Make
20 provisions for preset of anchors as required to accommodate both expansion and contraction of piping.

21
22 **EQUIPMENT CURBS**

23 Secure bottom of support flat on roof deck. Secure equipment to curb in accordance with equipment
24 manufacturer's instructions. Flashing and counterflashing by the General Contractor.

25
26 **PIPE PENETRATION THROUGH ROOF**

27 Install at points where pipes penetrate roof. Install as shown on the drawings, as detailed and according
28 to the manufacturer's installation instructions. Flashing and counterflashing by the General Contractor.

29
30
31 END SECTION 23 05 29

1 **SECTION 23 05 93 - TESTING, ADJUSTING, AND BALANCING FOR HVAC**

2
3 **PART 1 - GENERAL**

4
5 **SCOPE**

6 This section includes air and water testing, adjusting and balancing for the entire project. Included are the
7 following topics:

8 **PART 1 - GENERAL**

- 9 Scope
- 10 Related Work
- 11 Reference
- 12 Reference Standards
- 13 Description
- 14 Pre-Installation Meeting and Scheduling
- 15 Pre-Balance Conference
- 16 Submittals

17 **PART 2 - PRODUCTS**

- 18 Instrumentation

19 **PART 3 - EXECUTION**

- 20 Preliminary Procedures
- 21 Existing Equipment
- 22 Performing Testing, Adjusting and Balancing

23
24 **RELATED WORK**

- 25 Section 23 05 00 Common Work Results for HVAC
- 26 Section 23 07 00 HVAC Insulation
- 27 Section 23 09 23 Direct Digital Control System for HVAC

28
29 **REFERENCE**

30 Applicable provisions of the General Conditions, Supplementary General Conditions and Basic
31 Requirements in Division 1 govern work under this Section.

32
33 **REFERENCE STANDARDS**

- 34 AABC National Standards for Total System Balance, Sixth Edition, 2002.
- 35 ASHRAE ASHRAE Handbook, 2007 HVAC Applications, Chapter 37, Testing Adjusting and
36 Balancing.
- 37 NEBB Procedural Standards for Testing Adjusting Balancing of Environmental Systems,
38 Seventh Edition, 2005.

39
40 **DESCRIPTION**

41 The Contractor will separately contract with an independent test and balance agency to perform all
42 testing, adjusting, and balancing of air and hydronic systems required for this project. Work related to the
43 testing, adjusting, and balancing that must be performed by the installing mechanical contractor is
44 specified in other section of these specifications.

45
46 Provide total mechanical systems testing, adjusting and balancing. Requirements include the balance of
47 air and water distribution, adjustment of new and existing systems and equipment to provide design
48 requirements indicated on the drawings, electrical measurement and verification of performance of all
49 mechanical equipment, all in accordance with standards published by AABC or NEBB.

50
51 Test, adjust and balance all air and hydronic systems so that each room, piece of equipment or terminal
52 device meets the design requirements indicated on the drawings and in the specifications.

53
54 Accomplish testing, adjusting and balancing work in a timely manner that allows partial occupancy of
55 major buildings, occupancy of one building when the project involves many buildings, and completion of
56 the entire project in the time stated in the Instruction to Bidders and in accordance with the completion
57 schedule established for this project.

1 Verify that provisions are being made to accomplish the specified testing, adjusting and balancing work.
2 If problems are found, handle as specified in Part 3 under Deficiencies.

3 4 **QUALITY ASSURANCE**

5 **QUALIFICATIONS**

6 An independent Firm specializing in the Testing and Balancing of HVAC systems for a minimum of 3
7 years. A Firm not engaged in the commerce of furnishing or providing equipment or material generally
8 related to HVAC work other than that specifically related to installing Testing and Balancing components
9 necessary for work in this section such as, but not limited to sheaves, pulleys, and balancing dampers.

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.

13
14 Technicians on this project must have satisfactorily completed work on a minimum of (3) three projects of
15 at least 50% in size, and of similar complexity.

16
17 Submit Qualifications of firm and project staff to Dane County Project Manager upon requested.

18 19 **PRE-INSTALLATION MEETING AND SCHEDULING**

20 The test and balance agency is required to attend a pre-installation meeting with all other project
21 contractors before the construction process is started. The test and balance agency shall give the Lead
22 Contractor a detailed schedule of testing and balancing tasks for incorporation into the project schedule.

23 24 **PRE-BALANCE CONFERENCE**

25 90 days prior to beginning testing, adjusting and balancing, schedule and conduct a conference with the
26 Architect/Engineer and the mechanical system and temperature control system installing Contractors.
27 Provide A/E with a complete copy of the TAB plan for the project. The objective is final coordination and
28 verification of system operation and readiness for testing, adjusting and balancing procedures and
29 scheduling procedures with the above mentioned parties. Indicate work required to be completed prior to
30 testing, adjusting, and balancing and identify the party responsible for completion of that work.

31 32 **SUBMITTALS**

33 See also Related Work in this section.

34
35 Submit testing, adjusting and balancing reports bearing the seal and signature of the NEBB or AABC
36 Certified Test and Balance Supervisor. The reports certify that the systems have been tested, adjusted
37 and balanced in accordance with the referenced standards; are an accurate representation of how the
38 systems have been installed and are operating; and are an accurate record of all final quantities
39 measured to establish normal operating values of the systems.

40 41 Submission:

42
43 Distribute electronic copies of the Report to the Contractor, the Lead Contractor, the Owner, the Agency
44 Contact, the Prime A/E

45
46 Format: Cover page identifying project name, project number and descriptive title of contents. Divide the
47 contents of the report into the below listed divisions:

- 48 • General Information
- 49 • Summary
- 50 • Air Systems
- 51 • Hydronic Systems
- 52 • Special Systems

53
54 Contents: Provide the following minimum information, forms and data:

55
56 General Information: Inside cover sheet identifying Test and Balance Agency, Contractor, Architect,
57 Engineer, Project Name and Project Number. Include addresses, contact names and telephone
58 numbers. Also include a certification sheet containing the seal and signature of the Test and Balance
59 Supervisor.

60
61 Summary: Provide summary sheet describing mechanical system deficiencies. Describe objectionable
62 noise or drafts found during testing, adjusting and balancing. Provide recommendations for correcting
63 unsatisfactory performances and indicate whether modifications required are within the scope of the

1 contract, are design related or installation related. List instrumentation used during testing, adjusting and
2 balancing procedures.

3
4 The remainder of the report to contain the appropriate standard NEBB or AABC forms for each respective
5 item and system. Fill out forms completely. Where information cannot be obtained or is not applicable
6 indicate same.

7
8
9 **PART 2 - PRODUCTS**

10
11 **INSTRUMENTATION**

12 Provide all required instrumentation to obtain proper measurements. Application of instruments and
13 accuracy of instruments and measurements to be in accordance with the requirements of NEBB or AABC
14 Standards and instrument manufacturer's specifications.

15
16 All instruments used for measurements shall be accurate, and calibration histories for each instrument to
17 be available for examination by the Owner upon request. Calibration and maintenance of all instruments
18 to be in accordance with the requirements of NEBB or AABC Standards

19
20
21 **PART 3 - EXECUTION**

22
23 **DAILY REPORTS**

24 Submit to Dane County Project Manager daily work activity reports for each day on which testing and
25 balancing work is performed. Reports shall include description of day's activities and description of any
26 system deficiencies.

27
28 **PRELIMINARY PROCEDURES**

29 Review preconstruction meeting report, applicable construction bulletins, applicable change orders and
30 approved shop drawings of equipment, outlets/inlets and temperature controls.

31
32 Check filters for cleanliness, dampers and valves for correct positioning, equipment for proper rotation
33 and belt tension, temperature controls for completion of installation and hydronic systems for proper
34 charge and purging of air.

35
36 Notify the Dane County Project Manager on a daily basis during balancing. Identify deficiencies
37 preventing completion of testing, adjusting and balancing procedures. Do not proceed until systems are
38 fully operational with all components necessary for complete testing, adjusting and balancing. Installing
39 Contractors are required to provide personnel to check and verify system completion, readiness for
40 balancing and assist Balancing Agency in providing specified system performance.

41
42 **EXISTING EQUIPMENT**

43 Balance all existing exhaust fans to the air quantities shown on the drawings.

44
45 **PERFORMING TESTING, ADJUSTING AND BALANCING**

46 Perform testing, adjusting and balancing procedures on each system identified, in accordance with the
47 detailed procedures outlined in the referenced standards except as may be modified below.

48
49 Unless specifically instructed in writing, all work in this specification section is to be performed during the
50 normal workday.

51
52 In areas containing ceilings, remove ceiling tile to accomplish balancing work; replace tile when work is
53 complete and provide new tile for any tile that are damaged by this procedure. If the ceiling construction
54 is such that access panels are required for the work of this section and the panels have not been
55 provided, inform the owner's project representative.

56
57 Cut insulation, ductwork and piping for installation of test probes to the minimum extent necessary for
58 adequate performance of procedures. Patch using materials identical to those removed, maintaining
59 vapor barrier integrity and pressure rating of systems.

60
61 In air systems employing filters, blank off sufficient filter area to simulate a pressure drop that is midway
62 between that of a clean filter and that of a dirty filter.

1 Measure and record system measurements at the fan and/or pump to determine total flow. Adjust
2 equipment as required to yield specified total flow at terminals. Proceed taking measurements in mains
3 and branches as required for final terminal balancing. Perform terminal balancing to specified flows
4 balancing branch dampers, deflectors, extractors and valves prior to adjustment of terminals.

5
6 Measure and record static air pressure conditions across fans, coils and filters. Indicate in report if
7 cooling coil measurements were made on a wet or dry coil and if filter measurements were made on a
8 clean or dirty filter. Spot check static air pressure conditions directly ahead of terminal units.

9
10 Adjust outside air, return air and relief air dampers for design conditions at both the minimum and
11 maximum settings and record both sets of data. Balance modulating dampers at extreme conditions and
12 record both sets of data. Balance variable air volume systems at maximum air flow rate, full cooling, and
13 minimum flow rate, full heating; record all data.

14
15 Adjust register, grille and diffuser vanes and accessories to achieve proper air distribution patterns and
16 uniform space temperatures free from objectionable noise and drafts within the capabilities of the installed
17 system.

18
19 Provide fan and motor drive sheave adjustments necessary to obtain design performance. Provide drive
20 changes specifically noted on drawings, if any. If work of this section indicates that any drive or motor is
21 inadequate for the application, advise the owner's project representative by giving the representative
22 properly sized motor/drive information (in accordance with manufacturers original service factor and
23 installed motor horsepower requirements); Confirm any change will keep the duct/piping system within its
24 design limitations with respect to speed of the device and pressure classification of the distribution
25 system. Required motor/drive changes not specifically noted on drawings or in specifications will be
26 considered an extra cost and will require an itemized cost breakdown submitted to owner's project
27 representative. Prior authorization is needed before this work is started.

28
29 Areas or rooms designed to maintain positive, negative or balanced air pressures with respect to adjacent
30 spaces, as indicated by the design air quantities, require special attention. Adjust fan drives, distribution
31 dampers, terminals and controls to maintain indicated pressure relationship.

32
33 Final air system measurements to be within the following range of specified cfm:
34 Fans 0% to +10%
35 Supply grilles, registers, diffusers 0% to +10%
36 Return/exhaust grilles, registers 0% to -10%
37 Room pressurization air -5% to +5%

38
39 Final water system measurements must be within the following range of specified gpm:
40 Heating flow rates 0% to -10%

41
42 Contact the temperature control Contractor for assistance in operation and adjustment of controls during
43 testing, adjusting and balancing procedures. Cycle controls and verify proper operation and setpoints.
44 Include in report description of temperature control operation and any deficiencies found.

45
46 Permanently mark equipment settings, including damper and valve positions, control settings, and similar
47 devices allowing settings to be restored. Set and lock memory stops.

48
49 Leave systems in proper working order, replacing belt guards, closing access doors and electrical boxes,
50 and restoring temperature controls to normal operating settings.

51
52 Verify and record, in the T&B Report, "K" factors for all VAV air terminal devices and air flow stations.

53
54 Coordinate air handling unit minimum outside air set points with the Temperature Control Contractor.

55
56 **VAV SUPPLY AND EXHAUST DUCT SYSTEM STATIC PRESSURE SET POINT**
57 For VAV supply and exhaust systems with VAV air terminal devices, determine the minimum required
58 duct static pressure at the DDC static pressure sensor location(s) needed to insure that all VAV air
59 terminals are operating at their design airflows with the most demanding VAV terminal wide open.
60 Provide these static pressure numbers to the DDC temperature controls contractor and record them in the
61 T&B report for each system.

62
63 **HYDRONIC SYSTEM DIFFERENTIAL PRESSURE CONTROL SET POINT**

1 For hydronic systems with variable speed pumping, determine the minimum required system differential
2 pressure set point needed to insure that all terminal devices are operating at their design water flows with
3 the most demanding terminals device control valve wide open. Provide the differential control setting set
4 point to the DDC temperature control contractor and record them in the T&B report for each system.
5
6 For HVAC pumps 10 horsepower or less, valve throttling alone may be used for hydronic system
7 balancing.
8
9 Throttling of triple-duty valves shall not exceed 50% closed. Where additional throttling would be
10 necessary to achieve the system design flow the impellor shall be trimmed.
11
12 Verify Triple duty valve utilized on systems with Variable Frequency Drives are 100% open when
13 balancing work is complete.
14
15 The pressure drop across triple duty valves shall not exceed 25 ft. w.g. Where additional throttling would
16 be necessary to achieve the system design flow the impellor shall be trimmed.
17
18 Verify butterfly valves utilized for hydronic system balancing are provided with position-lock operators
19 (memory stops) in accordance with Section 23 05 23. The adjustment and marking of lever-lock operators
20 that use throttling notches will not be accepted. Lock all memory stops so the valves can be reopened to
21 their balanced positions if they are used for isolation purposes.
22
23
24 END SECTION 23 05 93

1 **SECTION 23 07 00 - HVAC INSULATION**

2
3 **PART 1 - GENERAL**

4
5 **SCOPE**

6 This section includes insulation specifications for heating, ventilating and air conditioning piping,
7 ductwork and equipment. Included are the following topics:

8 **PART 1 - GENERAL**

9 Scope

10 Related Work

11 Reference Standards

12 Quality Assurance

13 Description

14 Definitions

15 Shop Drawings

16 Operation and Maintenance Data

17 Environmental Requirements

18 **PART 2 - PRODUCTS**

19 Materials

20 Insulation Types

21 Jackets

22 Insulation Inserts and Pipe Shields

23 Accessories

24 **PART 3 - EXECUTION**

25 Examination

26 Installation

27 Protective Jacket Installation

28 Piping, Valve and Fitting Insulation

29 Piping Protective Jackets

30 Pipe Insulation Schedule

31 Duct Insulation

32 Ductwork Protective Coverings

33 Duct Insulation Schedule

34 Equipment Insulation

35 Equipment Insulation Schedule

36
37 **RELATED WORK**

38 Section 23 05 00 - Common Work Results for HVAC

39 Section 23 21 13 - Hydronic Piping

40 Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment

41 Section 23 31 00 - HVAC Ducts and Casings

42
43 **REFERENCE**

44 Applicable provisions of Division 1 govern work under this Section.

45
46 **REFERENCE STANDARDS**

47 ASTM B209 Aluminum and Aluminum Alloy Sheet and Plate

48 ASTM C165 Test Method for Compressive Properties of Thermal Insulations

49 ASTM C177 Heat Flux and Thermal Transmission Properties

50 ASTM C195 Mineral Fiber Thermal Insulation Cement

51 ASTM C240 Cellular Glass Insulation Block

52 ASTM C302 Density of Preformed Pipe Insulation

53 ASTM C303 Density of Preformed Block Insulation

54 ASTM C355 Test Methods for Test for Water Vapor Transmission of Thick Materials

55 ASTM C449 Mineral Fiber Hydraulic Setting Thermal Insulation Cement

56 ASTM C518 Heat Flux and Thermal Transmission Properties

57 ASTM C533 Calcium Silicate Block and Pipe Thermal Insulation

58 ASTM C534 Preformed Flexible Elastomeric Thermal Insulation

1	ASTM C547	Mineral Fiber Preformed Pipe Insulation
2	ASTM C552	Cellular Glass Block and Pipe Thermal Insulation
3	ASTM C553	Mineral Fiber Blanket and Felt Insulation
4	ASTM C578	Preformed, Block Type Cellular Polystyrene Thermal Insulation
5	ASTM C591	Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation
6	ASTM C610	Expanded Perlite Block and Thermal Pipe Insulation
7	ASTM C612	Mineral Fiber Block and Board Thermal Insulation
8	ASTM C921	Properties of Jacketing Materials for Thermal Insulation
9	ASTM C1136	Flexible Low Permeance Vapor Retarders for Thermal Insulation
10	ASTM D412	Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers-Tension
11	ASTM D1000	Methods for Pressure-Sensitive Adhesive-Coated Tapes Used for Electrical and
12		Electronic Applications
13	ASTM D1621	Standard Test Method for Compressive Properties Of Rigid Cellular Plastics
14	ASTM D1622	Standard Test Method for Apparent Density of Rigid Cellular Plastics
15	ASTM D1940	Method of Test for Porosity of Rigid Cellular Plastics
16	ASTM D2126	Method for Response of Rigid Cellular Plastics to Thermal and Humid Aging
17	ASTM D2240	Standard Test Method for Rubber Property—Durometer Hardness
18	ASTM E84	Surface Burning Characteristics of Building Materials
19	ASTM E814	Standard Test Method for Fire Tests of Penetration Firestop Systems
20	ASTM E2336	Standard Test Methods for Fire Resistive Grease Duct Enclosure Systems
21	MICA	National Commercial & Industrial Insulation Standards
22	NFPA 225	Surface Burning Characteristics of Building Materials
23	UL 723	Surface Burning Characteristics of Building Materials

24
25 **QUALITY ASSURANCE**
26 Refer to Division 1, General Conditions, Equals and Substitutions

27
28 Label all insulating products delivered to the construction site with the manufacturer's name and
29 description of materials.

30
31 Insulation systems shall be applied by experienced contractors. Within the past five (5) years, the
32 contractor shall be able to document the successful completion of a minimum of three (3) projects of at
33 least 50% of the size and similar scope of the work specified in this section.

34
35 **DESCRIPTION**
36 Furnish and install all insulating materials and accessories as specified or as required for a complete
37 installation. The following types of insulation are specified in this section:

- 38 • Pipe Insulation
- 39 • Duct Insulation
- 40 • Equipment Insulation

41
42 Install all insulation in accordance with the latest edition of MICA (Midwest Insulation Contractors
43 Association) Standard and manufacturer's installation instructions. Exceptions to these standards will
44 only be accepted where specifically modified in these specifications, or where prior written approval has
45 been obtained from the Dane County Project Manager.

46
47 **DEFINITIONS**
48 Concealed: shafts, furred spaces, space above finished ceilings, utility tunnels and crawl spaces. All
49 other areas, including walk-through tunnels, shall be considered as exposed.

50
51 **SHOP DRAWINGS**
52 Refer to division 1, General Conditions, Submittals.

53
54 Submit a schedule of all insulating materials to be used on the project, including adhesives, fastening
55 methods, fitting materials along with material safety data sheets and intended use of each material.
56 Include manufacturer's technical data sheets indicating density, thermal characteristics, jacket type, and
57 manufacturer's installation instructions.

58
59 **OPERATION AND MAINTENANCE DATA**
60 All operations and maintenance data shall comply with the submission and content requirements
61 specified under section Basic Requirements.

62
63 **ENVIRONMENTAL REQUIREMENTS**

1 Do not store insulation materials on grade or where they are at risk of becoming wet. Do not install
2 insulation products that have been exposed to water.

3
4 Protect installed insulation work with plastic sheeting to prevent water damage.
5

6 7 **PART 2 - PRODUCTS**

8 9 **MATERIALS**

10 Manufacturers: Armacell, Certainteed, Manson, Childers, Dow, Extol, Fibrex, Halstead, H.B. Fuller,
11 Imcoa, Johns Manville, Knauf, Owens-Corning, Partek, Pittsburgh Corning, Rubatex, VentureTape or
12 approved equal.

13
14 Materials or accessories containing asbestos will not be accepted.

15
16 Use composite insulation systems (insulation, jackets, sealants, mastics, and adhesives) that have a
17 flame spread rating of 25 or less and smoke developed rating of 50 or less, with the following exceptions:

18 Pipe insulation which is not located in an air plenum may have a flame spread rating not over 25
19 and a smoke developed rating no higher than 450 when tested in accordance with UL 723 and
20 ASTM E84.

21 22 **INSULATION TYPES**

23 Insulating materials shall be fire retardant, moisture and mildew resistant, and vermin proof. Insulation
24 shall be suitable to receive jackets, adhesives and coatings as indicated.

25 26 **FLEXIBLE FIBERGLASS INSULATION:**

27 Minimum nominal density of 0.75 lbs. per cu. ft., and thermal conductivity of not more than 0.3 at 75
28 degrees F, rated for service to 250 degrees F.

29 30 **RIGID FIBERGLASS INSULATION:**

31 Minimum nominal density of 3 lbs. per cu. ft., and thermal conductivity of not more than 0.23 at 75
32 degrees F, minimum compressive strength of 25 PSF at 10% deformation, rated for service to 450
33 degrees F.

34 35 **SEMI-RIGID FIBERGLASS INSULATION:**

36 Minimum nominal density of 3 lbs. per cu. ft., thermal conductivity of not more than 0.28 at 75 degrees
37 F, minimum compressive strength of 125 PSF at 10% deformation, rated for service to 450 degrees F.
38 Insulation fibers perpendicular to jacket and scored for wrapping cylindrical surfaces.

39 40 **JACKETS**

41 **PVC FITTING COVERS AND JACKETS (PFJ):**

42 White PVC film, gloss finish one side, semi-gloss other side, FS LP-535D, Composition A, Type II,
43 Grade GU. Ultraviolet inhibited indoor/outdoor grade to be used where exposed to high humidity,
44 ultraviolet radiation, in kitchens or food processing areas or installed outdoors. Jacket thickness to be
45 minimum .02" indoors/.03" outdoors for piping 12" and smaller, .03" indoors/.04" outdoors for piping 15"
46 and larger.

47 48 **ALL SERVICE JACKETS (ASJ):**

49 Heavy duty, fire retardant material with white kraft reinforced foil vapor barrier, factory applied to
50 insulation with a self-sealing pressure sensitive adhesive lap, maximum permeance of .02 perms and
51 minimum beach puncture resistance of 50 units.

52 53 **FOIL SCRIM ALL SERVICE JACKETS (FSJ):**

54 Glass fiber reinforced foil kraft laminate, factory applied to insulation. Maximum permeance of .02 perms
55 and minimum beach puncture resistance of 25 units.

56 57 **PROTECTIVE METAL JACKETS (PMJ):**

58 .016 inch thick aluminum or .010 inch thick stainless steel with safety edge.

59 60 **SELF-ADHERING JACKETS (SAJ):**

61 5-ply, self-adhering multiple laminated waterproofing material with reflective aluminum foil, high density
62 polymer films and cold weather acrylic adhesive providing zero (0.0) permeability. Minimum 6 mils

1 material thickness, 35lb puncture resistance when tested in accordance with ASTM D1000 and flame
2 spread/smoke developed rating of 10/20 when tested in accordance with UL 723.

3
4 Vapor retarding tape shall be specifically designed and manufactured for use with the self-adhering
5 jacket specified above. Tape shall be provided by the same manufacturer that provides jacketing. Vapor
6 retarding tapes used with self-adhering jackets shall have a maximum permeance of 0.0 perms.

7
8 **FABRIC REINFORCED MASTIC JACKETS (FMJ):**

9 Glass fiber reinforcing fabric imbedded in weather barrier mastic as per manufacturer's recommended
10 procedure for 2 coat application.

11
12 **VAPOR RETARDING JACKETS (VRJ):**

13 Polyvinylidene chloride (PVDC) vapor retarding jacket material with minimum 6 mils material thickness
14 and maximum permeance of 0.01 perms. Material shall not support the growth of mold or mildew. Dow
15 Saran or equivalent.

16
17 Vapor retarding tape shall be specifically designed and manufactured for use with the vapor retarding
18 jacket specified above. Tape shall be provided by the same manufacturer that provides jacketing. Vapor
19 retarding tapes used with vapor retarding jackets shall have a maximum permeance of 0.01 perms.

20
21 **INSULATION INSERTS AND PIPE SHIELDS**

22 Manufacturers: B-Line, Pipe Shields, Value Engineered Products

23
24 Construct inserts with calcium silicate or polyisocyanurate (service temperatures below 300 degrees F
25 only), minimum 140 psi compressive strength. Piping 12" and larger, supplement with high density 600
26 psi structural calcium silicate insert. Provide galvanized steel shield. Insert and shield to be minimum
27 180 degree coverage on bottom supported piping and full 360 degree coverage on clamped piping. On
28 roller mounted piping and piping designed to slide on support, provide additional load distribution steel
29 plate.

30
31 Where contractor proposes shop/site fabricated inserts and shields, submit schedule of materials,
32 thicknesses, gauges and lengths for each pipe size to demonstrate equivalency to
33 preengineered/premanufactured product described above. On low temperature systems, high density
34 rigid polyisocyanurate may be substituted for calcium silicate provided insert and shield length and shield
35 gauge are increased to compensate for lower insulation compressive strength.

36
37 Precompressed 20# density molded fiberglass blocks, Hamfab or equal, of the same thickness as
38 adjacent insulation may be substituted for calcium silicate inserts with one 1"x6" block for piping through
39 2-1/2" and three 1"x6" blocks for piping through 4". Submit shield schedule to demonstrate equivalency
40 to preengineered/premanufactured product described above.

41
42 Wood blocks will not be accepted.

43
44 **ACCESSORIES**

45 All products shall be compatible with surfaces and materials on which they are applied, and be suitable
46 for use at operating temperatures of the systems to which they are applied.

47
48 Adhesives, sealants, and protective finishes shall be as recommended by insulation manufacturer for
49 applications specified.

50
51 Insulation bands to be 3/4 inch wide, constructed of aluminum or stainless steel. Minimum thickness to
52 be .015 inch for aluminum and .010 inch for stainless steel.

53
54 Tack fasteners to be stainless steel ring grooved shank tacks.

55
56 Staples to be clinch style.

57
58 Insulating cement to be ANSI/ASTM C195, hydraulic setting mineral wool.

59
60 Finishing cement to be ASTM C449.

61
62 Fibrous glass or canvas fabric reinforcing shall have a minimum untreated weight of 6 oz./sq. yd.

1 Bedding compounds to be non-shrinking and permanently flexible.
2
3 Vapor barrier coatings to have maximum applied water vapor permeance of .05 perms.
4
5 Fungicidal water base coating (Foster 40-20 or equal) to be compatible with vapor barrier coating.
6
7

8 **PART 3 - EXECUTION**

9 **EXAMINATION**

10 Verify that all piping, equipment, and ductwork are tested and approved prior to installing insulation. Do
11 not insulate systems until testing and inspection procedures are completed.
12
13

14 Verify that all surfaces are clean, dry and without foreign material before applying insulation materials.
15

16 **INSTALLATION**

17 All materials shall be installed by skilled labor regularly engaged in this type of work. All materials shall
18 be installed in strict accordance with manufacturer's recommendations, building codes, and industry
19 standards. Do not install products when the ambient temperature or conditions are not consistent with the
20 manufacturer's recommendations. Surfaces to be insulated must be clean and dry.
21

22 Locate insulation and cover seams in the least visible location. All surface finishes shall be extended in
23 such a manner as to protect all raw edges, ends and surfaces of insulation.
24

25 Install insulation with smooth and even surfaces. Poorly fitted joints or use of filler in voids will not be
26 accepted. Provide neatly beveled and coated terminations at all nameplates, uninsulated fittings, or at
27 other locations where insulation terminates.
28

29 Install fabric reinforcing without wrinkles. Overlap seams a minimum of 2 inches.
30

31 Use full length material (as delivered from manufacturer) wherever possible. Scrap piecing of insulation
32 or pieces cut undersize and stretched to fit will not be accepted.
33

34 All pipe and duct insulation shall be continuous through walls, ceiling or floor openings and through
35 sleeves except where firestop or firesafing materials are required. Vapor barriers shall be maintained
36 continuous through all penetrations.
37

38 Provide a continuous unbroken moisture vapor barrier on insulation applied to systems noted below.
39 Attachments to cold surfaces shall be insulated and vapor sealed to prevent condensation.
40

41 Provide a complete vapor barrier for insulation on the following systems:

- 42 • Cold Water Make-Up
 - 43 • Insulated Duct
 - 44 • Equipment, ductwork or piping with a surface temperature below 65 degrees F
- 45

46 **PROTECTIVE JACKET INSTALLATION**

47 **SELF-ADHERING JACKETS (SAJ):**

48 Install according to manufacturer's recommendations. Cut allowing minimum 4" overlap on ends and 6"
49 on longitudinal joints. Align parallel to surface. Remove release paper and press flat to surface to avoid
50 wrinkles. Rub entire surface for full adhesion and sealing at joint overlaps. On exterior applications,
51 provide a bead of compatible caulk along exposed edges.
52

53 Piping with self-adhering (SAJ) jackets shall have elbows, fittings, valves and butt joints wrapped with 2
54 layers of vapor retarding tape. Piping with a PVC jacket (PFJ) installed over the self-adhering (SAJ)
55 jacket may be provided with a single, lapped layer of vapor retarding tape for elbows, fittings and valves
56 under the PVC jacket. Vapor retarding tape shall be compatible with the jacket material used.
57

58 **VAPOR RETARDING JACKETS (VRJ):**

59 Piping with vapor retarding (VRJ) jackets shall have elbows, fittings, valves and butt joints wrapped with
60 2 layers of vapor retarding tape. Piping with a PVC jacket (PFJ) installed over the vapor retarding (VRJ)
61 jackets may be provided with a single, lapped layer of vapor retarding tape for elbows, fittings and valves
62 under the PVC jacket. Vapor retarding tape shall be compatible with the jacket material used.
63

1 **PVC FITTING COVERS AND JACKETS (PFJ):**

2 Lap seams and joints a minimum of 2 inches and continuously seal PVC with welding solvent
3 recommended by jacket manufacturer. Lap slip joint ends 4" without fasteners where required to absorb
4 expansion and contraction. For sections where vapor barrier is not required and jacket requires routine
5 removal, tack fasteners may be used. Secure PVC fitting covers with tack fasteners. For systems
6 requiring a vapor barrier, apply a 1-1/2" band of mastic over ends, throat, seams and penetrations.
7

8 **PROTECTIVE METAL JACKET (PMJ):**

9 Lap seams a minimum of 2 inches. Secure with metal bands for end to end joints, and rivets or sheet
10 metal screws for longitudinal joints. Rivets, screws, and bands to be constructed of the same material as
11 the jacket. Locate seams on bottom for exterior applications.
12

13 **FABRIC REINFORCED MASTIC JACKETS (FMJ):**

14 Glass fiber fabric shall be fitted without wrinkles. Glass fiber fabric shall be sized immediately upon
15 application with lagging adhesive and shall be capable of drying within 6 hrs. Apply adhesive and coating
16 in accordance with manufacturer's recommendations. All seams shall overlap not less than 2".
17

18 **PIPING, VALVE, AND FITTING INSULATION**

19 **GENERAL:**

20 Install insulation with butt joints and longitudinal seams closed tightly. Provide minimum 2" lap on jacket
21 seams and 2" tape on butt joints, firmly cemented with lap adhesive unless otherwise noted. Additionally
22 secure with staples along seams and butt joints. Coat staples, longitudinal and transverse seams with
23 vapor barrier mastic on systems requiring vapor barrier.
24

25 Install insulation continuous through pipe hangers and supports with hangers and supports on the exterior
26 of insulation. Where a vapor barrier is not required or where roller hangers are not being used, hangers
27 and supports may be attached directly to piping with insulation completely covering hanger or support
28 and jacket sealed at support rod penetration. Where riser clamps are required to be attached directly to
29 piping requiring vapor barrier, extend insulation and vapor barrier jacketing/coating around riser clamp.
30

31 Where insulated piping is installed on hangers and supports, the insulation shall be installed continuous
32 through the hangers and supports. High density inserts shall be provided as required to prevent the
33 weight of the piping from crushing the insulation. Pipe shields are required at all support locations. The
34 insulation shall not be notched or cut to accommodate the supporting channels.
35

36 Fully insulate all reheat coil piping, fittings and valves (with the exception of unions) up to coil connection
37 to prevent condensation when coil is inactive during cooling season. Provide a vapor proof seal between
38 the pipe insulation and the insulated coil casing.
39

40 **INSULATION INSERTS AND PIPE SHIELDS:**

41 Provide pipe shields at all hanger and support locations. Rigid insulation inserts shall be installed
42 between the pipe and the insulation shields. Quantity and placement of inserts shall be according to the
43 manufacturer's installation instructions, however the inserts shall be no less than 12" in length. Inserts
44 shall be of equal thickness to the adjacent insulation and shall be vapor sealed as required for system.
45

46 Provide insulation inserts and pipe shields at all hanger and support locations. Inserts may be omitted on
47 3/4" and smaller copper piping provided 12" long 22 gauge pipe shields are used.
48

49 **FITTINGS AND VALVES:**

50 Fittings, valves, unions, flanges, couplings and specialties may be insulated with factory molded or built
51 up insulation of the same thickness as adjoining insulation. Where the ambient temperature exceeds 150
52 degrees F, cover insulation with fabric reinforcing and mastic. Where the ambient temperatures do not
53 exceed 150 degrees, furnish and install PVC fitting covers.
54

55 **PIPING PROTECTIVE JACKETS**

56 In addition to the the jackets specified in the pipe insulation schedule below the following protective
57 jackets are required:
58

59 Provide a protective PVC jacket (PFJ) for the following insulated piping:
60 Piping exposed in finished locations
61

62 Provide a protective PVC (PFJ) or Fabric Reinforced Mastic (FMJ) jacket for the following insulated
63 piping:

1 All piping within mechanical rooms

2
3 **PIPE INSULATION SCHEDULE:**

4 Provide insulation on new and existing remodeled piping as indicated in the following schedule:

5
6

<u>Service</u>	<u>Insulation</u>	<u>Jacket</u>	<u>Insulation Thickness by Pipe Size</u>				
			$\leq 1\text{-}1/4\text{'}$	1-1/2" <4"	2" to	4" to 6" larger	8" and
7 Heating Hot Water	Rigid Fiberglass	ASJ	1.5"	1.5"	2"	2"	2"

8
9

10 Note: On 1" or smaller hot water pipe runouts to terminal unit coils the insulation thickness may be
11 reduced to 1/2" on both the supply and return pipes within 4ft of the coil but not on the distribution system
12 side of the temperature control valve.

13
14
15 The following piping and fittings are not to be insulated:

- 16 • Hot water piping inside radiation, convector, or cabinet heater enclosures
 - 17 • Piping unions for systems not requiring a vapor barrier
- 18
19

20 For systems with fluid temperatures 65° F or less, furnish and install removable elastomeric insulation
21 covers, plugs or caps for all mechanical equipment and devices that require access by balancing
22 contractors or service and maintenance personnel. Examples include but are not limited to: flow sensing
23 devices, circuit setters, manual ball valve air vents, drain valves, blowdown valves,
24 pressure/temperature test plugs, grease fittings, pump bearing caps, equipment labels, etc. Covers shall
25 be tight fitting to ensure a complete vapor barrier.

26
27 **DUCT INSULATION**

28 **GENERAL:**

29 Secure flexible duct insulation on sides and bottom of ductwork over 24" wide and all rigid duct insulation
30 with weld pins. Space fasteners 18" on center or less as required to prevent sagging.

31
32 Secure rigid board insulation to ductwork with weld pins. Apply insulation with joints firmly butted as close
33 as possible to the equipment surface. Pins shall be located a maximum of 3" from each edge and spaced
34 no greater than 12" on center.

35
36 Install weld pins without damage to the interior galvanized surface of the duct. Clip pins back to washer
37 and cover penetrations with tape of same material as jacket. Firmly butt seams and joints and cover with
38 4" tape of same material as jacket. Seal tape with plastic applicator and secure with staples. All joints,
39 seams, edges and penetrations to be fully vapor sealed.

40
41 Stop and point insulation around access doors and damper operators to allow operation without
42 disturbing insulation or jacket material.

43
44 External supply duct insulation is not required where ductwork contains continuous 1" acoustical liner.
45 Provide 4" overlap of external insulation over ends of acoustically lined sections.

46
47 Where insulated ductwork is supported by trapeze hangers, the insulation shall be installed continuous
48 through the hangers. Drop the supporting channels required to facilitate the installation of the insulation.
49 Where rigid board or flexible insulation is specified, install high density inserts to prevent the weight of
50 the ductwork from crushing the insulation.

51
52 Where insulated duct risers are supported by steel channels secured directly to the duct, extend the
53 insulation and vapor barrier jacketing to encapsulate the support channels.

54
55 **BREECHING:**

56 Fasten insulation over weld pins and secure with washers. Space fasteners not less than 3" from edge or
57 corner and 12" on center longitudinally and 9" on center in the transverse direction. Clip pins back to
58 washer and cover penetrations with tape of same material as jacket. Firmly butt seams and joints and
59 cover with 4" tape of same material as jacket. Seal tape with plastic applicator and secure with staples.

60
61 **DUCT INSULATION SCHEDULE:**

62 Provide duct insulation on new and existing remodeled ductwork in the following schedule:

1	Service	Insulation Type	Jacket	Insulation Thickness
2	Concealed supply ducts	Flexible Fiberglass	FSJ	1-1/2"

3
4 * Exposed supply branch ducts located in the space they are serving do not require insulation.
5 Exposed supply main ducts running through spaces they serve shall be insulated as exposed supply
6 ducts scheduled above.

7
8 **EQUIPMENT INSULATION**

9 **GENERAL:**
10 Do not insulate over equipment access manholes, fittings, nameplates or ASME stamps. Bevel and seal
11 insulation at these locations.

12
13 **PROTECTIVE JACKETS:**
14 Provide a protective metal jacket (PMJ) for the following: Generator exhaust pipe (that is not concealed
15 in a shaft) and muffler.

16
17 **SEMI-RIGID FIBERGLASS:**
18 Apply insulation to equipment shells using weld pins, bonding adhesive, banded and wired in place. Fill
19 all joints, seams and depressions with insulating cement to a smooth, even surface. Cover with
20 reinforcing fabric and 2 coats of mastic (FMJ). Use vapor barrier mastic on systems requiring a vapor
21 barrier.

22
23 **EQUIPMENT INSULATION SCHEDULE:**

24 Provide equipment insulation as follows:

25	Equipment	Insulation	Jacket	Thickness Type
26	Reheat coil casing in concealed supply ducts	Flexible Fiberglass	FSJ	1-1/2"
27	Hot Water Air separators	Semi-Rigid Fiberglass	ASJ/FMJ	1.5"

28
29
30 ** The thickness and type of insulation provided for non-factory fabricated transitions or component
31 sections shall be consistent with the sections constructed at the factory.

32
33
34 **END SECTION 23 07 00**

1 **SECTION 23 09 23 - DIRECT DIGITAL CONTROL SYSTEM FOR HVAC**

2
3 **PART 1 - GENERAL**

4
5 **SCOPE**

6 Furnish all labor, materials, equipment, and service necessary for a complete and operating Facility
7 Management and Control System (FMCS), utilizing Direct Digital Controls as shown on the drawings and
8 as described herein. Drawings are diagrammatic only. The FMCS shall be capable of total integration of
9 the facility infrastructure systems with user access to all system data either locally over a secure Intranet
10 within the building or by remote access by a standard Web Browser over the Internet. This shall include
11 HVAC control, electrical, energy management, alarm monitoring, security and personnel access control,
12 fire-life safety systems, and all trending, reporting and maintenance management functions related to
13 normal building operations all as indicated on the drawings or elsewhere in this specification.
14

15 All labor, material, equipment and software not specifically referred to herein or on the plans, that are
16 required to meet the functional intent of this specification, shall be provided without additional cost to the
17 Owner.

18 **PART 1 – GENERAL**

- 19 Scope
- 20 System Description and Approved Vendors
- 21 Submittal
- 22 Related Work Specified Elsewhere
- 23 Agency and Code Approvals
- 24 Software License Agreement
- 25 Delivery, Storage and Handling
- 26 Job Conditions
- 27 Quality Assurance
- 28 Specification Nomenclature

29 **PART 2 - PRODUCTS**

- 30 General
- 31 Open, Interoperable, Integrated Architectures
- 32 Networks
- 33 Network Access
- 34 Network Area Controller (Nac)
- 35 Audit Log
- 36 Database Backup and Storage
- 37 Interoperable Digital Controller (Idc)
- 38 Interoperable Bacnet Controller (Ibc)
- 39 Web Browser Clients
- 40 Server Functions and Hardware
- 41 System Programming
- 42 Lonworks Network Management
- 43 Object Libraries
- 44 Graphical User Interface Computer Hardware (Desktop) Not Required Owner Provided
- 45 Graphical User Interface Computer Hardware (Laptop Computer) Not Required Owner Provided
- 46 Other Control System Hardware

47 **PART 3 - EXECUTION**

- 48 Installation
- 49 Wiring
- 50 Warranty
- 51 Warranty Access

1 Acceptance Testing
2 Operator Instruction, Training
3

4 **SYSTEM DESCRIPTION AND APPROVED VENDORS**

5 The entire Facility Management and Control System (FMCS) shall be comprised of a network of
6 interoperable, stand-alone digital controllers communicating on an open protocol communication network
7 to a host computer within the facility (when specified) and communicating via the internet to a host
8 computer in a remote location. The FMCS shall communicate to third party systems such as chillers,
9 boilers, air handling systems, energy metering systems, other energy management systems, access
10 control systems, fire-life safety systems and other building management related devices with open,
11 interoperable communication capabilities.
12

13 This system shall be integrated to the Server and have the identical graphics designed by Environmental
14 systems Inc. Please contact Environmental Systems Inc. at 262-544-8860.
15

16 **SUBMITTAL**

17 Eight copies of shop drawings of the entire control system shall be submitted and shall consist of a
18 complete list of equipment and materials, including manufacturers catalog data sheets and installation
19 instructions. Shop drawings shall also contain complete wiring and schematic diagrams, software
20 descriptions, calculations, and any other details required to demonstrate that the system has been
21 coordinated and will properly function as a system. Terminal identification for all control wiring shall be
22 shown on the shop drawings. A complete written Sequence of Operation as well as a hard copy
23 graphical depiction of the application control programs shall also be included with the submittal package.
24

25 Submittal shall also include a trunk cable schematic diagram depicting the Graphical User Interface
26 (GUI) computer, control panel locations and a description of the communication type, media and
27 protocol.
28

29 Submittal shall also include a complete point list of all connected points to the DDC system.
30

31 Upon completion of the work, provide a complete set of 'as-built' drawings and application software on
32 magnetic floppy disk media or compact disk. Drawings shall be provided as
33 AutoCAD™ or Visio™ compatible files. Eight copies of the 'as-built' drawings shall be provided in
34 addition to the documents on magnetic floppy disk media or compact disk.
35

36 **RELATED WORK SPECIFIED ELSEWHERE**

37 Division 15, Mechanical:

- 38 • Providing taps and installation of wells in piping for control system sensors and flow measurement
39 devices.
- 40 • Installation of any control system dampers.
41

42 Division 16, Electrical:

- 43 • Providing motor starters and disconnect switches (unless otherwise noted).
- 44 • Power wiring and conduit (unless otherwise noted).
- 45 • Provision, installation and wiring of smoke detectors (unless otherwise noted).
46

47 **AGENCY AND CODE APPROVALS**

48 All products of the FMCS shall be provided with the following agency approvals. Verification that the
49 approvals exist for all submitted products shall be provided with the submittal package. Systems or
50 products not currently offering the following approvals are not acceptable.

- 51 • UL-916; Energy Management Systems
- 52 • ULC; UL - Canadian Standards Association
- 53 • FCC, Part 15, Subpart J, Class A Computing Devices
54

1 **SOFTWARE LICENSE AGREEMENT**

2 The Owner shall sign a copy of the manufacturer's standard software and firmware licensing agreement
3 as a condition of this contract. Such license shall grant use of all programs and application software to
4 Owner as defined by the manufacturer's license agreement, but shall protect manufacturer's rights to
5 disclosure of trade secrets contained within such software.
6

7 **DELIVERY, STORAGE AND HANDLING**

8 Provide factory-shipping cartons for each piece of equipment and control device. Maintain cartons
9 through shipping, storage, and handling as required to prevent equipment damage. Store equipment and
10 materials inside and protected from weather.
11

12 **JOB CONDITIONS**

13 Cooperation with Other Trades: Coordinate the Work of this section with that of other sections to insure
14 that the Work will be carried out in an orderly fashion. It shall be this Contractor's responsibility to check
15 the Contract Documents for possible conflicts between his Work and that of other crafts in equipment
16 location, pipe, duct and conduit runs, electrical outlets and fixtures, air diffusers, and structural and
17 architectural features.
18

19 **QUALITY ASSURANCE**

20 The Manufacturer of the FMCS digital controllers shall provide documentation supporting compliance
21 with ISO-9001 (Model for Quality Assurance in Design/Development, Production, Installation and
22 Servicing). Product literature provided by the FMCS digital controller manufacturer shall contain the ISO-
23 9001 Certification Mark from the applicable registrar.
24

25 All components and systems shall be year 2000 (Y2K) compliant.
26

27 **SPECIFICATION NOMENCLATURE**

28 Acronyms used in this specification are as follows:

29 FMCS	Facility Management and Control System
30 NAC	Network Area Controller
31 IDC	Interoperable Digital Controller
32 IBC	Interoperable BACnet Controller
33 GUI	Graphical User Interface
34 WBI	Web Browser Interface
35 POT	Portable Operator's Terminal
36 PMI	Power Measurement Interface
37 DDC	Direct Digital Controls
38 LAN	Local Area Network
39 WAN	Wide Area Network
40 OOT	Object Oriented Technology
41 PICS	Product Interoperability Compliance Statement

42
43
44 **PART 2 - PRODUCTS**

45
46 **GENERAL**

47 The Facility Management Control System (FMCS) shall be comprised of a network of interoperable,
48 stand-alone digital controllers, a computer system, graphical user interface software, portable operator
49 terminals, printers, network devices and other devices as specified herein. All controllers and software
50 within FMCS shall be Year 2000 compliant and shall be supported by compliance documentation from
51 the manufacturer.
52

53 The installed system shall provide secure password access to all features, functions and data contained
54 in the overall FMCS.
55

1 **OPEN, INTEROPERABLE, INTEGRATED ARCHITECTURES**

2 The intent of this specification is to provide a peer-to-peer networked, stand-alone, distributed control
3 system with the capability to integrate both the ANSI/ASHRAE Standard 135-1995 BACnet and
4 LonWorks technology communication protocols in one open, interoperable system.
5

6 The supplied computer software shall employ object-oriented technology (OOT) for representation of all
7 data and control devices within the system. In addition, adherence to industry standards including ANSI /
8 ASHRAE™ Standard 135-1995, BACnet and LonMark to assure interoperability between all system
9 components is required. For each LonWorks device that does not have LonMark certification, the device
10 supplier must provide an XIF file for the device. For each BACnet device, the device supplier must
11 provide a PICS document showing the installed device's compliance level. Minimum compliance is
12 Level 3; with the ability to support data read and write functionality. Physical connection of BACnet
13 devices shall be via Ethernet.
14

15 All components and controllers supplied under this contract shall be true "peer-to-peer" communicating
16 devices. Components or controllers requiring "polling" by a host to pass data shall not be acceptable.
17

18 The supplied system must incorporate the ability to access all data using Java enabled browsers without
19 requiring proprietary operator interface and configuration programs. An Open DataBase Connectivity
20 (ODBC) or Structured Query Language (SQL) compliant server database is required for all system
21 database parameter storage. This data shall reside on a supplier-installed server for all database
22 access. Systems requiring proprietary database and user interface programs shall not be acceptable.
23

24 A hierarchical topology is required to assure reasonable system response times and to manage the flow
25 and sharing of data without unduly burdening the customer's internal Intranet network. Systems
26 employing a "flat" single tiered architecture shall not be acceptable.
27

28 Maximum acceptable response time from any alarm occurrence (at the point of origin) to the point of
29 annunciation shall not exceed 5 seconds for network connected user interfaces.
30

31 Maximum acceptable response time from any alarm occurrence (at the point of origin) to the point of
32 annunciation shall not exceed 60 seconds for remote or dial-up connected user interfaces.
33

34 **NETWORKS**

35 The Local Area Network (LAN) shall be either a 10 or 100 Megabits/sec Ethernet network supporting
36 BACnet, Java, XML, HTTP, and CORBA IIOP for maximum flexibility for integration of building data with
37 enterprise information systems and providing support for multiple Network Area Controllers (NACs), user
38 workstations and, if specified, a local host computer system.
39

40 Local area network minimum physical and media access requirements:

- 41 • Ethernet; IEEE standard 802.3
 - 42 • Cable; 10 Base-T, UTP-8 wire, category 5
 - 43 • Minimum throughput; 10 Mbps, with ability to increase to 100 Mbps
- 44

45 **NETWORK ACCESS**

46 REMOTE ACCESS.

47 For Local Area Network installations, provide access to the LAN from a remote location, via the Internet.
48 The owner shall provide a connection to the Internet to enable this access via high speed cable modem,
49 asynchronous digital subscriber line (ADSL) modem, ISDN line, T1 Line or via the customer's Intranet to
50 a corporate server providing access to an Internet Service Provider (ISP). Owner agrees to pay monthly
51 access charges for connection and ISP.
52

53 Where no Local Area Network exists, FMCS supplier shall provide the following:

- 54 • 8 Port Ethernet hub (3Com, or equal)

- 1 • Ethernet router (Cisco or equal)
- 2 • The owner shall provide a connection to the Internet to enable this access via high-speed cable
- 3 modem, asynchronous digital subscriber line (ADSL) modem, ISDN line or T1 Line. Owner agrees to
- 4 pay monthly access charges for connection and ISP

6 **NETWORK AREA CONTROLLER (NAC)**

7 The Network Area Controller (NAC) shall provide the interface between the LAN or WAN and the field
8 control devices, and provide global supervisory control functions over the control devices connected to
9 the NAC. It shall be capable of executing application control programs to provide:

- 10 • Calendar functions
- 11 • Scheduling
- 12 • Trending
- 13 • Alarm monitoring and routing
- 14 • Time synchronization
- 15 • Integration of LonWorks controller data and BACnet controller data
- 16 • Network Management functions for all LonWorks based devices

17
18 The Network Area Controller must provide the following hardware features as a minimum:

- 19 • One Ethernet Port -10 / 100 Mbps
- 20 • One RS-232 port
- 21 • One LonWorks Interface Port – 78KB FTT-10A
- 22 • Battery Backup
- 23 • Flash memory for long term data backup (If battery backup or flash memory is not supplied, the
- 24 controller must contain a hard disk with at least 1 gigabyte storage capacity)
- 25 • The NAC must be capable of operation over a temperature range of 0 to 55°C
- 26 • The NAC must be capable of withstanding storage temperatures of between 0 and 70°C
- 27 • The NAC must be capable of operation over a humidity range of 5 to 95% RH, non-condensing

28
29 The NAC shall provide multiple user access to the system and support for ODBC or SQL. A database
30 resident on the NAC shall be an ODBC-compliant database or must provide an ODBC data access
31 mechanism to read and write data stored within it.

32
33 The NAC shall support standard Web browser access via the Intranet/Internet. It shall support a
34 minimum of 16 simultaneous users.

35 **Event Alarm Notification and actions**

- 36 • The NAC shall provide alarm recognition, storage; routing, management, and analysis to supplement
- 37 distributed capabilities of equipment or application specific controllers.
- 38 • The NAC shall be able to route any alarm condition to any defined user location whether connected
- 39 to a local network or remote via dial-up, telephone connection, or wide-area network.
- 40 • Alarm generation shall be selectable for annunciation type and acknowledgement requirements
- 41 including but limited to:
 - 42 • To alarm
 - 43 • Return to normal
 - 44 • To fault
- 45 • Provide for the creation of an unlimited number of alarm classes for the purpose of routing types and
- 46 or classes of alarms, i.e.: security, HVAC, Fire, etc.
- 47 • Provide timed (schedule) routing of alarms by class, object, group, or node.
- 48 • Provide alarm generation from binary object “runtime” and /or event counts for equipment
- 49 maintenance. The user shall be able to reset runtime or event count values with appropriate
- 50 password control.

51
52
53 Control equipment and network failures shall be treated as alarms and annunciated.

- 1
2 Alarms shall be annunciated in any of the following manners as defined by the user:
3 • Screen message text
4 • Email of the complete alarm message to multiple recipients. Provide the ability to route and email
5 alarms based on:
6 • Day of week
7 • Time of day
8 • Recipient
9 • Pagers via paging services that initiate a page on receipt of email message
10 • Graphic with flashing alarm object(s)
11 • Printed message, routed directly to a dedicated alarm printer
12

- 13 The following shall be recorded by the NAC for each alarm (at a minimum):
14 • Time and date
15 • Location (building, floor, zone, office number, etc.)
16 • Equipment (air handler #, accessway, etc.)
17 • Acknowledge time, date, and user who issued acknowledgement.
18 • Number of occurrences since last acknowledgement.
19

20 Alarm actions may be initiated by user defined programmable objects created for that purpose.
21

22 Defined users shall be given proper access to acknowledge any alarm, or specific types or classes of
23 alarms defined by the user.
24

25 A log of all alarms shall be maintained by the NAC and/or a server (if configured in the system) and shall
26 be available for review by the user.
27

28 Provide a "query" feature to allow review of specific alarms by user defined parameters.
29

30 A separate log for system alerts (controller failures, network failures, etc.) shall be provided and available
31 for review by the user.
32

33 An Error Log to record invalid property changes or commands shall be provided and available for review
34 by the user.
35

36 DATA COLLECTION AND STORAGE

37 The NAC shall have the ability to collect data for any property of any object and store this data for future
38 use.
39

40 The data collection shall be performed by log objects, resident in the NAC that shall have, at a minimum,
41 the following configurable properties:

- 42 • Designating the log as interval or deviation.
43 • For interval logs, the object shall be configured for time of day, day of week and the sample
44 collection interval.
45 • For deviation logs, the object shall be configured for the deviation of a variable to a fixed value. This
46 value, when reached, will initiate logging of the object.
47 • For all logs, provide the ability to set the maximum number of data stores for the log and to set
48 whether the log will stop collecting when full, or rollover the data on a first-in, first-out basis.
49 • Each log shall have the ability to have its data cleared on a time-based event or by a user-defined
50 event or action.
51

52 All log data shall be stored in a relational database in the NAC and the data shall be accessed from a
53 server (if the system is so configured) or a standard Web Browser.
54

1 All log data, when accessed from a server, shall be capable of being manipulated using standard SQL
2 statements.

3
4 All log data shall be available to the user in the following data formats:

- 5 • HTML
- 6 • XML
- 7 • Plain Text
- 8 • Comma or tab separated values

9
10 Systems that do not provide log data in HTML and XML formats at a minimum shall not be acceptable.

11
12 The NAC shall have the ability to archive it's log data either locally (to itself), or remotely to a server or
13 other NAC on the network. Provide the ability to configure the following archiving properties, at a
14 minimum:

- 15 • Archive on time of day
- 16 • Archive on user-defined number of data stores in the log (buffer size)
- 17 • Archive when log has reached it's user-defined capacity of data stores
- 18 • Provide ability to clear logs once archived

19 20 **AUDIT LOG**

21 Provide and maintain an Audit Log that tracks all activities performed on the NAC. Provide the ability to
22 specify a buffer size for the log and the ability to archive log based on time or when the log has reached
23 its user-defined buffer size. Provide the ability to archive the log locally (to the NAC), to another NAC on
24 the network, or to a server. For each log entry, provide the following data:

- 25 • Time and date
- 26 • User ID
- 27 • Change or activity: i.e., Change setpoint, add or delete objects, commands, etc.

28 29 **DATABASE BACKUP AND STORAGE**

30 The NAC shall have the ability to automatically backup its database. The database shall be backed up
31 based on a user-defined time interval.

32
33 Copies of the current database and, at the most recently saved database shall be stored in the NAC.
34 The age of the most recently saved database is dependent on the user-defined database save interval.

35
36 The NAC database shall be stored, at a minimum, in XML format to allow for user viewing and editing, if
37 desired. Other formats are acceptable as well, as long as XML format is supported.

38 39 **INTEROPERABLE DIGITAL CONTROLLER (IDC)**

40 Controls shall be microprocessor based Interoperable LonMark™ or LonWorks Controllers (IDC). Where
41 possible, all Interoperable Digital Controllers shall bear the applicable LonMark™ interoperability logo on
42 each product delivered.

43
44 HVAC control shall be accomplished using LonMark™ based devices where the application has a
45 LonMark profile defined. Where LonMark devices are not available for a particular application, devices
46 based on LonWorks shall be acceptable. For each LonWorks device that does not have LonMark
47 certification, the device supplier must provide an XIF file for the device. Publicly available specifications
48 for the Applications Programming Interface (API) must be provided for each LonWorks / LonMark
49 controller defining the programming or setup of each device. All programming, documentation and
50 programming tools necessary to set up and configure the supplied devices per the specified sequences
51 of operation shall be provided.

52
53 The LonWorks network trunk shall be run to the nearest Network Area Controller (NAC). A maximum of
54 126 devices may occupy any one LonWorks trunk and must be installed using the appropriate trunk

1 termination device. All LonWorks and LonMark devices must be supplied using FTT-10A LonWorks
2 communications transceivers.

3
4 The Network Area Controller will provide all scheduling, alarming, trending, and network management for
5 the LonMark / LonWorks based devices.

6
7 The IDCs shall communicate with the NAC at a baud rate of not less than 78.8K baud. The IDC shall
8 provide LED indication of communication and controller performance to the technician, without cover
9 removal.

10
11 All IDCs shall be fully application programmable and shall at all times maintain their LONMARK
12 certification. Controllers offering application selection only (non-programmable), require a 10% spare
13 point capacity to be provided for all applications. All control sequences within or programmed into the
14 IDC shall be stored in non-volatile memory, which is not dependent upon the presence of a battery, to be
15 retained.

16
17 The supplier of any programmable IDC shall provide one copy of the manufacturer's programming tool,
18 with documentation, to the owner.

19 20 **INTEROPERABLE BACnet CONTROLLER (IBC)**

21 Controls shall be microprocessor based Interoperable BACnet Controllers (IBC) in accordance with the
22 ANSI/ASHRAE Standard 135-1995. IBCs shall be provided for Unit Ventilators, Fan Coils, Heat Pumps,
23 Variable Air Volume (VAV) Terminals and other applications as shown on the drawings. The application
24 control program shall be resident within the same enclosure as the input/output circuitry, which translates
25 the sensor signals. The system supplier must provide a PICS document showing the installed systems
26 compliance level to the ANSI/ASHRAE Standard 135-1995. Minimum compliance is Level 3.

27
28 The IBCs shall communicate with the NAC via an Ethernet connection at a baud rate of not less than 10
29 Mbps.

30
31 The IBC Sensor shall connect directly to the IBC and shall not utilize any of the I/O points of the
32 controller. The IBC Sensor shall provide a two-wire connection to the controller that is polarity and wire
33 type insensitive. The IBC Sensor shall provide a communications jack for connection to the BACnet
34 communication trunk to which the IBC controller is connected. The IBC Sensor, the connected
35 controller, and all other devices on the BACnet bus shall be accessible by the POT.

36
37 All IBCs shall be fully application programmable and shall at all times maintain their BACnet Level 3
38 compliance. Controllers offering application selection only (non-programmable), require a 10% spare
39 point capacity to be provided for all applications. All control sequences within or programmed into the
40 IBC shall be stored in non-volatile memory, which is not dependent upon the presence of a battery, to be
41 retained.

42 43 **WEB BROWSER CLIENTS**

44 The system shall be capable of supporting an unlimited number of clients using a standard Web browser
45 such as Internet Explorer™ or Netscape Navigator™. Systems requiring additional software (to enable a
46 standard Web browser) to be resident on the client machine, or manufacture-specific browsers shall not
47 be acceptable.

48
49 The Web browser software shall run on any operating system and system configuration that is supported
50 by the Web browser. Systems that require specific machine requirements in terms of processor speed,
51 memory, etc., in order to allow the Web browser to function with the FMCS, shall not be acceptable.

52
53 The Web browser shall provide the same view of the system, in terms of graphics, schedules, calendars,
54 logs, etc., and provide the same interface methodology as is provided by the Graphical User Interface.

1 Systems that require different views or that require different means of interacting with objects such as
2 schedules, or logs, shall not be permitted.

3
4 The Web browser client shall support at a minimum, the following functions:

- 5 • User log-on identification and password shall be required. If an unauthorized user attempts access, a
6 blank web page shall be displayed. Security using Java authentication and encryption techniques to
7 prevent unauthorized access shall be implemented.
- 8 • Graphical screens developed for the GUI shall be the same screens used for the Web browser client.
9 Any animated graphical objects supported by the GUI shall be supported by the Web browser
10 interface.
- 11 • HTML programming shall not be required to display system graphics or data on a Web page. HTML
12 editing of the Web page shall be allowed if the user desires a specific look or format.
- 13 • Storage of the graphical screens shall be in the Network Area Controller (NAC), without requiring any
14 graphics to be stored on the client machine. Systems that require graphics storage on each client
15 are not acceptable.
- 16 • Real-time values displayed on a Web page shall update automatically without requiring a manual
17 "refresh" of the Web page.
- 18 • User's shall have administrator-defined access privileges. Depending on the access privileges
19 assigned, the user shall be able to perform the following:
 - 20 • Modify common application objects, such as schedules, calendars, and set points in a
21 graphical manner.
 - 22 • Schedule times will be adjusted using a graphical slider, without requiring
23 any keyboard entry from the operator.
 - 24 • Holidays shall be set by using a graphical calendar, without requiring any
25 keyboard entry from the operator.
 - 26 • Commands to start and stop binary objects shall be done by right-clicking the selected
27 object and selecting the appropriate command from the pop-up menu. No entry of text
28 shall be required.
 - 29 • View logs and charts
 - 30 • View and acknowledge alarms
- 31 • The system shall provide the capability to specify a user's (as determined by the log-on user
32 identification) home page. Provide the ability to limit a specific user to just their defined home page.
33 From the home page, links to other views, or pages in the system shall be possible, if allowed by the
34 system administrator.
- 35 • Graphic screens on the Web Browser client shall support hypertext links to other locations on the
36 Internet or on Intranet sites, by specifying the Uniform Resource Locator (URL) for the desired link.

37 38 **SERVER FUNCTIONS AND HARDWARE**

39 A central server, located in the maintenance office, with web supervisor software is existing and was
40 provided. The server shall support all Network Area Controllers (NAC) connected to the customer's
41 network whether local or remote and shall support future network controllers. Any new Network
42 controllers shall communicate directly with the existing server, have enterprise connectivity and all
43 graphics shall be identical as provided by Environmental systems Inc.

44
45 Local connections shall be via an Ethernet LAN. Remote connections can be via ISDN, ADSL, T1 or
46 dial-up connection.

47
48 It shall be possible to provide access to all Network Area Controllers via a single connection to the
49 server. In this configuration, each Network Area Controller can be accessed from the Graphical User
50 Interface (GUI) or from a standard Web browser (WBI) by connecting to the server.

51
52 The server shall provide the following functions, at a minimum:

- 53 • Global Data Access: The server shall provide complete access to distributed data defined anywhere
54 in the system.

- 1 • Distributed Control: The server shall provide the ability to execute global control strategies based on
2 control and data objects in any NAC in the network, local or remote.
- 3 • The server shall include a master clock service for its subsystems and provide time synchronization
4 for all Network Area Controllers (NAC).
- 5 • The server shall accept time synchronization messages from trusted precision Atomic Clock Internet
6 sites and update its master clock based on this data.
- 7 • The server shall provide scheduling for all Network Area Controllers and their underlying field control
8 devices.
- 9 • The server shall provide demand limiting that operates across all Network Area Controllers. The
10 server must be capable of multiple demand programs for sites with multiple meters and or multiple
11 sources of energy. Each demand program shall be capable of supporting separate demand shed
12 lists for effective demand control.
- 13 • The server shall implement the BACnet Command Prioritization scheme (16 levels) for safe and
14 effective contention resolution of all commands issued to Network Area Controllers. Systems not
15 employing this prioritization shall not be accepted.
- 16 • Each Network Area Controller supported by the server shall have the ability to archive its log data,
17 alarm data and database to the server, automatically. Archiving options shall be user-defined
18 including archive time and archive frequency.
- 19 • The server shall provide central alarm management for all Network Area Controllers supported by
20 the server. Alarm management shall include:
 - 21 • Routing of alarms to display, printer, email and pagers
 - 22 • View and acknowledge of alarms
 - 23 • Query alarm logs based on user-defined parameters
- 24 • The server shall provide central management of log data for all Network Area Controllers supported
25 by the server. Log data shall include process logs, runtime and event counter logs, audit logs and
26 error logs. Log data management shall include:
 - 27 • Viewing and printing log data
 - 28 • Exporting log data to other software applications
 - 29 • Query log data based on user-defined parameters

- 30
- 31 Server Hardware Requirements: The server hardware platform shall have the following requirements:
- 32 • The computer shall be an Intel Pentium based computer (minimum processing speed of 2.8 GHz,
33 2GB cache, 800MHz FSB with 1.0GB RAM, upgradeable to 2 Gb.) It shall include a CD-RW/DVD
34 drive, dual 73Gb hard drives, Two 10/100 Network Interface Cards, dual power supplies with y power
35 card, and 2-USB ports. A minimum 17", 28-dot pitch SVGA (1024 x 768) color monitor with a
36 minimum 80 Hz refresh rate shall also be included.
 - 37 • Acceptable manufacturers: Dell PowerEdge
 - 38 • The server operating system shall be Microsoft Windows 2000, Windows Server 2000, Windows XP
39 Professional or Windows Server 2003. World Wide Web Server (an ISS Windows Component)
40 must not be installed. Include Microsoft Internet Explorer 4.0 or later or Netscape Navigator 4.5 or
41 later.
 - 42 • Connection to the FMCS network shall be via an Ethernet network interface card, 10 or 100 Mbps.
 - 43 • A system printer shall be provided. Printer shall be laser type with a minimum 600 x 600-dpi
44 resolution and rated for 8-PPM print speed minimum.
 - 45 • For dedicated alarm printing, provide a dot matrix printer, either 80 or 132 column width. The printer
46 shall have a parallel port interface.

47

48 **SYSTEM PROGRAMMING**

49 The Graphical User Interface software (GUI) shall provide the ability to perform system programming
50 and graphic display engineering as part of a complete software package. Access to the programming
51 functions and features of the GUI shall be through password access as assigned by the system
52 administrator.

53

1 A library of control, application, and graphic objects shall be provided to enable the creation of all
2 applications and user interface screens. Applications are to be created by selecting the desired control
3 objects from the library, dragging or pasting them on the screen, and linking them together using a built
4 in graphical connection tool. Completed applications may be stored in the library for future use.
5 Graphical User Interface screens shall be created in the same fashion. Data for the user displays is
6 obtained by graphically linking the user display objects to the application objects to provide "real-time"
7 data updates. Any real-time data value or object property may be connected to display its current value
8 on a user display. Systems requiring separate software tools or processes to create applications and user
9 interface display shall not be acceptable.

10 PROGRAMMING METHODS

11 Provide the capability to copy objects from the supplied libraries, or from a user-defined library to the
12 user's application. Objects shall be linked by a graphical linking scheme by dragging a link from one
13 object to another. Object links will support one-to-one, many-to-one, or one-to-many relationships.
14 Linked objects shall maintain their connections to other objects regardless of where they are positioned
15 on the page and shall show link identification for links to objects on other pages for easy identification.
16 Links will vary in color depending on the type of link; i.e., internal, external, hardware, etc.

17 Configuration of each object will be done through the object's property sheet using fill-in the blank fields,
18 list boxes, and selection buttons. Use of custom programming, scripting language, or a manufacturer-
19 specific procedural language for configuration will not be accepted.

20 The software shall provide the ability to view the logic in a monitor mode. When on-line, the monitor
21 mode shall provide the ability to view the logic in real time for easy diagnosis of the logic execution.
22 When off-line (debug), the monitor mode shall allow the user to set values to inputs and monitor the logic
23 for diagnosing execution before it is applied to the system.

24 All programming shall be done in real-time. Systems requiring the uploading, editing, and downloading of
25 database objects shall not be allowed.

26 The system shall support object duplication within a customer's database. An application, once
27 configured, can be copied and pasted for easy re-use and duplication. All links, other than to the
28 hardware, shall be maintained during duplication.

29 **LonWorks NETWORK MANAGEMENT**

30 The Graphical User Interface software (GUI) shall provide a complete set of integrated LonWorks
31 network management tools for working with LonWorks networks. These tools shall manage a database
32 for all LonWorks devices by type and revision, and shall provide a software mechanism for identifying
33 each device on the network. These tools shall also be capable of defining network data connections
34 between LonWorks devices, known as "binding". Systems requiring the use of third party LonWorks
35 network management tools shall not be accepted.

36 Network management shall include the following services: device identification, device installation,
37 device configuration, device diagnostics, device maintenance and network variable binding.

38 The Network configuration tool shall also provide diagnostics to identify devices on the network, to reset
39 devices, and to view health and status counters within devices.

40 These tools shall provide the ability to "learn" an existing LonWorks network, regardless of what network
41 management tool(s) were used to install the existing network, so that existing LonWorks devices and
42 newly added devices are part of a single network management database.

43 The network management database shall be resident in the Network Area Controller (NAC), ensuring that
44 anyone with proper authorization has access to the network management database at all times. Systems
45

1 employing network management databases that are not resident, at all times, within the control system
2 shall not be accepted.

3
4 **OBJECT LIBRARIES**

5 A standard library of objects shall be included for development and setup of application logic, user
6 interface displays, system services, and communication networks.

7
8 The objects in this library shall be capable of being copied and pasted into the user's database and shall
9 be organized according to their function. In addition, the user shall have the capability to group objects
10 created in their application and store the new instances of these objects in a user-defined library.

11
12 In addition to the standard libraries specified here, the supplier of the system shall maintain an on-line
13 accessible (over the Internet) library, available to all registered users to provide new or updated objects
14 and applications as they are developed.

15
16 All control objects shall conform to the control objects specified in the BACnet specification.

17
18 The library shall include applications or objects for the following functions, at a minimum:

- 19 • Scheduling Object. The schedule must conform to the schedule object as defined in the BACnet
20 specification, providing 7-day plus holiday & temporary scheduling features and a minimum of 10
21 on/off events per day. Data entry to be by graphical sliders to speed creation and selection of on-off
22 events.
- 23 • Calendar Object. . The calendar must conform to the calendar object as defined in the BACnet
24 specification, providing 12-month calendar features to allow for holiday or special event data entry.
25 Data entry to be by graphical "point-and-click" selection. This object must be "linkable" to any or all
26 scheduling objects for effective event control.
- 27 • Duty Cycling Object. Provide a universal duty cycle object to allow repetitive on/off time control of
28 equipment as an energy conserving measure. Any number of these objects may be created to
29 control equipment at varying intervals
- 30 • Temperature Override Object. Provide a temperature override object that is capable of overriding
31 equipment turned off by other energy saving programs (scheduling, duty cycling etc.) to maintain
32 occupant comfort or for equipment freeze protection.
- 33 • Start-Stop Time Optimization Object. Provide a start-stop time optimization object to provide the
34 capability of starting equipment just early enough to bring space conditions to desired conditions by
35 the scheduled occupancy time. Also, allow equipment to be stopped before the scheduled un-
36 occupancy time just far enough ahead to take advantage of the building's "flywheel" effect for energy
37 savings. Provide automatic tuning of all start / stop time object properties based on the previous
38 day's performance.
- 39 • Demand Limiting Object. Provide a comprehensive demand-limiting object that is capable of
40 controlling demand for any selected energy utility (electric, oil, and gas). The object shall provide the
41 capability of monitoring a demand value and predicting (by use of a sliding window prediction
42 algorithm) the demand at the end of the user defined interval period (1-60 minutes). This object
43 shall also accommodate a utility meter time sync pulse for fixed interval demand control. Upon a
44 prediction that will exceed the user defined demand limit (supply a minimum of 6 per day), the
45 demand limiting object shall issue shed commands to either turn off user specified loads or modify
46 equipment set points to effect the desired energy reduction. If the list of sheddable equipment is not
47 enough to reduce the demand to below the set point, a message shall be displayed on the users
48 screen (as an alarm) instructing the user to take manual actions to maintain the desired demand.
49 The shed lists are specified by the user and shall be selectable to be shed in either a fixed or rotating
50 order to control which equipment is shed the most often. Upon suitable reductions in demand, the
51 demand-limiting object shall restore the equipment that was shed in the reverse order in which it was
52 shed. Each sheddable object shall have a minimum and maximum shed time property to effect both
53 equipment protection and occupant comfort.

- 1 The library shall include control objects for the following functions. All control objects shall conform to the
2 objects as specified in the BACnet specification.
- 3 • Analog Input Object - Minimum requirement is to comply with the BACnet standard for data sharing.
4 Allow high, low and failure limits to be assigned for alarming. Also, provide a time delay filter
5 property to prevent nuisance alarms caused by temporary excursions above or below the user
6 defined alarm limits.
 - 7 • Analog Output Object - Minimum requirement is to comply with the BACnet standard for data
8 sharing.
 - 9 • Binary Input Object - Minimum requirement is to comply with the BACnet standard for data sharing.
10 The user must be able to specify either input condition for alarming. This object must also include
11 the capability to record equipment run-time by counting the amount of time the hardware input is in
12 an "on" condition. The user must be able to specify either input condition as the "on" condition.
 - 13 • Binary Output Object - Minimum requirement is to comply with the BACnet standard for data sharing.
14 Properties to enable minimum on and off times for equipment protection as well as interstart delay
15 must be provided. The BACnet Command Prioritization priority scheme shall be incorporated to
16 allow multiple control applications to execute commands on this object with the highest priority
17 command being invoked. Provide sixteen levels of priority as a minimum. Systems not employing
18 the BACnet method of contention resolution shall not be acceptable.
 - 19 • PID Control Loop Object - Minimum requirement is to comply with the BACnet standard for data
20 sharing. Each individual property must be adjustable as well as to be disabled to allow proportional
21 control only, or proportional with integral control, as well as proportional, integral and derivative
22 control.
 - 23 • Comparison Object - Allow a minimum of two analog objects to be compared to select either the
24 highest, lowest, or equality between the two linked inputs. Also, allow limits to be applied to the
25 output value for alarm generation.
 - 26 • Math Object - Allow a minimum of four analog objects to be tested for the minimum or maximum, or
27 the sum, difference, or average of linked objects. Also, allow limits to be applied to the output value
28 for alarm generation.
 - 29 • Custom Programming Objects - Provide a blank object template for the creation of new custom
30 objects to meet specific user application requirements. This object must provide a simple BASIC-
31 like programming language that is used to define object behavior. Provide a library of functions
32 including math and logic functions, string manipulation, and e-mail as a minimum. Also, provide a
33 comprehensive on-line debug tool to allow complete testing of the new object. Allow new objects to
34 be stored in the library for re-use.
 - 35 • Interlock Object - Provide an interlock object that provides a means of coordination of objects within
36 a piece of equipment such as an Air Handler or other similar types of equipment. An example is to
37 link the return fan to the supply fan such that when the supply fan is started, the return fan object is
38 also started automatically without the user having to issue separate commands or to link each object
39 to a schedule object. In addition, the control loops, damper objects, and alarm monitoring (such as
40 return air, supply air, and mixed air temperature objects) will be inhibited from alarming during a
41 user-defined period after startup to allow for stabilization. When the air handler is stopped, the
42 interlocked return fan is also stopped, the outside air damper is closed, and other related objects
43 within the air handler unit are inhibited from alarming thereby eliminating nuisance alarms during the
44 off period.
 - 45 • Temperature Override Object - Provide an object whose purpose is to provide the capability of
46 overriding a binary output to an "On" state in the event a user specified high or low limit value is
47 exceeded. This object is to be linked to the desired binary output object as well as to an analog
48 object for temperature monitoring, to cause the override to be enabled. This object will execute a
49 Start command at the Temperature Override level of start/stop command priority unless changed by
50 the user.
 - 51 • Composite Object - Provide a container object that allows a collection of objects representing an
52 application to be encapsulated to protect the application from tampering, or to more easily represent
53 large applications. This object must have the ability to allow the user to select the appropriate

1 parameters of the “contained” application that are represented on the graphical shell of this
2 container.
3

4 The object library shall include objects to support the integration of devices connected to the Network
5 Area Controller (NAC). At a minimum, provide the following as part of the standard library included with
6 the programming software:

- 7 • LonMark/LonWorks devices. These devices shall include, but not be limited to, devices for control of
8 HVAC, lighting, access, and metering. Provide LonMark manufacturer-specific objects to facilitate
9 simple integration of these devices. All network variables defined in the LonMark profile shall be
10 supported. Information (type and function) regarding network variables not defined in the LonMark
11 profile shall be provided by the device manufacturer.
- 12 • For devices not conforming to the LonMark standard, provide a dynamic object that can be assigned
13 to the device based on network variable information provided by the device manufacturer. Device
14 manufacturer shall provide an XIF file and documentation for the device to facilitate device
15 integration.
- 16 • For BACnet devices, provide the following objects at a minimum:
 - 17 • BACnet AI
 - 18 • BACnet AO
 - 19 • BACnet BI
 - 20 • BACnet BO
 - 21 • BACnet Device
- 22 • For each BACnet object, provide the ability to assign the object to a BACnet device and object's
23 instance number.

24
25 Note to specifiers: Depending on the project configuration and requirements, it may be desired to
26 integrate data from a legacy system. This is not always straightforward and care should be taken when
27 using this approach. This approach may require the development of a custom communications driver to
28 the legacy system, which can add cost and time. However, if legacy system integration is required, use
29 Item 2.18.
30

31 **LEGACY SYSTEM INTEGRATION**

32 The Network Area Controller shall support the integration of device data from the existing control system.
33 The connection to the existing system shall be via an RS-232 connection between the Network Area
34 Controller and the existing control system.
35

36 The owner, and/or the existing control system representative shall ensure that the existing system's
37 database is setup to make all data to be integrated into the FMCS available at the RS-232 port. Any
38 modifications to the existing system database to accomplish this shall be the responsibility of the owner.
39

40 Provide the required objects in the library, included with the Graphical User Interface programming
41 software, to support the integration of the existing system data into the FMCS. Objects provided shall
42 include at a minimum:

- 43 • LEGACY SYSTEM Generic AI Object
 - 44 • LEGACY SYSTEM Generic AO Object
 - 45 • LEGACY SYSTEM Generic BO Object
 - 46 • LEGACY SYSTEM Generic BI Object
- 47

48 All scheduling, alarming, logging and global supervisory control functions (demand limiting, etc.), of the
49 existing system devices, shall be performed by the Network Area Controller. Integration of the existing
50 system's schedules, alarms, logs, etc. is neither required nor desired.
51

52 **GRAPHICAL USER INTERFACE COMPUTER HARDWARE (DESKTOP) Not required owner**
53 **provided**

1 The desktop computer shall be an Intel Pentium based computer (minimum processing speed of 400
2 Mhz with 256 MB RAM and a 10-gigabyte minimum hard drive). It shall include a 32X CD-ROM drive,
3 3.5" floppy drive, a 100 MB Zip drive, 2-parallel ports, 2-asynchronous serial ports and 2-USB ports. A
4 minimum 17", 28-dot pitch SVGA (1024 x 768) color monitor with a minimum 80 Hz refresh rate shall
5 also be included.

6
7 A system printer shall be provided. Printer shall be laser type with a minimum 600 x 600-dpi resolution
8 and rated for 8 PPM print speed minimum.

9
10 **GRAPHICAL USER INTERFACE COMPUTER HARDWARE (LAPTOP COMPUTER) not required**
11 **owner provided**

12 The laptop computer shall consist of an Intel Pentium based laptop computer (minimum processing
13 speed of 200 Mhz with 128 MB RAM and a 2-gigabyte minimum hard drive). It shall include a CD-ROM
14 drive, a 3.5" floppy drive and appropriate connectors and cables for communication connection to the
15 NAC, Ethernet, LonWorks or BACnet networks.

16
17 **OTHER CONTROL SYSTEM HARDWARE**

18 Motorized Control Dampers (where furnished by the Temperature Control sub-contractor): Dampers shall
19 be black enamel finish or galvanized, with nylon bearings. Blade edge and tip seals shall be included for
20 all dampers. Blades shall be 16-gauge minimum and 6 inches wide maximum and frame shall be of
21 welded channel iron. Dampers with both dimensions less than 18 inches may have strap iron frames.

22
23 Control Damper Actuators (where furnished by the Temperature Control sub-contractor): Two-position or
24 proportional electric actuators shall be direct-mount type sized to provide a minimum of 5 in-lb torque per
25 square foot of damper area. Damper actuators shall be spring return type. Provide one actuator per
26 damper minimum. Pneumatic actuators shall be sized to provide a minimum of 5 in-lb torque per square
27 foot of damper area and shall include positive positioning pneumatic relays when sequenced with other
28 actuators or when control action is to be proportional.

29
30 Control Valves: Control valves shall be 2-way or 3-way pattern as shown constructed for tight shutoff and
31 shall operate satisfactorily against system pressures and differentials. Two-position valves shall be 'line'
32 size. Proportional control valves shall be sized for a maximum pressure drop of 5.0 psi at rated flow
33 (except as may be noted on the drawings). Valves with sizes up to and including 2 inches shall be
34 "screwed" configuration and 2-1/2 inch and larger valves shall be "flanged" configuration. Electrically
35 controlled valves shall include spring return type actuators sized for tight shut-off against system
36 pressures and furnished with integral switches for indication of valve position (open-closed).
37 Pneumatically actuators for valves, when utilized, shall be sized for tight shut-off against system
38 pressures. Three-way butterfly valves, when utilized, shall include a separate actuator for each butterfly
39 segment.

40
41 Wall Mount Room Thermostats: Each room thermostat shall provide temperature indication to the digital
42 controller, provide the capability for a software-limited set point adjustment and operation override
43 capability. An integral LCD shall annunciate current room temperature and set point as well as override
44 status indication. In addition, the thermostat shall include a port for connection of the portable operator's
45 terminal described elsewhere in this specification.

46
47 Duct Mount, Pipe Mount and Outside Air Temperature Sensors: 10,000-ohm thermistor temperature
48 sensors with an accuracy of $\pm 0.2^{\circ}\text{C}$. Outside air sensors shall include an integral sun shield.

49
50 Current Sensitive Switches: Solid state, split core current switch that operates when the current level
51 (sensed by the internal current transformer) exceeds the adjustable trip point. Current switch to include
52 an integral LED for indication of trip condition and a current level below trip set point.

53
54 Power Monitoring Interface: The Power Measurement Interface (PMI) device shall include the
55 appropriate current and potential (voltage) transformers. The PMI shall be certified under UL-3111. The

1 PMI shall perform continuous true RMS measurement based on 32 samples-per-cycle sampling on all
2 voltage and current signals. The PMI shall provide outputs to the FMCS based on the measurement and
3 calculation of the following parameters: (a) current for each phase and average of all three phases, (b)
4 kW for each phase and total of all three phases, (c) power factor for each phase and all three phases, (d)
5 percent voltage unbalance and (e) percent current unbalance. These output values shall be hard-wired
6 inputs to the FMCS or shall be communicated to the FMCS over the open-protocol LAN.
7

8 Temperature Control Panels: Furnish temperature control panels of code gauge steel with locking doors
9 for mounting all devices as shown. Control panels shall meet all requirements of Title 24, California
10 Administrative Code. All electrical devices within a control panel shall be factory wired. All external
11 wiring shall be connected to terminal strips mounted within the panel. Provide engraved phenolic
12 nameplates identifying all devices mounted on the face of control panels. A complete set of 'as-built'
13 control drawings (relating to the controls within that panel) shall be furnished within each control panel.
14

15 **PART 3 - EXECUTION**

16 **INSTALLATION**

17 All work described in this section shall be installed, wired, circuit tested and calibrated by factory certified
18 technicians qualified for this work and in the regular employment of the temperature control system
19 manufacturer or its exclusive factory authorized installing contracting field office (representative). The
20 installing office shall have a minimum of five years of installation experience with the manufacturer and
21 shall provide documentation in submittal package verifying longevity of the installing company's
22 relationship with the manufacturer. Supervision, calibration and checkout of the system shall be by the
23 employees of the local exclusive factory authorized temperature control contracting field office (branch
24 or representative).
25

26
27 Install system and materials in accordance with manufacturer's instructions, and as detailed on the
28 project drawing set.
29

30 Drawings of temperature control systems are diagrammatic only and any apparatus not shown, such as
31 relays, accessories, etc., but required to make the system operative to the complete satisfaction of the
32 Architect shall be furnished and installed without additional cost.
33

34 Line and low voltage electrical connections to control equipment shown specified or shown on the control
35 diagrams shall be furnished and installed by the Temperature Control sub-contractor in accordance with
36 these specifications.
37

38 Equipment furnished by the HVAC Contractor that is normally wired before installation shall be furnished
39 completely wired. Control wiring normally performed in the field will be furnished and installed by the
40 Temperature Control sub-contractor.
41

42 All control devices mounted on the face of control panels shall be clearly identified as to function and
43 system served with permanently engraved phenolic labels.
44

45 **WIRING**

46 All electrical control wiring and power wiring to the control panels shall be the responsibility of the FMCS
47 contractor.
48

49 The electrical contractor (Div. 16) shall furnish all power wiring to electrical starters and motors.
50

51 All wiring shall be in accordance with the Project Electrical Specifications (Division 16), the National
52 Electrical Code and any applicable local codes. All FMCS wiring shall be installed in the conduit types
53 specified in the Project Electrical Specifications (Division 16) unless otherwise allowed by the National
54 Electrical Code or applicable local codes. Where FMCS plenum rated cable wiring is allowed it shall be

1 run parallel to or at right angles to the structure, properly supported and installed in a neat and
2 workmanlike manner.

3 4 **WARRANTY**

5 Equipment, materials and workmanship incorporated into the work shall be warranted for a period of one
6 year from the time of system acceptance.

7
8 Within this period, upon notice by the Owner, any defects in the FMCS due to faulty materials, methods
9 of installation or workmanship shall be promptly (within 48 hours after receipt of notice) repaired or
10 replaced by the Temperature Control sub-contractor at no expense to the Owner

11 12 **WARRANTY ACCESS**

13 The Owner shall grant to the Temperature Control sub-contractor, reasonable access to the FMCS during
14 the warranty period. The owner shall allow the contractor to access the FMCS from a remote location for
15 the purpose of diagnostics and troubleshooting, via the Internet, during the warranty period.

16 17 **ACCEPTANCE TESTING**

18 Upon completion of the installation, the Temperature Control sub-contractor shall load all system
19 software and start-up the system. The Temperature Control sub-contractor shall perform all necessary
20 calibration, testing and de-bugging and perform all required operational checks to insure that the system
21 is functioning in full accordance with these specifications.

22
23 The Temperature Control sub-contractor shall perform tests to verify proper performance of components,
24 routines, and points. Repeat tests until proper performance results. This testing shall include a point-by-
25 point log to validate 100% of the input and output points of the DDC system operation.

26
27 Upon completion of the performance tests described above, repeat these tests, point by point as
28 described in the validation log above in presence of Owner's Representative, as required. Properly
29 schedule these tests so testing is complete at a time directed by the Owner's Representative. Do not
30 delay tests so as to prevent delay of occupancy permits or building occupancy.

31
32 System Acceptance: Satisfactory completion is when the Temperature Control sub-contractor has
33 performed successfully all the required testing to show performance compliance with the requirements of
34 the Contract Documents to the satisfaction of the Owner's Representative. System acceptance shall be
35 contingent upon completion and review of all corrected deficiencies.

36 37 **OPERATOR INSTRUCTION, TRAINING**

38 During system commissioning and at such time acceptable performance of the FMCS hardware and
39 software has been established the Temperature Control sub-contractor shall provide on-site operator
40 instruction to the owner's operating personnel. Operator instruction shall be done during normal working
41 hours and shall be performed by a competent representative familiar with the system hardware, software
42 and accessories.

43
44 The Temperature Control sub-contractor shall provide 40 hours of instruction to the owner's designated
45 personnel on the operation of the FMCS and describe its intended use with respect to the programmed
46 functions specified. Operator orientation of the FMCS shall include, but not be limited to; the overall
47 operation program, equipment functions (both individually and as part of the total integrated system),
48 commands, systems generation, advisories, and appropriate operator intervention required in responding
49 to the System's operation.

50
51 The training shall be in three sessions as follows:

- 52 • Initial Training: One day session (8 hours) after system is started up and at least one week before
53 first acceptance test. Manual shall have been submitted at least two weeks prior to training so that
54 the owners' personnel can start to familiarize themselves with the system before classroom
55 instruction begins.

- 1 • First Follow-Up Training: Two days (16 hours total) approximately two weeks after initial training, and
2 before Formal Acceptance. These sessions will deal with more advanced topics and answer
3 questions.
 - 4 • Warranty Follow Up: Two days (16 hours total) in no less than 4 hour increments, to be scheduled at
5 the request of the owner during the one year warranty period. These sessions shall cover topics as
6 requested by the owner such as; how to add additional points, create and gather data for trends,
7 graphic screen generation or modification of control routines.
8
9
- 10 END SECTION 23 09 23

1 **SECTION 23 21 13 - PIPING**

2
3 **PART 1 - GENERAL**

4
5 **SCOPE**

6 This section contains specifications for all HVAC hydronic pipe and pipe fittings for this project. Included
7 are the following topics:

8 **PART 1 - GENERAL**

9 Scope
10 Related Work
11 Reference
12 Reference Standards
13 Shop Drawings
14 Quality Assurance
15 Delivery, Storage, and Handling
16 Design Criteria
17 Welder Qualifications

18 **PART 2 - PRODUCTS**

19 Heating Hot Water
20 Natural Gas
21 Makeup Water
22 Chemical Treatment
23 Vents and Relief Valves
24 Unions and Flanges
25 Gaskets

26 **PART 3 - EXECUTION**

27 Preparation
28 Erection
29 Welded Pipe Joints
30 Threaded Pipe Joints
31 Copper Pipe Joints
32 Water Systems
33 Makeup Water
34 Chemical Treatment
35 Vents and Relief Valves
36 Natural Gas
37 Unions and Flanges
38 Gaskets
39 Piping System Leak Tests
40 Hydronic Piping System Flushing
41 Piping System Test Report

42
43 **RELATED WORK**

44 Section 23 05 23 - General-Duty Valves for HVAC Piping
45 Section 23 05 15 - Piping Specialties
46 Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment
47 Section 23 07 00 - HVAC Insulation
48 Section 23 25 00 - HVAC Water Treatment.

49
50 **REFERENCE**

51 Applicable provisions of Division 1 govern work under this Section.

52
53 **REFERENCE STANDARDS**

54 ANSI B16.3 Malleable Iron Threaded Fittings
55 ANSI B16.4 Cast Iron Threaded Fittings
56 ANSI B16.5 Pipe Flanges and Flanged Fittings
57 ANSI B16.22 Wrought Copper and Wrought Copper Alloy Solder Joint Pressure Fittings
58 ASTM A53 Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless
59 ASTM A74 Cast Iron Soil Pipe and Fittings

1	ASTM A105	Forgings, Carbon Steel, for Piping Components
2	ASTM A126	Gray Cast Iron Castings for Valves, Flanges, and Pipe Fittings
3	ASTM A181	Forgings, Carbon Steel for General Purpose Piping
4	ASTM A197	Cupola Malleable Iron
5	ASTM A234	Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated
6		Temperatures
7	ASTM B75	Seamless Copper Tube
8	ASTM B88	Seamless Copper Water Tube

9

SHOP DRAWINGS

11 Refer to Division 1, General Conditions, Submittals.

12

13 Contractor shall submit schedule indicating the ASTM specification number of the pipe being proposed
 14 along with its type and grade and sufficient information to indicate the type and rating of fittings for each
 15 service.

16

TYPE F STEEL PIPE:

17 Statement from manufacturer on his letterhead that the pipe furnished meets the ASTM specification
 18 contained in this section.

19

20

TYPE E OR S STEEL PIPE:

21 Mill certification papers, also known as material test reports, for the pipe furnished for this project, in
 22 English. Heat numbers on these papers to match the heat numbers stenciled on the pipe. Chemical
 23 analysis indicated on the mill certification papers to meet or exceed the requirements of the referenced
 24 ASTM specification.

25

26

COPPER TUBE:

27 Statement from manufacturer on his letterhead that the pipe furnished meets the ASTM specification
 28 contained in this section.

29

30

QUALITY ASSURANCE

31 Order all Type E and Type S steel pipe with heat numbers rolled, stamped, or stenciled to each length or
 32 each bundle, depending on the size of the pipe, and in accordance with the appropriate ASTM
 33 specification.

34

35

36 Any installed material not meeting the specification requirements must be replaced with material that
 37 meets these specifications without additional cost to the Owner.

38

DELIVERY, STORAGE, AND HANDLING

39 Promptly inspect shipments to insure that the material is undamaged and complies with specifications.

40

41

42 Cover pipe to eliminate rust and corrosion while allowing sufficient ventilation to avoid condensation. Do
 43 not store materials directly on grade. Protect pipe, tube, and fitting ends so they are not damaged.
 44 Where end caps are provided or specified, take precautions so the caps remain in place. Protect fittings,
 45 flanges, and unions by storage inside or by durable, waterproof, above ground packaging.

46

47 Offsite storage agreements will not relieve the contractor from using proper storage techniques.

48

49 Storage and protection methods must allow inspection to verify products.

50

DESIGN CRITERIA

51 Use only new material, free of defects, rust and scale, and meeting the latest revision of ASTM
 52 specifications as listed in this specification.

53

54

55 Construct all piping for the highest pressures and temperatures in the respective system in accordance
 56 with ANSI B31, but not less than 125 psig unless specifically indicated otherwise.

57

58 Where weld fittings or mechanical grooved fittings are used, use only long radius elbows having a
 59 centerline radius of 1.5 pipe diameters.

60

61 Where ASTM A53 type F pipe is specified, ASTM A53 grade A type E or S, or ASTM A53 grade B type E
 62 or S may be substituted at Contractor's option. Where ASTM A53 grade A pipe is specified, ASTM A53

1 grade B pipe may be substituted at Contractor's option. Where the grade or type is not specified,
2 Contractor may choose from those commercially available.

3
4 Where ASTM B88, type L hard temper copper tubing is specified, ASTM B88, type K hard temper copper
5 tubing may be substituted at Contractor's option.
6

7 **WELDER QUALIFICATIONS**

8 Before any metallic welding is performed, the Contractor shall submit his Standard Welding Procedure
9 Specifications, Procedure Qualification Records and Qualification Test Records for each Welder along
10 with associated continuity records to demonstrate compliance with ASME Section IX, paragraph QW-
11 322.
12

13 The Contractor shall maintain a complete set of welder qualification documents at the jobsite, including
14 Test Records and Continuity Records for each welder.
15

16 The A/E or Dane County Project Manager reserves the right to test the work of any welder employed on
17 the project, at the Contractor's expense. Testing will include a visual examination of the pipe and weld
18 and may include radiography of any suspect welds. If the work of the welder is found to be
19 unsatisfactory, the welder shall be prevented from doing further welding on the project. Any welds
20 deemed unacceptable will be repaired at the contractor's expense.
21

22 **PART 2 - PRODUCTS**

23 **HEATING HOT WATER**

24
25
26 2" and Smaller: ASTM A53, type F, standard weight (schedule 40) black steel pipe with ASTM
27 A126/ANSI B16.4, class 125, standard weight cast iron threaded fittings.
28

29 2-1/2" and Larger: ASTM A53, standard weight (schedule 40) black steel pipe with ASTM A234 grade
30 WPB/ANSI B16.9 standard weight, seamless, carbon steel weld fittings.
31

32 Contractor may use ASTM B88 seamless, type L, hard temper copper tube with ANSI B16.22 wrought
33 copper solder-joint fittings in lieu of steel pipe for all sizes. Mechanically formed tee fittings may be used
34 in lieu of wrought copper solder-joint tee fittings for branch takeoff up to one-half (1/2) the diameter of
35 the main.
36

37 **NATURAL GAS**

38 2" and Smaller: ASTM A53, type E or S, standard weight (schedule 40) black steel pipe with ASTM
39 A197/ANSI B16.3 class 150 black malleable iron threaded fittings or ASTM A234 grade WPB/ANSI
40 B16.9 standard weight, seamless, carbon steel weld fittings.
41

42 2-1/2" and Larger: ASTM A53, type E or S, standard weight black steel pipe with ASTM A234 grade
43 WPB/ANSI B16.9 standard weight, seamless, carbon steel weld fittings.
44

45 **MAKEUP WATER**

46 Extend from where left by the Plumbing Contractor with the same materials.
47

48 **CHEMICAL TREATMENT**

49 Use pipe and pipe fittings as specified for the system to which the chemical treatment piping is
50 connected. Plastic pipe furnished with the chemical treatment materials may also be used if its
51 pressure/temperature rating is acceptable for the service.
52

53 **VENTS AND RELIEF VALVES**

54 Use pipe and pipe fittings as specified for the system to which the relief valve or vent is connected.
55

56 **UNIONS AND FLANGES**

57 2" and Smaller: ASTM A197/ANSI B16.3 malleable iron unions with brass seats. Use black malleable
58 iron on black steel piping and galvanized malleable iron on galvanized steel piping. Use ANSI B16.18
59 cast copper alloy unions on copper piping. Use unions of a pressure class equal to or higher than that
60 specified for the fittings of the respective piping service but not less than 250 psi.
61

62 2-1/2" and Larger: ASTM A181 or A105, grade 1 hot forged steel flanges of threaded, welding and of a
63 pressure class compatible with that specified for valves, piping specialties and fittings of the respective

1 piping service. Flanges smaller than 2-1/2" may be used as needed for connecting to equipment and
2 piping specialties. Use raised face flanges ANSI B16.5 for mating with other raised face flanges on
3 equipment with flat ring or full face gaskets. Use ANSI B16.1 flat face flanges with full face gaskets for
4 mating with other flat face flanges on equipment.

5 6 **GASKETS**

7 Water and Glycol Systems: Branded, compressed, non-asbestos sheet gaskets. Klingersil C4401,
8 Garlock 3000, JM Clipper 978 or approved equal.

10 **PART 3 - EXECUTION**

11 **PREPARATION**

12
13 Remove all foreign material from interior and exterior of pipe and fittings.

14 **ERECTION**

15
16 Carefully inspect all pipe, fittings, valves, equipment and accessories before installation. Any items that
17 are unsuitable, cracked or otherwise defective shall be rejected and removed from the job site
18 immediately. Excluding minor surface rust, piping that exhibits significant oxidation or corrosion will be
19 rejected.

20
21 Exercise care at every stage of storage, handling, laying and erecting to prevent entry of foreign matter
22 into piping, fittings, valves, equipment and accessories. Do not erect or install any item that is not clean.

23
24 Remove all loose dirt, scale, oil, chips, burrs and other foreign material from the internal and external
25 surfaces of all pipe and piping components prior to assembly, including debris associated with cutting,
26 threading and welding.

27
28 During fabrication and assembly, remove slag and weld spatter from internal pipe surfaces at all joints by
29 peening, chipping and wire brushing.

30
31 During construction, until system is fully operational, keep all openings in piping and equipment closed
32 except when actual work is being performed on that item of the system. Use plugs, caps, blind flanges
33 or other items designed for this purpose.

34
35 Furnish and install all flanges, caps, bypasses, drains, valves, etc. required to facilitate flushing and
36 draining all heating and cooling system piping.

37
38 Install all piping parallel to building walls and ceilings and at heights which do not obstruct any portion of
39 a window, doorway, stairway, or passageway. Where interferences develop in the field, offset or reroute
40 piping as required to clear such interferences. In all cases, consult drawings for exact location of pipe
41 spaces, ceiling heights, door and window openings, or other architectural details before installing piping.

42
43 Provide anchors, expansion joints, swing joints and/or expansion loops so that piping may expand and
44 contract without damage to itself, equipment, or building.

45
46 Mitered ells, notched tees, and orange peel reducers are not acceptable. On threaded piping, bushings
47 are not acceptable.

48
49 "Weldolets" and "Threadolets" may be used for branch takeoffs up to one-half (1/2) the diameter of the
50 main.

51
52 Install drains throughout the systems to permit complete drainage.

53
54 Do not route piping through transformer vaults or above transformers, panelboards, or switchboards,
55 including the required service space for this equipment, unless the piping is serving this equipment
56
57

1 Install all valves, control valves, and piping specialties, including items furnished by others, as specified
2 and/or detailed. Make connections to all equipment installed by others where that equipment requires
3 the piping services indicated in this section.
4

5 **WELDED PIPE JOINTS**

6 Make all welded joints by fusion welding in accordance with ASME Codes, ANSI B31, and State Codes
7 where applicable.
8

9 All pipe welding shall be completed by Qualified Welders in accordance with the Contractor's Procedure
10 Specifications.
11

12 Contractor will ensure that these steps are followed where pipe sections will be joined by welding:

- 13 1. Cleaning – Welding surfaces will be clean and free of defects.
- 14 2. Alignment – Inside diameter of piping components will be aligned as accurately as possible.
15 Internal misalignment shall not exceed 1/16".
- 16 3. Spacing – Pipe sections will be spaced to allow deposition of weld filler material through the
17 entire weld joint thickness.
- 18 4. Girth Butt Welds:
 - 19 a. Girth butt welds shall be complete penetration welds.
 - 20 b. Concavity will not exceed 1/32"
 - 21 c. Under cuts will not exceed 1/32"
 - 22 d. As welded surfaces are permitted however surfaces will be free from coarse ripples,
23 grooves, abrupt ridges and valleys.
24

25 Electrodes shall be Lincoln, or approved equal, with coating and diameter as recommended by the
26 manufacturer for the type and thickness of work being done.
27

28 **THREADED PIPE JOINTS**

29 Use a Teflon based thread lubricant or Teflon tape when making joints; no hard setting pipe thread
30 cement or caulking will be allowed.
31

32 **COPPER PIPE JOINTS**

33 Remove all slivers and burrs remaining from the cutting operation by reaming and filing both pipe
34 surfaces. Clean fitting and tube with emery cloth or sandpaper. Remove residue from the cleaning
35 operation, apply flux, and assemble joint. Use 95-5 solder or brazing to secure joint as specified for the
36 specific piping service.
37

38 Where mechanically formed tee fittings are allowed, form mechanically extracted collars in a continuous
39 operation, consisting of drilling a pilot hole and drawing out the tube surface to form a collar having a
40 height of not less than three times the thickness of the tube wall. Use an adjustable collaring device.
41 Notch and dimple the branch tube. Braze the joint, applying heat properly so that pipe and tee do not
42 distort; remove distorted connections.
43

44 **WATER SYSTEM**

45 Run water mains level or pitch horizontal mains up 1 inch in 40 feet in the direction of flow. Install
46 manual air vents at all high points where air may collect. If vent is not in an accessible location, extend
47 air vent piping to the nearest code acceptable drain location with vent valve located at the drain.
48

49 Main branches and runouts to terminal equipment may be made at the top, top 45 degree, side, and/or
50 bottom 45 degree of the main provided that there are drain valves suitably located for complete system
51 drainage and manual air vents are located at all top and top 45 degree connections.
52

53 Use top or top 45 degree connection to main for upfeed risers and bottom 45 degree connection to main
54 for downfeed risers. Bottom connections are not acceptable.
55

56 Use a minimum of two elbows in each pipe line to a piece of terminal equipment to provide flexibility for
57 expansion and contraction of the piping systems. Offset pipe connections at equipment to allow for
58 service, such as removal of the terminal device.
59

60 Use eccentric fittings for changes in horizontal pipe sizes with the fittings installed for proper air venting.
61 Concentric fittings may be used for changes in vertical pipe sizes.
62

63 **MAKEUP WATER**

1 Install where indicated and/or specified, including all valves, piping specialties and dielectric unions
2 required for a functional system.

3
4 **CHEMICAL TREATMENT**

5 Install chemical treatment piping as indicated on the drawings, as detailed, and as recommended by the
6 supplier of the chemical treatment equipment.

7
8 **VENTS AND RELIEF VALVES**

9 Install vent and relief valve discharge lines as indicated on the drawings, as detailed, and as specified for
10 each specific valve or piping specialty item. In no event is a termination to occur less than six feet
11 above a roof line.

12
13 **NATURAL GAS**

14 Pitch horizontal piping down 1" in 60 feet in the direction of flow. Install a 4" minimum depth dirt leg at
15 the bottom of each vertical run and at each appliance. When installing mains and branches, cap gas
16 tight each tee or pipe end which will not be immediately extended. All branch connections to the main
17 shall be from the top or side of the main.

18 Do not install gas pipe in a ventilation air plenum.

19
20
21 If an above ground vent terminates in an area subject to snow accumulation, terminate the line at least
22 five feet above grade.

23
24 Install a shut off valve at each appliance. Provide a valved connection at the main for equipment and
25 appliances furnished by others.

26
27 Piping through a roof shall be run through an approved roof penetration with flashing and counter
28 flashing.

29
30 Each gas pressure reducing valve vent and relief valve vent shall be run separately to a point outside of
31 the building, terminated with a screened vent cap, and located according to gas utility regulations.

32
33 Clean all welded piping before all regulators and control valves. Test by placing target cloth over piping
34 and blow with compressed air. Clean piping until target cloth is clean and free of debris.

35
36 **UNIONS AND FLANGES**

37 Install a union or flange, as required, at each automatic control valve and at each piping specialty or
38 piece of equipment which may require removal for maintenance, repair, or replacement. Where a valve
39 is located at a piece of equipment, locate the flange or union connection on the equipment side of the
40 valve. Concealed unions or flanges are not acceptable.

41
42 **GASKETS**

43 Store horizontally in cool, dry location and protect from sunlight, water and chemicals. Inspect flange
44 surfaces for warping, radial scoring or heavy tool marks. Inspect fasteners, nuts and washers for burrs or
45 cracks. Replace defective materials.

46
47 Align flanges parallel and perpendicular with bolt holes centered without using excessive force. Center
48 gasket in opening. Lubricate fastener threads, nuts and washers with lubricant formulated for application.

49
50 Draw flanges together evenly to avoid pinching gasket. Tighten fasteners in cross pattern sequence (12 –
51 6 o'clock, 3 – 9 o'clock, etc.), one pass by hand and four passes by torque wrench at 30% full torque,
52 60% full torque and two passes at full torque per ASME B16.5.

53
54 **PIPING SYSTEM LEAK TESTS**

55 Verify that the piping system being tested is fully connected to all components and that all equipment is
56 properly installed, wired, and ready for operation. If required for the additional pressure load under test,
57 provide temporary restraints at expansion joints or isolate them during the test. Verify that hangers can
58 withstand any additional weight load that may be imposed by the test.

59
60 Provide all piping, fittings, blind flanges, and equipment to perform the testing.

61
62 Conduct pressure test with test medium of air or water unless specifically indicated. Minimum test time
63 is indicated in the table below; additional time may be necessary to conduct an examination for leakage.

1 Each test must be witnessed by Dane County's Representative. If leaks are found, repair the area with
2 new materials and repeat the test; caulking will not be acceptable.

3
4 Do not insulate pipe until it has been successfully tested.

5
6 For hydrostatic tests, use clean water and remove all air from the piping being tested by means of air
7 vents or loosening of flanges/unions. Measure and record test pressure at the high point in the system.

8
9 For air tests, gradually increase the pressure to not more than one half of the test pressure; then increase
10 the pressure in steps of approximately one-tenth of the test pressure until the required test pressure is
11 reached. Examine all joints and connections with a soap bubble solution or equivalent method. The
12 piping system exclusive of possible localized instances at pump or valve packing shall show no evidence
13 of leaking. After testing is complete, slowly release the pressure in a safe manner.

14
15 Measure natural gas system test pressure with a water manometer or an equivalent device calibrated in
16 increments not greater than 0.1 inch water column. System will not be approved until it can be
17 demonstrated that there is no measurable loss of test pressure during the test period.

<u>System</u>	<u>Pressure</u>	<u>Medium</u>	<u>Duration</u>
Heating hot water	100 psig	Water	8 hr
Natural gas	100 psig	Air	24 hr

18
19
20
21
22
23 All pressure tests are to be documented on a form included in this specification.

24
25 On piping that can not be tested because of connection to an active line, provide temporary blind flanges
26 and hydrostatically test new section of piping. After completion of test, remove temporary flanges and
27 make final connections to piping. Die penetrate test pass weld or x-ray the piping that was not
28 hydrostatically tested up to the active system.

29 **HYDRONIC PIPING SYSTEM FLUSHING**

30 All new heating hot water system piping shall be flushed thoroughly before the systems are put in to
31 operation. Subsequent to executing the chemical cleaning processes specified in Section 23 25 00 –
32 HVAC WATER TREATMENT, and prior to adding scale and corrosion inhibitors, flush all piping and
33 components with a clean source of water until the discharge from the system is clean. Discharge shall
34 be from drains provided at all low points in the piping, ends of headers and as otherwise necessary to
35 flush and drain the entire system.

36
37
38 Project specific procedures shall be established prior to flushing. Before beginning flushing operations,
39 submit proposed flushing procedures to the A/E and Dane County's Project Manager for review and
40 approval.

41
42 A clean water source shall be tapped into the system downstream of the main circulation pump(s).
43 Provide minimum 2" connection between water source and hot water system including taps with ball
44 valves (or line size tap and ball valve for piping systems smaller than 2"). Provide minimum 2" taps (or
45 line size if mains are smaller than 2") at the ends of headers, the low pint of each of the mains on each
46 floor and as otherwise necessary to flush and drain the entire system. Provide minimum 2" bypass with
47 shut off valve (or line size if mains are smaller than 2") between the supply and return mains on each
48 floor as where directed by the A/E or where shown on the drawings. Contractor shall identify proposed
49 clean water source along with the method/location of drain discharge and review with the A/E prior to
50 installing flushing connections to water source and drain outlets. Provide code required temporary
51 backflow prevention for the clean water source if needed. Provide all temporary taps, valves, piping,
52 bypasses and hoses as needed to accomplish flushing procedures.

53
54 Flush piping systems using the following procedure:

55
56 Flushing sequence for hot water system is as follows:

- 57 • Close isolation valves at all coils and radiant ceiling panels (RCPs).
- 58 • Open the temporary bypasses that connect the ends of supply and return mains.

- 1 • Flush mains by turning on flushing water source and sequentially opening drains on mains on each
2 floor until the discharge is clean. This will flush the mains without forcing water/debris into the
3 branches and run out pipes.
4 • Close isolation valves located downstream of coils/RCPs.
5 • Open isolation valves located upstream of coils/RCPs.
6 • Open individual drain valves upstream of coils/RCPs until the discharge is clean. This will flush the
7 supply branch and run out lines between the mains and the coils/RCPs without running water/debris
8 through the TCV or coils/RCPs.
9 • Close the individual drain valves upstream of coils/RCPs.
10 • Open drain valves at low points in the return piping mains.
11 • Open the individual isolation valves located downstream of the coils/RCPs. This will flush the return
12 branch and run out lines located between the coils/RCPs and the mains back into the mains and out
13 the drains on the return mains. The water going through the coil/RCPs should be already be clean
14 since this section was flushed previously.
15 • Repeat steps 1-3 to clean debris from the mains.

16
17 Isolate all coils while flushing risers and mains. Flush the mains on each floor individually, starting at the
18 top of the building and working down towards the basement level. After risers and mains have been
19 flushed clean, individually open the drain valves in each branch circuit to discharge any debris that may
20 have accumulated in the branch piping.

21
22 As directed by A/E, the Contractor will be required to open drain valves at selected locations in the
23 system to verify the effectiveness of flushing procedures. If sediment or debris is identified in the
24 system, it will be flushed again and reinspected at no expense to the Owner.

25
26 After flushing operations are complete, drain and/or blow out any residual water, clean and replace all
27 strainers, and add scale and corrosion inhibitors as specified in Section 23 25 00. Leave flushing
28 connections/valves in place and cap.

29
30 All flushing procedures shall be documented by completing and submitting the report form included at
31 the end of this Section.

32 33 **INITIAL FILL AND VENT**

34 Fill hydronic systems with appropriate working fluids as specified. All system fluids shall be chemically
35 treated as specified in Section 23 25 00 – HVAC WATER TREATMENT.

36
37 For closed piping systems, all air trapped at high points shall be relieved through the manual air vents
38 prior to notifying A/E that the systems are ready to be tested and balanced.
39
40

PIPING SYSTEM LEAKAGE TEST REPORT

Date Submitted: _____

Project Name: _____

Location: _____ Project No: _____

Contractor: _____

- HVAC Refrigeration Controls
 Power Plant Plumbing Sprinkler
Test Medium: Air Water Other _____

Test performed per specification section No. _____

Specified Test Duration _____ Hours Specified Test Pressure _____ PSIG

System Identification: _____

Describe Location: _____

Test Date: _____	
Start Test Time: _____	Initial Pressure: _____ PSIG
Stop Test Time: _____	Final Pressure: _____ PSIG

Tested By: _____

Witnessed By: _____

Title: _____

Title: _____

Signed: _____

Signed: _____

Date: _____

Date: _____

Comments: _____

PIPING SYSTEM FLUSHING REPORT

Date 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: _____

END SECTION 23 21 13

1 **SECTION 23 21 23 - HYDRONIC PUMPS**

2
3 **PART 1 - GENERAL**

4
5 **SCOPE**

6 This section includes specifications for water pumps used for HVAC applications. Included are the
7 following topics:

8 **PART 1 - GENERAL**

9 Scope

10 Related Work

11 Reference

12 Quality Assurance

13 Shop Drawings

14 Operation and Maintenance Data

15 Design Criteria

16 **PART 2 - PRODUCTS**

17 Base Mounted Centrifugal Pumps

18 **PART 3 - EXECUTION**

19 Installation

20 Base Mounted Pumps

21
22 **RELATED WORK**

23 Section 23 05 13 - Common Motor Requirements for HVAC Equipment

24
25 **REFERENCE**

26 Applicable provisions of Division 1 shall govern work under this Section.

27
28 **QUALITY ASSURANCE**

29 Refer to Division 1, General Conditions, Equals and Substitutions.

30
31 **SHOP DRAWINGS**

32 Refer to Division 1, General Conditions, Submittals.

33
34 Include data concerning dimensions, capacities, materials of construction, ratings, weights, pump curves
35 with net positive suction head requirements, manufacturer's installation requirements, manufacturer's
36 performance limitations, and appropriate identification.

37
38 Pump curves shall identify design point of operation.

39
40 **OPERATION AND MAINTENANCE DATA**

41 All operations and maintenance data shall comply with the submission and content requirements
42 specified under section Basic Requirements.

43
44 **DESIGN CRITERIA**

45 Pump sizes, capacities, pressures and operating characteristics shall be as scheduled.

46
47 Pumps shall meet or exceed operating efficiencies scheduled.

48
49 Provide all pumps with motors, impellers, drive assemblies, bearings, coupling guard, and other
50 accessories specified. Statically and dynamically balance all rotating parts. Provide flanged connections
51 on all pumps unless specified otherwise. Service or repair of base mounted pumps shall not require
52 breaking piping connections or removal of motor.

53
54 Provide pump with a motor sized for non-overloading over the entire pump curve. Motors to be 1750
55 rpm unless specified otherwise.

- 1 Furnish each pump and motor with a nameplate giving the manufacturer's name, serial number of pump,
2 capacity in GPM and head in feet at design condition, horsepower, voltage, frequency, speed and full
3 load current.
4
5 Test all pumps, clean and paint before shipment. The manufacturer shall certify all pump ratings.
6
7 All pumps to operate without excessive noise or vibration.
8
9 After completion of balancing, provide replacement of impellers, or trim impellers to provide specified
10 flow at actual pumping head, as installed.
11
12 Furnish one spare seal and casing gasket for each pump to user agency.
13

14 **PART 2 - PRODUCTS**

15 **BASE MOUNTED CENTRIFUGAL PUMPS**

16 **MANUFACTURERS:**

17 Bell and Gossett, Taco or approved equal.
18

19 **TYPE:**

20 Horizontal shaft, single stage, single or double suction, split casing, 175 psig working pressure at
21 operating temperature of 225°F continuous, 250°F intermittent.
22

23 **CASING:**

24 Cast iron with suction and discharge gauge ports, renewable bronze wear rings, vent and drain plugs,
25 flanged suction and discharge connections.
26

27 **IMPELLER:**

28 Bronze, hydraulically and dynamically balanced, keyed and locked to pump shaft, and protected by a
29 replaceable bronze shaft sleeve.
30

31 **BEARINGS:**

32 Oil or grease lubricated ball or roller bearings.
33

34 **SHAFT:**

35 Alloy steel with copper, bronze, or stainless steel shaft sleeve.
36

37 **SEAL:**

38 Carbon rotating against a stationary ceramic seat, 225°F maximum continuous operating temperature.
39

40 **DRIVE:**

41 Flexible spacer type coupling or coupling with extended hub to allow for pump service. Provide guard for
42 shaft/coupling assembly.
43

44 **BASEPLATE:**

45 Cast iron or fabricated steel with integral drain rim.
46

47 **PART 3 - EXECUTION**

48 **INSTALLATION**

49 Install all pumps in strict accordance with manufacturer's instructions. Access/service space around
50 pumps shall not be less than minimum space recommended by pump manufacturer.
51

52 Support piping adjacent to pump such that no weight is carried on pump casings.
53

54 Decrease from line size at pump connections with suction diffusers where specified, long radius reducing
55 elbows or concentric reducers/increasers in the vertical piping, and eccentric reducers/increasers for
56 horizontal piping. Install eccentric reducers/increasers with the top of the pipe level.
57

58 All valves and piping specialties must be full line size as indicated on the drawings
59

60 Lubricate pumps before startup.
61
62
63

1 Install a full line size spring loaded check valve and balancing valve in the pump discharge piping. At
2 contractor's option, combination shut-off, check, balancing valve may be substituted instead of separate
3 valves. Reference Section 23 05 23.
4

5 **BASE MOUNTED PUMPS**

6 Set base mounted pumps on concrete bases, or concrete inertia base, level and bolt down prior to
7 grouting. Fill the entire base with non-shrinking grout when required by the manufacturer's installation
8 instructions.
9

10 Align all flexible coupled base-mounted pumps in accordance with the manufacturer's instructions.

11
12 Provide supports for elbows on pump suction and discharge piping 4" and over.

13
14 Provide air vent and drain valve on horizontal pump casings.

15
16 Provide drains for bases and seals, piped to and discharging into floor drains.

17
18 END SECTION 23 21 23

1 **SECTION 23 25 00 - HVAC WATER TREATMENT**

2
3 **PART 1 - GENERAL**

4
5 **SCOPE**

6 This section includes specifications for chemical treatment of all water, steam, and condensate systems.
7 Included are the following topics:

8 **PART 1 - GENERAL**

9 Scope
10 Reference
11 Related Work
12 Quality Assurance
13 Shop Drawings
14 Operation and Maintenance Data
15 Design Criteria
16 Maintenance Service

17 **PART 2 - PRODUCTS**

18 Manufacturers
19 System Cleaner
20 System Inhibitor
21 Closed Water System Treatment
22 Treatment Equipment
23 Test Equipment

24 **PART 3 - EXECUTION**

25 Preparation
26 Cleaning Sequence
27 Closed Water Systems
28 Test Cabinet

29 **Appendix**

30 Pipe Cleaning and Treatment Report

31
32 **REFERENCE**

33 Applicable provisions of Division 1 shall govern work under this Section.

34
35 **RELATED WORK**

36 Section 23 05 15 - Piping Specialties

37
38 **QUALITY ASSURANCE**

39 Refer to Division 1, General Conditions, Equals and Substitutions.

40
41 **SHOP DRAWINGS**

42 Refer to Division 1, General Conditions, Submittals.

43
44 Required for all equipment and chemicals specified including data concerning dimensions, capacities,
45 materials of construction, weights, operating sequence, composite wiring diagrams and appropriate
46 identification. Chemical data to include the description of the chemical, its composition, its function, and
47 the associated material safety data sheet.

48
49 **OPERATION AND MAINTENANCE DATA**

50 Provide for the services of the manufacturer's trained representative to approve the installation and
51 instruct the user agency in the operation of each system.

52
53 Include data on procedures and treatment programs. Include step by step instructions on test
54 procedures including target concentrations.

55
56 **DESIGN CRITERIA**

57 Recommend a periodic test procedure and chemical treatment program for each system.
58

1 Treat the following systems:

- 2 • Hot water

3
4 Provide the initial chemical treatment for all systems based on a complete system fluid analysis prior to
5 the equipment installation. The initial chemical treatment supply of chemicals for each system shall be
6 adequate for the start-up and testing period, for the time the systems are being operated by the
7 Contractor for temporary heating and cooling, and for one year after start-up of the system.

8 9 **MAINTENANCE SERVICE**

10 Furnish service and maintenance of treatment systems for one year from date of substantial completion.

11
12 Provide monthly technical service visits to perform field inspections and make water analysis on site.
13 Detail findings in writing on proper practices, chemical treating requirements, and corrective actions
14 needed. Submit two copies of field service report after each visit.

15 Provide laboratory and technical assistance services for the warranty period.

16
17
18 Include two hour training course for operating personnel, instructing them on installation, care,
19 maintenance, testing, and operation of the treatment systems. Arrange course at startup of systems.

20
21 Provide site inspection of equipment during scheduled shutdown to evaluate success of the treatment
22 program. Make recommendations in writing based on these inspections.

23 24 **PART 2 - PRODUCTS**

25 26 **MANUFACTURERS**

27 Betz Entac, Dearborn Div. - W. R. Grace & Co., Fremont Industries, Mitco Water Labs, Mogul
28 Corporation, Nalco Chemical Co., Western Water Management, or approved equal.

29 30 **SYSTEM CLEANER**

31 Blend of organic alkaline penetrants, emulsifiers, surfactants and corrosion inhibitors that remove grease
32 and petroleum products from the interior of piping systems. Cleaners that contain trisodium phosphate
33 are specifically not acceptable.

34 35 **SYSTEM INHIBITOR**

36 Scale and corrosion inhibitor consisting of boron nitrite, benzol thiazol, benzotriazole, mercapto-benzo-
37 thiazole, and tolyltrizole silicates.

38 39 **CLOSED WATER SYSTEM TREATMENT**

40 Sequestering agent to reduce deposits and adjust pH: polyphosphate.

41
42 Corrosion inhibitors: boron-nitrite, sodium nitrite and borax, sodium tolyltriazole, low molecular weight
43 polymers, phosphonates, sodium molybdate, or sulphites.

44
45 Conductivity enhancers: phosphates or phosphonates.

46 47 **TREATMENT EQUIPMENT**

48 **BYPASS FEEDER:**

49 5 gallon minimum capacity, 125 psig working pressure, either a screw type cover or a valved funnel
50 opening to feed chemical into the system, prime coat of paint.

51 52 **TEST EQUIPMENT**

53 Provide an enameled test cabinet with local fluorescent light, capable of accommodating a sufficient
54 quantity of 10 milliliter burettes and associated reagents for the tests listed below.

55
56 Provide the following test kits:

- 57 • Alkalinity titration test kit
- 58 • Sulphite titration test kit
- 59 • Total hardness titration test kit
- 60 • Low phosphate test kit
- 61 • Conductivity bridge, range 0 to 10,000 microhms
- 62 • Creosol red pH slide complete with reagent
- 63 • Portable electronic conductivity meter

- 1 • High nitrite test kit
2

3 **PART 3 - EXECUTION**
4

5 **PREPARATION**

6 Prior to cleaning, verify that systems are operational, filled, started, and vented. Use water meter to
7 record capacity in each system.
8

9 Place terminal control valves in the full-open position
10

11 **CLEANING SEQUENCE**

12 **GENERAL:**

13 Systems are to be cleaned before they are used for any purpose except conduct pressure test before
14 cleaning. Add cleaner to closed systems at concentrations as recommended by the manufacturer.
15 Remove water filter elements from the system before starting circulation.
16

17 Use neutralizer agents on recommendation of the system cleaner supplier and approval of the
18 Architect/Engineer.
19

20 Flush open systems with clean water for one hour minimum. Drain completely and refill.
21

22 Remove, clean, and replace strainer screens.
23

24 Inspect, remove sludge, and flush low points with clean water after cleaning process is completed.
25 Include disassembly of components as required.
26

27 **HOT WATER HEATING SYSTEMS:**

28 Add cleaner to the system water until the M alkalinity value is 250 above that of the initial fill water.
29 Verify the M alkalinity level before and after the addition of the cleaner by means of chemical tests that
30 are observed by the Owner's construction representative; include results of all tests in the Operating and
31 Maintenance manuals. Apply heat while circulating, slowly raising temperature to 160°F and maintain for
32 12 hours minimum; vent all high points to assure 100% system circulation. Remove heat and circulate
33 to 100°F or less; drain system as quickly as possible and refill with clean water. Circulate for 6 hours at
34 design temperature, vent air at all high points, then drain. Refill with clean water and repeat until the
35 system cleaner is removed and the M alkalinity level returns to normal. Remove and clean all strainers.
36 Re-vent the system and install clean filter elements in water filters. Treat with scale and corrosion
37 inhibitors before using the system for building heating or cooling.
38

39 **CLOSED WATER SYSTEMS**

40 Install a separate bypass type feeder at the pumps for each closed hot water heating system. Provide a
41 separate set of supply and return lines from each pump in the system and install ball valves in each of
42 these lines. Locate the system connection that supplies the feeder upstream of the discharge shutoff
43 valve for the pump. Locate the system connection that returns treatment back to the system at a
44 convenient point downstream of the pump discharge shutoff valve. Provide a drain valve at the bottom
45 of the feeder.
46

47 Install a water meter upstream of the pressure reducing valve in the makeup line to each closed system.
48 Locate the meter on the domestic water side of the pressure reducing valve and in such a manner that
49 the meter can be easily read.
50

51 **TEST CABINET**

52 Locate test cabinet where indicated on the drawings.

PIPE CLEANING AND TREATMENT REPORT

Dane County Job Center

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: _____

Terminal Units: _____

Boilers: _____

Chillers: _____

Comments: _____

END SECTION 23 25 00

BID NO. 109001
HVAC WATER TREATMENT
23 25 00-5

1 **SECTION 23 31 00 - HVAC DUCTS and CASINGS**

2
3 **PART 1 - GENERAL**

4
5 **SCOPE**

6 This section includes specifications for all duct systems used on this project. Included are the following
7 topics:

8 **PART 1 - GENERAL**

9 Scope
10 Related Work
11 Reference
12 Reference Standards
13 Quality Assurance
14 Shop Drawings
15 Design Criteria

16 **PART 2 - PRODUCTS**

17 General
18 Materials
19 Low Pressure Ductwork (Maximum 2 inch pressure class)
20 Duct Sealant
21 Gaskets

22 **PART 3 - EXECUTION**

23 Installation
24 Low Pressure Duct (Maximum 2 inch pressure class)
25 Cleaning
26 Leakage Test

27 **APPENDIX**

28 Duct Leakage Test Report
29 Duct Structural Test Report

30
31 **RELATED WORK**

32 Section 23 33 00 – Air Duct Accessories
33 Section 23 05 93 - Testing, Adjusting, and Balancing for HVAC

34
35 **REFERENCE**

36 Applicable provisions of Division 1 govern work under this Section.

37
38 **REFERENCE STANDARDS**

39 ANSI SS-EN 485-2 Aluminum and Aluminum Alloys-Sheet, Strip and Plate-Part 2: Mechanical
40 Properties
41 ASTM A90 Test Method for Weight of Coating on Zinc-Coated (Galvanized) Iron or Steel
42 Articles
43 ASTM A623 Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip
44 Process
45 ASTM A527 Specification for Basic Requirements for Steel Sheet, Zinc-Coated (Galvanized)
46 by the Hot-Dip Process, Lock-Forming Quality
47 ASTM 924 Standard Specification for Basic Requirements for Sheet Steel, Metallic-coated
48 by the Hot-dip Method
49 ASTM C 1071 Specification for Fibrous Glass Duct Lining Insulation
50 ASTM C 411 Test Method for Hot Surface Performance of High Temperature Thermal Insulation
51 ASTM E 84 Test Method for Surface Burning Characteristics of Building Materials
52 ASTM C 1338 Test Method for Determining Fungal Resistance of Insulation Materials
53 and Facings
54 ASTM G 21 Standard Practice for Determining Resistance of Synthetic Polymeric Materials to
55 Fungi
56 ASTM C 916 Standard Specification for Adhesives for Duct Thermal Insulation
57 NFPA 90A Standard for the Installation of Air Conditioning and Ventilating Systems

- 1 UL 181 Standard for Safety for Factory Made Air Ducts and Air Connectors.
2 NAIMA Fibrous Glass Duct Liner Standard
3

4 **QUALITY ASSURANCE**

5 Refer to Division 1, General Conditions, Equals and Substitutions.
6

7 **SHOP DRAWINGS**

8 Refer to Division 1, General Conditions, Submittals.
9

10 Include manufacturer's data and/or Contractor data for the following:

- 11 • Fabrication and installation drawings.
- 12 • Schedule of duct systems including material of construction, gauge, pressure class, system class, method of reinforcement, joint construction, fitting construction, and support methods, all with details as appropriate.
- 13
- 14
- 15 • Duct sealant and gasket material.
- 16

17 **DESIGN CRITERIA**

18 Construct all ductwork to be free from vibration, chatter, objectionable pulsations and leakage under
19 specified operating conditions.
20

21 Use material, weight, thickness, gauge, construction and installation methods as outlined in the following
22 SMACNA publications, unless noted otherwise:

- 23 • HVAC Duct Construction Standards, Metal and Flexible, 2nd Edition, 1995
- 24 • HVAC Air Duct Leakage Test Manual, 1st Edition, 1985
- 25 • HVAC Systems - Duct Design, 3rd Edition, 1990
- 26 • Rectangular Industrial Duct Construction Standard, 1st Edition, 1980
- 27 • Round Industrial Duct Construction Standards, 2nd Edition, 1999
- 28 • Thermoplastic Duct (PVC) Construction Manual, 2nd Edition, 1995
- 29 • Round Industrial Duct Construction Standards, 2nd Edition, 1999
- 30 • Rectangular Industrial Duct Construction Standards, 1st Edition, 1980
- 31

32 Use products which conform to NFPA 90A, possessing a flame spread rating of not over 25 and a smoke
33 developed rating no higher than 50.
34

35 **DELIVERY, STORAGE AND HANDLING**

36 Promptly inspect shipments to ensure that Ductwork is undamaged and complies with the specification.
37

38 Protect Ductwork against damage.
39

40 Protect Ductwork by storing inside or by durable, waterproof, above ground packaging. Do not store
41 material on grade. Protect Ductwork from dirt, dust, construction debris and foreign material. Where end
42 caps/packaging are provided, take precautions so caps/packaging remain in place and free from
43 damage.
44

45 Offsite storage agreements do not relieve the contractor from using proper storage techniques.
46

47 Storage and protection methods must allow inspection to verify products.
48

49 **PART 2 - PRODUCTS**

50 **GENERAL**

51 All sheet metal used for construction of duct shall be 24 gauge or heavier except for round and spiral
52 ductwork and spiral duct take-offs 12" and below may be 26 gauge where allowed in SMACNA HVAC
53 Duct Construction Standards, Metal and Flexible, 2nd Edition, 1995.
54
55

56 Duct sizes indicated on plans are net inside dimensions; where duct liner is specified, dimensions are
57 net, inside of liner.
58

59 **DUCTWORK PRESSURE CLASS**

1 Minimum acceptable duct pressure class, for all ductwork except transfer ductwork, is 2 inch W.G.
2 positive or negative, depending on the application. Transfer ductwork minimum acceptable duct pressure
3 class is 1 inch W.G. positive or negative, depending on the application. Duct system pressure classes
4 not indicated on the drawings to be as follows:

5				
6	Supply duct upstream of VAV boxes	_____	1.0 in. calc. S.P.	___2.0 in. pressure class
7	Supply duct downstream of VAV terminals	_____	1.0 in. calc. S.P.	___2.0 in. pressure class
8	Transfer ducts	_____	0.5 in. calc. S.P.	___2.0 in. pressure class
9	Exhaust ducts	_____	1.0 in. calc. S.P.	___2.0 in. pressure class
10	Return ducts	_____	1.0 in. calc. S.P.	___2.0 in. pressure class

11 **MATERIALS**

12 **GALVANIZED STEEL SHEET:**

13 Use ASTM A 653 galvanized steel sheet of lock forming quality. Galvanized coating to be 1.25 ounces
14 per square foot, both sides of sheet, G90 in accordance with ASTM A90. Provide "Paint Grip" finish for
15 ductwork that will be painted.

16 **LOW PRESSURE DUCTWORK (Maximum 2 inch pressure class)**

17 Fabricate and install ductwork in sizes indicated on the drawings and in accordance with SMACNA
18 recommendations, except as modified below.

19 Construct so that all interior surfaces are smooth. Use slip and drive or flanged and bolted construction
20 when fabricating rectangular ductwork. Use spiral lock seam construction when fabricating round spiral
21 ductwork. Sheet metal screws may be used on duct hangers, transverse joints and other SMACNA
22 approved locations if the screw does not extend more than 1/2 inch into the duct.

23 Use elbows and tees with a center line radius to width or diameter ratio of 1.5 wherever space permits.
24 When a shorter radius must be used due to limited space, install single wall sheet metal splitter vanes in
25 accordance with SMACNA publications, Type RE 3. Where space will not allow and the C value of the
26 radius elbow, as given in SMACNA publications, exceeds 0.31, use rectangular elbows with turning
27 vanes as specified in Section 23 33 00. Square throat-radius heel elbows will not be acceptable. Straight
28 taps or bullhead tees are not acceptable.

29 Where rectangular elbows are used, provide turning vanes in accordance with Section 23 33 00.

30 Provide expanded take-offs or 45 degree entry fittings for branch duct connections with branch ductwork
31 airflow velocities greater than 700 fpm. Square edge 90-degree take-off fittings or straight taps will not
32 be accepted.

33 Button punch snaplock construction will not be accepted.

34 Round ducts may be substituted for rectangular ducts if sized in accordance with ASHRAE table of
35 equivalent rectangular and round ducts. No variation of duct configuration or sizes permitted except by
36 written permission of the Architect/Engineer.

37 Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible. Divergence
38 upstream of equipment shall not exceed 30 degrees; convergence downstream shall not exceed 45
39 degrees.

40 **DUCT SEALANT**

41 Manufacturer: 3M 800, 3M 900, H.B. Fuller/Foster, Hardcast, Hardcast Peal & Seal, Lockformer cold
42 sealant, Mon-Eco Industries, United Sheet Metal, or approved equal. Silicone sealants are not allowed in
43 any type of ductwork installation.

44 Install sealants in strict accordance with manufacturer's recommendations, paying special attention to
45 temperature limitations. Allow sealant to fully cure before pressure testing of ductwork, or before startup
46 of air handling systems.

47 **GASKETS**

48 **2 INCH PRESSURE CLASS AND LOWER:**

49 Soft neoprene or butyl gaskets in combination with duct sealant for flanged joints.

1 **PART 3 - EXECUTION**

2
3 **INSTALLATION**

4 Verify dimensions at the site, making field measurements and drawings necessary for fabrication and
5 erection. Check plans showing work of other trades and consult with Architect in the event of any
6 interference.

7
8 Make allowances for beams, pipes or other obstructions in building construction and for work of other
9 contractors. Transform, divide or offset ducts as required, in accordance with SMACNA HVAC Duct
10 Construction Standards, Figure 2-7, except do not reduce duct to less than six inches in any dimension
11 and do not exceed an 4:1 aspect ratio. Where it is necessary to take pipes or similar obstructions
12 through ducts, construct easement as indicated in SMACNA HVAC Duct Construction Standards, Figure
13 2-8, Fig. E. In all cases, seal to prevent air leakage. Pipes or similar obstructions may not pass through
14 high pressure or fume exhaust ductwork.

15
16 Test openings for test and balance work will be provided under Section 23 05 93.

17
18 Provide frames constructed of angles or channels for coils, filters, dampers or other devices installed in
19 duct systems, and make all connections to such equipment including equipment furnished by others.
20 Secure frames with gaskets and screws or nut, bolts and washers.

21
22 Install duct to pitch toward outside air intakes and drain to outside of building. Solder or seal seams to
23 form watertight joints.

24
25 Where two different metal ducts meet, the joint shall be installed in such a manner that metal ducts do
26 not contact each other by using proper seal or compound.

27
28 Install all motor operated dampers and connect to or install all equipment furnished by others. Blank off
29 all unused portions of louvers, as indicated on the drawings, with 1-1/2 inch board insulation with
30 galvanized sheet metal backing on both sides.

31
32 Do not install ductwork through dedicated electrical rooms or spaces unless the ductwork is serving this
33 room or space.

34
35 Locate ducts with sufficient space around equipment to allow normal operating and maintenance
36 activities.

37
38 Provide adequate access to ductwork for cleaning purposes.

39
40 Provide temporary capping of ductwork openings to prevent entry of dirt, dust and foreign material.

41
42 Protect diffusers, registers and grilles with plastic wrap or some other approved form of protection to
43 maintain dirt and dust free and to prevent entry of dirt, dust and foreign material into the Ductwork.

44
45 During construction provide temporary closures of metal or taped polyethylene on open ductwork to
46 prevent construction dust from entering ductwork system.

47
48 **DUCTWORK SUPPORT**

49 Support ductwork in accordance with SMACNA HVAC Duct Construction Standards, Figure 4-4, except
50 supporting ductwork with secure wire method is not allowed.

51
52 Support with 3/32 inch, 7 x 7, stainless steel air-craft cable, with matching fastener rated for 50% of
53 actual load, will be allowed on round ductwork under 12 inches if installed as detailed, with cable double
54 looped on duct and at point of support.

55
56 **LOW PRESSURE DUCT (Maximum 2 inch pressure class)**

57 Seal all duct, with the exception of transfer ducts, in accordance with SMACNA seal class "A"; all seams,
58 joints, and penetrations shall be sealed.

59
60 Install a manual balancing damper in each branch duct and for each diffuser or grille. The use of splitter
61 dampers, extractors, or grille face dampers will not be accepted for balancing dampers.

1
2 Hangers must be wrapped around bottom edge of duct and securely fastened to duct with sheetmetal
3 screws or pop rivets. Trapeze hangers may be used at contractor's option.
4

5 **CLEANING**

6 Remove all dirt and foreign matter from the entire duct system and clean diffusers, registers, grilles and
7 the inside of air-handling units before operating fans.
8

9 Clean duct systems with high power vacuum machines where systems have been used for temporary
10 heat, air-conditioning, or ventilation purposes during construction. Protect equipment that may be
11 harmed by excessive dirt with filters, or bypass during cleaning.
12

13 **LEAKAGE TEST**

14 Test all ductwork in accordance with test methods described in Section 5 of SMACNA HVAC Air Duct
15 Leakage Test Manual. Do not insulate ductwork until it has been successfully tested. Test pressure shall
16 be equal to the duct pressure class.
17

18 If excessive air leakage is found locate leaks, repair the duct in the area of the leak, seal the duct, and
19 retest.
20

21 Leakage rate shall not exceed more than 5% of the system air quantity for low pressure ductwork,
22 determined in accordance with Appendix C of the SMACNA HVAC Air Duct Leakage Test Manual.
23

24 Leakage rate shall not exceed more than 1% of the system air quantity for high pressure ductwork,
25 determined in accordance with Appendix C of the SMACNA HVAC Air Duct Leakage Test Manual.
26

27 Leakage test for ductwork downstream of air terminal devices may be omitted but will not relieve the
28 contractor from duct sealing requirements.
29

30 Submit a signed report to the Dane County's Project Manager, indicating test apparatus used, results of
31 the leakage test, and any remedial work required to bring duct systems into compliance with specified
32 leakage rates.
33

34 **STRUCTURAL TEST**

35 Random test all ductwork per Owner direction. Do not insulate ductwork until it has been successfully
36 tested. Test pressure shall be equal to the duct pressure class.
37

38 Deflection limits shall not exceed those listed in accordance with Chapter 7 of SMACNA HVAC Duct
39 Construction Standards, 3.0 Performance Requirements.
40

41 Submit a signed report to the Dane County's Project Manager, indicating test apparatus used, results of
42 the structural test, and any remedial work required.
43

DUCT LEAKAGE TEST REPORT

Dane Co. Job Center	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 Equipment	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													
-------	--	--	--	--	--	--	--	--	--	--	--	--	--

DUCT STRUCTURAL TEST REPORT

Dane County Job Center	Project Number: _____
	Date Submitted: _____

Project	Name: _____		
	Location: _____		
	Contractor: _____		
System Data	Fan No: _____		
Description of Test Method: _____			
Test Equipment	Manufacturer: _____	Model	Serial No: _____
		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 Test Location	Ductwork Shape		Duct Pressure Class	Allowable Ductwork Wall Deflection		Allowable Joint/Reinforcement Deflection		Pressure (in. wc.) In Duct	Measured Ductwork Wall Deflection		Measured Joint/Reinforcement Deflection		Performed By/Date	Witnessed By/Date
	H	W		H	W	H	W		H	W	H	W		

END SECTION 23 31 00

1 **SECTION 23 33 00 - AIR DUCT ACCESSORIES**

2
3 **PART 1 - GENERAL**

4
5 **SCOPE**

6 This section includes accessories used in the installation of duct systems. Included are the following
7 topics:

8 **PART 1 - GENERAL**

9 Related Work
10 Reference
11 Reference Standards
12 Quality Assurance
13 Shop Drawings
14 Operation and Maintenance Data

15 **PART 2 - PRODUCTS**

16 Manual Volume Dampers
17 Smoke Dampers
18 Control Dampers
19 Smoke Detectors
20 Access Doors
21 Flexible Duct
22 Flashings
23 Duct Flexible Connections

24 **PART 3 - EXECUTION**

25 Manual Volume Dampers
26 Smoke Dampers
27 Control Dampers
28 Smoke Detectors
29 Access Doors
30 Flashings
31 Duct Flexible Connections
32

33 **RELATED WORK**

34 23 05 29 – Hanger and Supports for HVAC Piping and Equipment
35 23 05 48 – Vibration and Seismic Controls for HVAC Piping and Equipment
36 23 31 00 – HVAC Ducts and Casings
37

38 **REFERENCE**

39 Applicable provisions of Division 1 govern work under this Section.
40

41 **REFERENCE STANDARDS**

42 NFPA 90A Standard for Installation of Air Conditioning and Ventilating Systems
43 SMACNA HVAC Duct Construction Standards - Metal and Flexible, 2nd Edition, 1995
44 UL 214
45 UL 555 (6th edition) Standard for Fire Dampers and Ceiling Dampers
46 UL 555S (4th edition) Leakage Rated Dampers for Use in Smoke Control Systems
47

48 **QUALITY ASSURANCE**

49 Refer to Division 1, General Conditions, Equals and Substitutions
50

51 **SHOP DRAWINGS**

52 Refer to Division 1, General Conditions, Submittals.
53

54 Submit for all accessories and include dimensions, capacities, ratings, installation instructions, and
55 appropriate identification.
56

1 **OPERATION AND MAINTENANCE DATA**

2 All operations and maintenance data shall comply with the submission and content requirements
3 specified under section Basic Requirements.

4
5 **PART 2 - PRODUCTS**

6
7 **MANUAL VOLUME DAMPERS**

8 Manufacturers: Ruskin, Vent Products, Air Balance, or approved equal.

9
10 Dampers must be constructed in accordance with SMACNA Fig. 2-12, Fig. 2-13, and notes relating to
11 these figures, except as modified below.

12
13 Reinforce all blades to prevent vibration, flutter, or other noise. Construct dampers in multiple sections
14 with mullions where width is over 48 inches. Use rivets or tack welds to secure individual components;
15 sheet metal screws will not be accepted. Provide operators with locking devices and damper position
16 indicators for each damper; use an elevated platform on insulated ducts. Provide end bearings or
17 bushings for all volume damper rods penetrating ductwork constructed to a 3" w.c. pressure class or
18 above.

19
20 **SMOKE DAMPERS**

21 Manufacturers: Ruskin, Johnson Controls, Air Balance, Advanced Air, American Warming and
22 Ventilating, Greenheck, Safe-Air, Phillips-Aire, Prefco, or approved equal.

23
24 Smoke damper assemblies to be UL 555S (4th edition) listed and labeled, and leakage rated at no higher
25 than Class II under UL 555S (4th edition). Unless ratings are indicated elsewhere, dampers should be
26 rated for minimum 2,000 fpm air velocity and 4" static pressure.

27
28 Provide factory installed electrically operated dampers with linkage arranged so that the damper is
29 closed on loss of power. For electric actuation, provide electric operated dampers with linkage and UL
30 listed operators arranged so that the damper is closed on a loss of power. Where electric actuation is
31 controlled by the DDC system use 0-10 VDC inputs, with stall protection, and with and zero and span
32 adjustments for modulating or 24 VAC for two-position control. All electric actuators will be provided with
33 overload protection to prevent motor from damage when stall condition is encountered. Locate all
34 operators out of the air stream unless large damper size will not allow. Provide form "C" end switches to
35 indicate damper position.

36
37 **CONTROL DAMPERS**

38 Control dampers are specified in section 23 09 14.

39
40 **SMOKE DETECTORS**

41 Smoke detectors are furnished and installed by the Electrical Contractor.

42
43 **ACCESS DOORS**

44 Access door to be designed and constructed for the pressure class of the duct in which the door is to be
45 installed. Doors in exposed areas shall be hinged type with cam sash lock. Hinges shall be steel full
46 length continuous piano type. Doors in concealed spaces may be secured in place with cam sash
47 latches. For both hinged and non hinged doors provide sufficient number of camp sash latches to
48 provide air tight seal when door is closed. Do not use hinged doors in concealed spaces if this will restrict
49 access. Use minimum 1" deep 24 gauge galvanized steel double wall access doors with minimum 24
50 gauge galvanized steel frames. For non-galvanized ductwork, use minimum 1" deep double wall access
51 door with frame that shall use materials of construction identical to adjacent ductwork. Provide double
52 neoprene gasket that shall provide seals from the frame to the door and frame to the duct. When access
53 doors are installed in insulated ductwork or equipment provide insulated doors with insulation equivalent
54 to what is provided for adjacent ductwork or equipment. Access doors constructed with sheet metal
55 screw fasteners will not be accepted.

56
57 Use insulated 1-1/2 hour UL 1978 listed and labeled access doors in kitchen exhaust ducts.

58
59 **FLEXIBLE DUCT**

60 Manufacturers: Anco Products, Clevaflex, Thermaflex, Flexmaster or approved equal.

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
5 inch 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 15 **FLASHINGS**

16 Provide flashing to completely weatherproof connection of ductwork to louvers. Flashing to be
17 constructed of material similar to louver material.

18
19 Flashing and counterflashing for roof curbs will be provided by others.

20
21 Flashing and curbs for duct and pipe penetrations of roof assemblies to be in accordance with details.

22 23 **DUCT FLEXIBLE CONNECTIONS**

24 Material to be fire retardant, be UL 214 listed, and meet the requirements of NFPA 90A.

25
26 Connections to be a minimum of 3 inches wide, crimped into metal edging strip, and air tight.
27 Connections to have adequate flexibility and width to allow for thermal expansion/contraction, vibration
28 of connected equipment, and other movement.

29
30 Use coated glass fiber fabric for all applications. Material for inside applications to be double coated with
31 neoprene, air and water tight, suitable for temperatures between -10°F and 200°F, and have a nominal
32 weight of 30 ounces per square yard. Material used for outdoor applications to be double coated with
33 Hypalon, air and water tight, suitable for temperatures between -10°F and 250°F, and have a nominal
34 weight of 26 ounces per square yard.

35 36 **PART 3 - EXECUTION**

37 38 **MANUAL VOLUME DAMPERS**

39 Install manual volume dampers in each branch duct and for each grille, register, or diffuser as far away
40 from the outlet as possible while still maintaining accessibility to the damper. Install so there is no flutter
41 or vibration of the damper blade(s).

42 43 **SMOKE DAMPERS**

44 Install smoke dampers in locations indicated on the drawings in accordance with the manufacturer's
45 instructions. Install an access door adjacent to each damper for inspection and cleaning. Coordinate
46 damper linkage with operators so the dampers are closed when the air system is not operating.

47 48 **CONTROL DAMPERS**

49 Install dampers in locations indicated on the drawings, as detailed, and according to the manufacturer's
50 instructions. Install blank-off plates or transitions where required for proper mixing of airstreams in
51 mixing plenums. Provide adequate operating clearance and access to the operator. Install an access
52 door adjacent to each control damper for inspection and maintenance.

53 54 **SMOKE DETECTORS**

55 Installation and wiring of detectors will be by the Electrical Contractor. Install an access door at each
56 detector location.

57 58 **ACCESS DOORS**

59 Install access doors where specified, indicated on the drawings, and in locations where maintenance,
60 service, cleaning or inspection is required. Examples include, but are not limited to motorized dampers,
61 fire and smoke dampers, smoke detectors, fan bearings, heating and cooling coils, filters, valves, and
62 control devices needing periodic maintenance.

1 Size and numbers of duct access doors to be sufficient to perform the intended service. Minimum
2 access door size shall be 8 x 8 inch size for hand access, 18 x 18 inch size for shoulder access, or other
3 size as indicated. Install access doors on both inlet and outlet sides of reheat coils as well as other duct
4 mounted coils.

5
6 **FLEXIBLE DUCT**

7 Flexible duct may only be used for final connections of air inlets and outlets at diffuser, register, and
8 grille locations. Where flexible duct is used, it shall be the minimum length required to make the final
9 connections, but no greater than 5 feet in length, and have no more than one (1) 90 degree bend.

10
11 Secure inner jacket of flexible duct in place with stainless steel metal band clamp. Secure insulation
12 vapor barrier jacket in place with steel or nylon draw band. Sheetmetal screws and/or duct tape will not
13 be accepted.

14
15 Flexible duct used to compensate for misalignment of main duct or branch duct will not be accepted.

16
17 Individual sections of flexible ductwork shall be of one piece construction. Splicing of short sections will
18 not be accepted.

19
20 Flexible ductwork used as transfer duct shall be sized for a maximum velocity of 300 fpm.

21
22 Penetration of any partition, wall, or floor with flexible duct will not be accepted.

23
24 **FLASHINGS**

25 Flashing for roof curbs, equipment supports or rails located on roof, will be installed by others.

26
27 Flashing and curbs for duct and pipe penetrations of roof assemblies to be in accordance with details.

28
29 **DUCT FLEXIBLE CONNECTIONS**

30 Install at all duct connections to rotating or vibrating equipment, including roof top units (unless unit is
31 internally isolated), fans, or other motorized equipment in accordance with SMACNA Figure 2-19. Install
32 thrust restraints to prevent excess strain on duct flexible connections at fan inlets and outlets; see
33 Related Work.

34
35 For applications in corrosive environments or fume exhaust systems, use a double layer of the Teflon
36 coated fabric when making the connector.

37
38 END SECTION 23 33 00

1 **SECTION 23 34 00 - HVAC FANS**

2
3 **PART 1 - GENERAL**

4
5 **SCOPE**

6 This section includes specifications for fans that are not an integral part of a manufactured device.
7 Included are the following topics:

8 PART 1 - GENERAL

- 9 Scope
- 10 Related Work
- 11 Reference
- 12 Reference Standards
- 13 Quality Assurance
- 14 Shop Drawings
- 15 Operation and Maintenance Data
- 16 Design Criteria

17 PART 2 - PRODUCTS

- 18 General
- 19 Power Roof Exhaust Fans

20 PART 3 - EXECUTION

- 21 Installation

22
23 **RELATED WORK**

- 24 Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment
- 25 Section 23 05 13 - Common Motor Requirements for HVAC Equipment
- 26 Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment

27
28 **REFERENCE**

29 Applicable provisions of Division 1 govern work under this Section.

30
31 **REFERENCE STANDARDS**

- 32 AMCA 203 AMCA Fan Application Manual - Troubleshooting
- 33 AMCA 210 Laboratory Method of Testing Fans for Rating
- 34 AMCA 300 Reverberant Room Method for Sound Testing of Fans
- 35 NFPA 90A Standard for the Installation of Air Conditioning and Ventilating Systems

36
37 **QUALITY ASSURANCE**

38 Refer to Division 1, General Conditions, Equals and Substitutions.

39
40 **SHOP DRAWINGS**

41 Refer to Division 1, General Conditions, Submittals.

42
43 Include dimensions, capacities, fan curves, materials of construction, ratings, weights, motors and drives,
44 sound power levels, appropriate identification and vibration isolation for all equipment. Sound power
45 levels to be based on tests performed in accordance with AMCA Standard 300.

46
47 Fan curves shall indicate the relationship of CFM to static or total pressure for various fan speeds. Brake
48 horsepower, recommended selection range, and limits of operation are to also be indicated on the
49 curves. Indicate operating point on the fan curves at design air quantity and indicate the manufacturer's
50 recommended drive loss factor for the specific application. Tabular fan performance data is not
51 acceptable.

52
53 **OPERATION AND MAINTENANCE DATA**

54 All operations and maintenance data shall comply with the submission and content requirements
55 specified under section Basic Requirements.

56
57 **DESIGN CRITERIA**

58 Tested and certify all fans in accordance with the applicable AMCA test code.

1
2 Each fan and motor combination shall be capable of delivering 110% of air quantity scheduled at
3 scheduled static pressure. The motor furnished with the fan shall not operate into the motor service
4 factor when operating under these conditions.
5

6 Consider drive efficiency in motor selection according to manufacturer's published recommendation or
7 according to AMCA Publication 203, Appendix L.
8

9 Where inlet and outlet ductwork at any fan is changed from that shown on the drawings, provide any
10 motor, drive and/or wiring changes required due to increased static pressure or baffling necessary to
11 prevent uneven airflow or improve mixing.
12

13 All internal insulation and other components exposed to the airstream are to meet the flame spread and
14 smoke ratings contained in NFPA 90A.
15

16 All roof mounted equipment to be provided with curbs or equipment stands in accordance with
17 specification in Section 23 05 29.
18

19 **PART 2 - PRODUCTS**

20 **GENERAL**

21 Use fan size, class, type, arrangement, and capacity as scheduled.
22
23

24 Furnish complete with motors, wheels, drive assemblies, bearings, vibration isolation devices, and
25 accessories required for specified performance and proper operation. All single phase motors to have
26 inherent thermal overload protection.
27

28 Provide variable pitch sheaves for drives 3 hp and smaller, fixed pitch sheaves for drives 5 hp and
29 larger. Design all drives for 150% of motor rating.
30

31 Use OSHA approved belt guards that totally enclose the entire drive. Construct guards of expanded
32 metal to allow for ventilation; provide tachometer openings at shaft locations.
33

34 Statically and dynamically balance all fans so they operate without objectionable noise or vibration.
35

36 **POWER ROOF EXHAUST FANS**

37 Manufacturers: Carnes, Greenheck, Penn, Jenn-Air, Cook, ACME, or approved equal.
38

39 Provide upblast or downblast units, as scheduled, with aluminum housing, non-overloading type
40 centrifugal wheel, inlet cone, factory mounted and wired motor and disconnect switch, and bird screen.
41

42 Electrical Contractor will provide disconnect switches and thermal overload protection for units with three
43 phase motors.
44

45 Upblast units to have motor, bearings, and drives completely enclosed and isolated from the exhaust air
46 stream with ventilation provided by outside air. Units handling grease laden vapors to be U.L. listed for
47 conveying such vapors, operating continuously at 300 degrees F.
48

49 **PART 3 - EXECUTION**

50 **INSTALLATION**

51 Install as shown on the drawings, as detailed, and according to manufacturer's installation instructions.
52 On units provided with a drain connection, reduce drain connection down to ½" fitting and leave open.
53
54

55 Install thrust restraints in accordance with the requirements of Section 23 05 48.
56

57 Contractor shall balance blade assembly of destratification fans after installation to assure stable
58 operation.
59

60 END SECTION 23 34 00

1 **SECTION 23 36 00 - AIR TERMINAL UNITS**

2
3 **PART 1 - GENERAL**

4
5 **SCOPE**

6 This section includes specifications for air terminal equipment. Included are the following topics:

7 **PART 1 - GENERAL**

8 Scope

9 Related Work

10 Reference

11 Reference Standards

12 Quality Assurance

13 Shop Drawings

14 Operation and Maintenance Data

15 Design Criteria

16 **PART 2 - PRODUCTS**

17 Supply Air Terminal Boxes

18 Terminal Air Box Controls

19 Insulation

20 **PART 3 - EXECUTION**

21 Installation

22 Adjusting

23
24 **RELATED WORK**

25 Section 23 82 00 - Convection Heating and Cooling Units

26 Section 23 31 00 - HVAC Ducts and Casings

27 Section 23 33 00 - Air Duct Accessories

28 Section 23 09 23 - Electric Instrumentation and Control Devices for HVAC

29 Section 23 09 93 – Sequence of Operation for HVAC Controls

30
31 **REFERENCE**

32 Applicable provisions of Division 1 govern work under this Section.

33
34 **REFERENCE STANDARDS**

35 NFPA 90A - Installation of Air Conditioning and Ventilation Systems.

36 UL 181 - Factory-Made Air Ducts and Connectors.

37 ARI-ADC Standard 880

38 ASTM E84 – Surface Burning Characteristics of Building Materials

39 UL 723 – Surface Burning Characteristics of Building Materials

40
41 **QUALITY ASSURANCE**

42 Refer to Division 1, General Conditions, Equals and Substitutions.

43
44 **SHOP DRAWINGS**

45 Refer to Division 1, General Conditions, Submittals.

46
47 Contractor shall submit air terminal unit data including materials of construction, dimensions, scheduled
48 flow rates, pressure drops, radiated and discharge sound power levels, reset volume controller data,
49 actuator spring range and torque data.

50
51 **OPERATION AND MAINTENANCE DATA**

1 All operations and maintenance data shall comply with the submission and content requirements
2 specified under section Basic 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 **PART 2 - PRODUCTS**

9
10 **SUPPLY AIR TERMINAL BOXES**

11 Units shall be single duct and pressure independent.

12
13 **MANUFACTURERS:**

14 Carnes, Envirotec, Metal-Aire, Titus, Trane, Price, Nailor or equal.

15
16 **CONSTRUCTION:**

17 Unit casing shall be minimum 22 gauge steel and internally insulated with 13/16" rigid fiberglass
18 insulation with a foil scrim face or 3/4" thick polyolefin closed cell insulation. Construction to meet UL 181
19 and NFPA 90A. Casing shall be sealed to limit leakage to a maximum of 15 cfm at 6.0 inches of static
20 pressure. Casing outlet shall have slip and drive joint for connection to discharge ductwork.

21
22 Metal damper blade shall be mounted to shaft having self-lubricated bearings. Shaft end shall be
23 marked to indicate damper position and shall have a built-in stop to prevent overstroking. Damper
24 blade shall close off against gasket to limit leakage to 10 cfm at 6.0 inches of differential static pressure.
25 Damper linkage shall be sized to accept at least 40 inch-pounds of torque to the damper shaft. Damper
26 shaft shall be provided with a marking indicating damper position.

27
28 Round inlet collar shall be equipped with a multi-point flow sensor that shall amplify the measured
29 velocity pressure.

30
31 **HOT WATER REHEAT COIL:**

32 Reference section 23 82 00 for hot water reheat coil specifications.

33
34 **TERMINAL AIR BOX CONTROLS**

35 **DDC CONTROLS**

36 Damper actuator and differential pressure sensor for flow measurement shall be provided under Section
37 23 09 23.

38
39 **INSULATION**

40 Materials or accessories containing asbestos will not be accepted.

41
42 Use composite insulation systems (insulation, jackets, sealants, and adhesives) that have a flame spread
43 rating of 25 or less and smoke developed rating of 50 or less.

44
45 The following two internal insulation options may be utilized.

46
47 **RIGID FIBERGLASS INSULATION:**

48 Minimum nominal density of 3 lbs. per cu. ft., and thermal conductivity of not more than 0.23 at 75
49 degrees F, minimum compressive strength of 25 PSF at 10% deformation, rated for service to 450
50 degrees F.

51
52 Foil-scrim-kraft vapor barrier jacket, factory applied to insulation, maximum permeance of .02 perms. All
53 exposed insulation edges shall be covered with metal nosing.

54
55 **POLYOLEFIN INSULATION:**

56 Flexible closed cell, minimum nominal density of 1.5 lbs. per cu. ft., thermal conductivity of not more
57 than 0.24 at 75 degrees F, minimum compressive strength of 5 psi at 25% deformation, maximum water

1 vapor permeability of 0.0 perm inch, maximum water absorption of 0% by weight and volume, rated for
2 service range of -165 degrees F to 210 degrees F.

3
4 **PART 3 - EXECUTION**

5
6 **INSTALLATION**

7 Install air terminal units as indicated on project drawings and in accordance with the manufacturer's
8 installation instructions.

9
10 Mount air terminal boxes with a minimum 3 feet of straight ductwork upstream of inlet flow sensor for
11 sizes 12" diameter and below. Provide a minimum of 3X the inlet diameter of straight duct upstream of
12 the inlet flow sensor for inlet sizes above 12" diameter.

13
14 Where hot water reheat coils are provided with air terminal boxes the following two options may be used.

15
16 Field mount coil separate from box with a 12-18" section of duct between the air terminal box and reheat
17 coil. The reheat coil and 12-18" section of duct shall be wrapped with external insulation as indicated in
18 specification section 23 07 00 – HVAC Insulation.

19
20 Factory mount coil in extended supply air terminal unit. The supply air terminal unit shall be extended at
21 the factory 12-18" and internally insulated to match the insulation used for the supply air terminal unit

22
23 Provide at least 24" of clearance on controller side of the air terminal unit. The clearance area shall
24 extend the full length of the supply air terminal unit and the full length (including the access door) of the
25 exhaust/return air terminal unit

26
27 Support air terminal units from building structure using sheet metal straps or trapeze hanger with rods.
28 Do not mount air terminal units off of adjacent ductwork or piping.

29
30 **INSULATION**

31 **RIGID FIBERGLASS INSULATION:**

32 All rigid duct insulation edges shall be covered with metal nosing. Foil scrim face must completely
33 separate the rigid fiberglass duct material from the air stream.

34
35 **POLYOLEFIN INSULATION:**

36 Apply full cover coat of adhesive to surface to be insulated, insulation and edge butt joints. Place
37 insulation with edge joints firmly butted pressing to surface for full adhesion. Seal seams and joints vapor
38 tight.

39
40 For supply air terminal units, provide five feet of 1" thick lining immediately downstream from air terminal
41 unit discharge. Where hot water reheat coils are field or factory installed, provide five feet of 1" thick
42 lining in ductwork immediately downstream of reheat coil. Refer to specification section 23 33 00 – Air
43 Duct Accessories for liner specification.

44
45 **ADJUSTING**

46 Coordinate adjustment of air terminal units with section 23 05 93 - Testing, Adjusting and Balancing.

47
48 **END SECTION 23 36 00**

1 **SECTION 23 37 13 - DIFFUSERS, REGISTERS & GRILLES**

2
3 **PART 1 - GENERAL**

4
5 **SCOPE**

6 This section includes specifications for air terminal equipment. Included are the following topics:

7 **PART 1 - GENERAL**

8 Scope

9 Related Work

10 Reference

11 Reference Standards

12 Quality Assurance

13 Submittals

14 Design Criteria

15 **PART 2 - PRODUCTS**

16 Manufacturers

17 Square Ceiling Diffusers

18 Side-Wall Registers and Grilles

19 **PART 3 - EXECUTION**

20 Installation

21
22 **RELATED WORK**

23 Section 23 31 00 - HVAC Ducts and Casings

24 Section 23 33 00 - Air Duct Accessories

25 Section 23 05 93 - Testing, Adjusting and Balancing for HVAC

26
27 **REFERENCE**

28 Applicable provisions of Division 1 govern work under this Section.

29
30 **REFERENCE STANDARDS**

31 NFPA 90A - Installation of Air Conditioning and Ventilation Systems.

32 UL 181 - Factory-Made Air Ducts and Connectors.

33 ARI-ADC Standard 880

34
35 **QUALITY ASSURANCE**

36 Refer to Division 1, General Conditions, Equals and Substitutions.

37
38 **SUBMITTALS**

39 Refer to Division 1, General Conditions, Submittals.

40
41 Furnish submittal information including, but not limited to, the following:

42 Manufacturer's name and model number

43 Identification as referenced in the documents

44 Capacities/ratings

45 Materials of construction

46 Sound ratings

47 Dimensions

48 Finish

49 Color selection charts where applicable

50 Manufacturer's installation instructions

51 All other appropriate data

52

1 **DESIGN CRITERIA**

2 All performance data shall be based on tests conducted in accordance with Air Diffusion Council (ADC) Test
3 Code 1062 GRD 84.

4
5 **PART 2 - PRODUCTS**

6
7 **MANUFACTURERS**

8 Manufacturers: Carnes, Krueger, Titus, Metal-Aire, and E.H. Price, and United Sheet Metal.

9
10 Acceptable manufacturers for specific products are listed under each item.

11
12 **SQUARE CEILING DIFFUSERS**

13 Carnes series SHPA or approved equal.

14
15 Aluminum unless otherwise indicated, plaque diffuser furnished with frame type appropriate to installation.

16
17 Directional blow pattern as shown on the drawings and/or as scheduled.

18
19 Unless otherwise indicated, baked enamel finish with color selected by Architect.

20
21 **SIDE-WALL REGISTERS AND GRILLES**

22 Titus series 300 (supply) and series 350 (return/exhaust), Carnes model R series, EH Price model NM22S/T or
23 C22S/3, Metal Aire series V4000 or H4000, Krueger series 880.

24
25 Aluminum unless otherwise indicated, with frame type appropriate to installation.

26
27 Double deflection type blade supply registers and supply grilles allow deflection adjustment in all direction.

28
29 Opposed blade volume control damper supply registers, operable from face.

30
31 Fixed blade (45 degree) core return and exhaust registers and grilles.

32
33 Opposed blade volume control damper return registers, operable from face.

34
35 Register and grille sizes as shown on drawings and/or as scheduled. Unless noted otherwise, baked enamel
36 finish with color selected by Architect.

37
38 Screw holes on surface counter sunk to accept recessed type screws.

39
40 **PART 3 - EXECUTION**

41
42 **INSTALLATION**

43 Install grilles, registers and diffusers as shown on drawings and according to manufacturer's instructions.

44
45 Furnish diffusers with equalizing grids where it is not possible to maintain minimum 2 duct diameter straight duct
46 into diffuser. Equalizing grids shall consist of individually adjustable vanes designed for equalizing airflow into
47 diffuser neck and providing directional control of airflow.

48
49 Unless otherwise indicated, size ductwork drops to diffusers or grilles to match unit collar size.

50
51 Seal connections between ductwork drops and diffusers/grilles airtight.

52
53 Where diffusers, registers and grilles cannot be installed to avoid seeing inside duct, paint inside of duct with flat
54 black paint to reduce visibility.

1 END SECTION 23 37 13

1 **SECTION 23 41 00 - PARTICULATE AIR FILTRATION**

2
3 **PART 1 - GENERAL**

4
5 **SCOPE**

6 This section includes specifications for air system filters. Included are the following topics:

7 **PART 1 - GENERAL**

- 8 Scope
- 9 Related Work
- 10 Reference
- 11 Reference Standards
- 12 Quality Assurance
- 13 Shop Drawings
- 14 Operation and Maintenance Data
- 15 Design Criteria

16 **PART 2 - PRODUCTS**

- 17 Manufacturers
- 18 Panel Filters
- 19 MERV 7 Filters
- 20 Housings for Panel Filters
- 21 Housings for MERV 7 Filters
- 22 Filter Gauges

23 **PART 3 - EXECUTION**

- 24 Installation
- 25 Filter Gauges

26
27 **RELATED WORK**

28 Section 23 07 00 - HVAC Insulation

29
30 **REFERENCE**

31 Applicable provisions of Division 1 govern work under this Section.

32
33 **REFERENCE STANDARDS**

- 34 ASHRAE Standard 52
- 35 UL 181 – Standard for Factory-Made Air Ducts and Air Connectors
- 36 UL 586 – Standard for High Efficiency Particulate Air Filter Units
- 37 UL 900 – Standard for Air Filter Units

38
39 **QUALITY ASSURANCE**

40 Refer to division 1, General Conditions, Equals and Substitutions.

41
42 **SHOP DRAWINGS**

43 Refer to Division 1, General Conditions, Submittals.

44
45 Include data concerning dimensions, materials, efficiencies, installation instructions and appropriate
46 identification.

47
48 Independent test reports verifying filter performance, test procedures and ratings.

49
50 **OPERATION AND MAINTENANCE DATA**

51 All operations and maintenance data shall comply with the submission and content requirements
52 specified under section Basic Requirements.

53
54 **DESIGN CRITERIA**

55 Use UL Class 1 or Class 2 filters unless noted otherwise. (Reference applicable UL standard referenced)

56
57 Efficiencies indicated in this section are based on ASHRAE Standard 52.
58

1 Fan motors have been selected to operate against the resistance of dirty filters as specified in this
2 section.

3 **PART 2 - PRODUCTS**

4 **MANUFACTURERS**

5
6 American Air Filter, Barnebey-Cheney, Cambridge, Continental, Flanders, Camil-Farr, Mine Safety
7 Appliances, Research Products, or approved equal.
8

9 **PANEL FILTERS**

10 Use 1" (or as scheduled) thick fiberglass blanket enclosed in a cardboard frame and reinforced with a
11 perforated metal retainer on the air leaving side, Coat media with flameproof, non- volatile adhesive.
12

13
14 Media nominal rating to be 500 FPM face velocity, 0.15 inch WG initial resistance, 0.50 inches WG
15 recommended final resistance. Average arrestance of filter media shall be 80%.
16

17 Provide filter holding frame.
18

19 **MERV 7 FILTERS**

20 Use 2" thick, pleated panels, 100% synthetic, self supported media fully bonded and sealed in cardboard
21 frame.
22

23 Media nominal rating to be 500 FPM face velocity, 0.20 inch WG initial resistance, 1.0 inches WG
24 recommended final resistance, Average arrestance of filter media shall be 90-92%
25

26 Furnish a side access housing or holding frame as scheduled.

27 Filter tracks shall be constructed to provide a minimum clearance of 2 inches between the pre-filter and
28 final-filter media to facilitate the installation of static pressure tips.
29

30 **HOUSINGS FOR PANEL FILTERS**

31 Manufactured by air handling unit manufacturer, filter media manufacturer, or contractor fabricated.
32 Casing and tracks constructed of galvanized or enameled steel or aluminum. Provide access to the
33 media tracks from outside the casing so media and be readily changed.
34

35 **HOUSINGS FOR MERV 7 FILTERS**

36 Housing or holding frame to be of the same manufacturer as filter media or provided by the air handling
37 unit manufacturer. Contractor fabricated housings or filter racks will not be accepted. Casing and tracks
38 constructed of galvanized or enameled steel or aluminum. Provide access to the media tracks from
39 outside the casing so media and be readily changed. Filter tracks shall be constructed to provide a
40 minimum clearance of 2 inches between the pre-filter and final-filter media to facilitate the installation of
41 static pressure tips.
42

43 **FILTER GAUGES**

44 Manufacturers: Dwyer, or approved equal.

45 Direct reading, 3-1/2 inch dial type, diaphragm actuated, in a metal case. Lettering shall be black figures
46 on white background. Provide front recalibration adjustment.
47

48 Provide gauges with the following ranges:
49

50 Filter Type	51 Scale Range (inch W.G.)
52 Panel filters	53 0.0 to 0.5
54 MERV 7	55 0.0 to 1.0

56 Provide one gauge for each filter bank, suitable for flush or surface mounting. Include an air filter gauge
57 accessory package consisting of mounting bracket, aluminum tubing, two static pressure tips, and vent
58 valves for each gauge
59

60 **PART 3 - EXECUTION**

61 **INSTALLATION**

- 1 Where air handling equipment is to be used for temporary heating or ventilation of a facility, do not
2 operate the equipment until specified filter media has been installed. Contractor shall be responsible for
3 maintaining the cleanliness of air handling apparatus and air distribution systems during construction
4 through regular inspection and changing of filter media throughout the construction period.
5
6 Where air handling apparatus is used during the construction period, install new filter media prior to start
7 of air balancing. Additionally, deliver one new set of media to the owner prior to substantial completion.
8
9 Install units as shown on drawings and details according to manufacturer's instructions.
10
11 Reinforce filter holding frames per manufacturer's instructions.
12
13 Maintain necessary clearance for changing filters.
14
15 **FILTER GAUGES**
16 Install filter gauge static pressure tips upstream and downstream of filters. Mount gauge on outside of
17 filter housing or filter plenum in accessible position outside of the unit housing, install tubing and gauge
18 valves between gauge and sensor tips. Adjust and level each gauge.
19
20 END SECTION 23 41 00

1 **SECTION 23 51 00 - BREECHINGS, CHIMNEYS, AND STACKS**

2
3 **PART 1 - GENERAL**

4
5 **SCOPE**

6 This section includes specifications for all breechings, chimneys, stacks, emergency generator exhaust
7 pipe, and automatic vent dampers. Included are the following topics:

8 **PART 1 - GENERAL**

9 Scope

10 Related Work

11 Reference

12 Reference Standards

13 Quality Assurance

14 Shop Drawings

15 Design Criteria

16 **PART 2 - PRODUCTS**

17 Vents for Condensing Appliances

18 Double Wall Type "B" Vents and Breeching

19 Double Wall Positive Pressure Vents and Breeching

20 **PART 3 - EXECUTION**

21 Installation

22 Cleaning and Protection

23
24 **RELATED WORK**

25 Section 23 07 00 - HVAC Insulation

26
27 **REFERENCE**

28 Applicable provisions of Division 1 govern work under this Section.

29
30 **REFERENCE STANDARDS**

31 UL 959

32 ANSI/ASTM C64

33 ANSI/ASTM C105

34 ANSI/ASTM A525

Specification for Basic Requirements for Steel Sheet, Zinc-Coated (Galvanized)
by the Hot-Dipped Process

35
36 ASTM A527

Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dipped
Process, Lock-Forming Quality

37
38 ASTM A53

Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and
Seamless

39
40 ASTM A234

Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for
Moderate and Elevated Temperatures

41
42
43 **QUALITY ASSURANCE**

44 Refer to Division 1, General Conditions, Equals and Substitutions

45
46 **SHOP DRAWINGS**

47 Refer to Division 1, General Conditions, Submittals.

48
49 Include materials of construction, dimensions, weight, support and layout of breechings. Where factory
50 built units are used, submit layout drawings indicating plan view and elevations. Identify all methods of
51 support and building structural members utilized for such support.

52
53 Submit manufacturer's installation instructions including required clearance to combustible materials.

54
55 All submittals are to comply with submission and content requirements specified in Division 1.

56
57
58 **DESIGN CRITERIA**

1 Follow the requirements of NFPA 211 and State codes.

2
3 Factory built vents and chimneys used for venting natural draft appliances shall comply with NFPA 211
4 and be UL listed and labeled.

5
6 **PART 2 - PRODUCTS**

7
8 **VENTS FOR CONDENSING APPLIANCES**

9 Size vents and material shall be in strict accordance with appliance manufacturer's requirements.

10
11 Combustion air intakes may be PVC, CPVC, galvanized sheet metal, or aluminum.

12
13 Flue gas venting is based on Heat Fab Saf-T Vent CI Plus system consisting of air insulated double wall
14 venting system designed for use on individual or common vented ANSI Category I, II, III or IV gas
15 burning appliances and direct vent appliances.

16
17 Factory built Special Gas Vent system is tested and listed by Underwriters Laboratories UL 1738/ULC
18 S636 for use with natural gas or propane burning equipment that produces continuous flue gas
19 temperatures not above 550 degrees F.

20
21 System shall be a double wall product that consists of a flue gas conduit fabricated of AL 29-4C stainless
22 steel, suited for use with high efficiency gas burning equipment, which produces excessive amounts of
23 condensation in the vent. The outer jacket of the system is constructed of type 403 stainless steel with a
24 space of approximately 1 inch between the flue gas conduit and the jacket.

25
26 All joints in the system are fastened with a manufacturer's closure system. When installed on positive
27 pressure of condensing appliances, the joints are to be sealed with a factory adhered seal of an
28 approved sealant. The closure system is tested to be gas tight at two and one-half times the listed
29 pressure rating of 15 inch water column.

30
31 **DOUBLE WALL TYPE "B" GAS VENTS AND BREECHING**

32 Size vents and material shall be in strict accordance with appliance manufacturer's requirements.

33
34 For use with natural draft vented appliances.

35
36 Manufacturer: Selkirk Metalbestos, Air-Jet, Hart & Cooley, General Products Co., or approved equal.

37
38 Vent pipe, breeching, and accessory fittings to be UL listed type "B".

39
40 Fabricate inner pipe of sheet aluminum or stainless steel, and outer pipe of galvanized sheet steel,
41 tested in compliance with UL 441. Minimum thickness of inner and outer pipes to be as follows:

42
43

Pipe Size	Thickness Inner Pipe	Thickness Outer Pipe
Round, up to 6"	0.012"	28 gage
Round, 7" to 18"	0.014"	28 gage
Round, 20" to 24"	0.018"	26 gage
Oval, up to 4"	0.012"	28 gage
Oval, 5" and 6"	0.014"	28 gage

44
45
46
47
48
49
50

51
52 Provide all necessary accessories including flashing, counter flashing, storm collar, insulated thimble,
53 rain cap with bird screen, clean out, fittings and all necessary supports.

54
55
56
57 **DOUBLE WALL POSITIVE PRESSURE VENTS AND BREECHING**

58 Size vents and material shall be in strict accordance with appliance manufacturer's requirements.

1 For use with direct vent, sealed combustion or separated combustion appliances.

2
3 Manufacturers: Selkirk Metalbestos, Van Packer, Stacks Inc., General Products Co., or approved equal.

4
5 Stack, breeching, and accessory fittings to be double wall type with minimum 1" air space between walls,
6 and U.L. listed for continuous operation at 1400°F under positive pressure.

7
8 Inner pipe to be type 304 stainless steel of 0.035" minimum thickness for sizes through 36" ID and
9 minimum thickness of 0.048" for sizes over 36" ID.

10
11 Construct outer jacket of aluminized steel where located inside building, and Type 304 stainless steel
12 where located outside building. Minimum thickness of outer jacket to be 24 gage for sizes 10 inches to
13 24 inches and 20 gage for sizes 28 inches to 48 inches.

14
15 Join sections with high temperature acid-resistance joint cement and steel drawbands. Stacks to be self
16 supporting and mounted on a concrete foundation. Allow for expansion of stacks from -20°F. to 1100°F.

17
18 Provide all necessary accessories including flashing, counter-flashing, cable guys where required,
19 cleanout, drain, exit cone, roof thimble and necessary supports. Coat all external welded joints and
20 seams with galvanized paint. Provide expansion guides for stacks over 40 feet in height.

21 **PART 3 - EXECUTION**

22 **INSTALLATION**

23 **CONDENSING APPLIANCE VENTS:**

24
25 Pitch exhaust vents up from appliance to point of termination outside building or to a drain at the bottom
26 of vertical stacks.

27
28
29 Locate exhaust termination and combustion air intake in accordance with appliance manufacturer's
30 recommendations to prevent re-entry of products of combustion.

31
32 Termination of exhaust within 10 feet of operable windows, other building openings, or air intakes will not
33 be accepted.

34
35 Pitch combustion air vents from intake down toward appliance connection.

36
37 All joints of combustion air intakes shall be solvent welded and leak tight. Provide drain connection at
38 base of exhaust vent, and pipe to nearest open site drain.

39 **DOUBLE WALL METAL STACKS AND BREECHING:**

40
41 Install stack, breeching, and accessories in accordance with the manufacturer's recommendations,
42 maintaining minimum clearances from combustibles specified in UL listing.

43
44 Support breechings from building structure with suitable ties, braces, hangers and anchors to hold shape
45 and prevent buckling. Minimum support for vertical sections shall be at all floor penetrations. Support
46 from floor structure, roof structure, or adjacent structural surfaces. Verify load bearing capacity of
47 support points with Architect/Engineer.

48
49 Install breechings with a minimum of joints. Align connections accurately and maintain smooth internal
50 surfaces.

51
52 Install concrete inserts for support of breechings, chimneys, and stacks in coordination with formwork.

53
54 Maintain UL listed minimum clearances from combustibles.

55
56 Install vent dampers at draft hood outlet for natural draft applications. Secure damper to draft hood
57 collar and breeching.

58
59 Install stacks plumb. Pitch breeching upward from fuel-fired equipment to chimney or stack.

60
61 Clean breechings, chimneys, and stacks during installation, removing dust and debris.

62

- 1 At appliances, provide slip joints to allow removal of appliances without removal or dismantling of
2 breechings, chimneys, or stacks.
3
- 4 Seal all joints of positive pressure stacks and breeching in accordance with manufacturer's
5 recommendations, using only sealants recommended by stack manufacturer.
6
- 7 **CLEANING AND PROTECTION**
- 8 Clean breeching internally during installation to remove dust and debris. Clean external surfaces to
9 remove welding slag and mill film.
10
- 11 At ends of breeching and chimneys which are not completed or connected to equipment, provide
12 temporary closure which will prevent entrance of dust and debris until final connections are made.
13
- 14 END SECTION 23 51 00

1 **SECTION 23 52 00 - CONDENSING BOILERS**

2
3 **PART 1 - GENERAL**

4
5 **SCOPE**

6 This section includes specifications for hot water equipment. Included are the following topics:

7 **PART 1 - GENERAL**

- 8 Scope
- 9 Related Work
- 10 Reference
- 11 Reference Standards
- 12 Quality Assurance
- 13 Energy Efficiency
- 14 Submittals
- 15 Operation and Maintenance Data
- 16 Registration
- 17 Warranty

18 **PART 2 - PRODUCTS**

- 19 Sealed Combustion Boiler, Condensing, Hi-efficiency, Modular

20 **PART 3 - EXECUTION**

- 21 Installation
- 22 Boilers
- 23 Training

24
25 **RELATED WORK**

- 26 Section 23 05 13 – Common Motor Requirements for HVAC Equipment
- 27 Section 23 21 13 – Hydronic Piping
- 28 Section 23 05 23 – General Duty Valves for HVAC Piping
- 29 Section 23 21 23 – Hydronic Pumps
- 30 Section 23 51 00 – Breeching, Chimneys and Stacks

31
32 **REFERENCE**

33 Applicable provisions of Division 1 govern work under this Section.

34
35 **REFERENCE STANDARDS**

- 36 ASME CSD-1 Control and Safety Devices for Automatically Fired Boilers
- 37 ASME Boiler and Pressure Vessel Code I - Rules of Construction of Power Boilers
- 38 ASME Boiler and Pressure Vessel Code VIII - Rules for Construction of Pressure Vessels
- 39 ASME Boiler and Pressure Vessel Code IX - Welding and Brazing Qualifications
- 40 ASME Boiler and Pressure Vessel Code IV - Rules for Construction of Heating Boilers
- 41 UL 795 Commercial Industrial Gas Heating Equipment
- 42 NFPA 70 Electrical wiring and devices
- 43 National Electric Code

44
45 **QUALITY ASSURANCE**

46 Refer to Division 1, General Conditions, Equals and Substitutions

47
48 **ENERGY EFFICIENCY**

49 All boilers with a capacity of 300,000 btu/hr input or greater must meet the efficiencies specified. Minimum
50 boiler efficiencies are based on Federal Energy Management Program (FEMP) recommendations.

51
52 **SUBMITTALS**

53 Refer to Division 1, General Conditions, Submittals.

54

1 Include data concerning dimensions, capacities, and material of construction, ratings, weights, manufacturer's
2 installation requirements and performance limitations.

3 Submit manufacturer's installation instructions including required clearance to combustible materials.
4

5 All submittals are to comply with submission and content requirements specified in division 1.
6

7 **OPERATION AND MAINTENANCE DATA**

8 All operations and maintenance data shall comply with the submission and content requirements specified
9 under section Basic Requirements and Division 1.
10

11 **REGISTRATION**

12 Complete Boiler and Unfired Pressure Vessel (UPV) Installation Registration and forward to the Department of
13 Commerce in accordance with the Wisconsin Administrative Code Chapter Comm 41.24.
14

15 **WARRANTY**

16 5-year Boiler pressure vessel warranty against leakage due to defective workmanship. 5- year period heat
17 exchanger tubes/combustion chamber assembly warranty against failure due to thermal stress or failure of
18 condensate corrosion. All other boiler, burner and control parts warranted for one year from startup.
19

20 Sealed combustion boiler, condensing, hi-efficiency, (modular,) helical heat exchanger/combustion chamber
21 design that will be self-supporting, and warranted for a period of 10 years to withstand thermal shock. Heat
22 exchanger shall be warranted against leakage for a period of 3 years. The burner shall be warranted (limited)
23 for a period 10. All other parts shall be warranted for a period of 1 year. All warranties shall start at date of
24 project substantial completion.
25

26 **PART 2- PRODUCTS**

27 **SEALED COMBUSTION BOILER, CONDENSING, HI-EFFICIENCY, MODULAR**

28 Manufactures: Aerco, Thermal Solutions.

29 Manufacturers, other than those listed above by name, requesting approval for bidding shall submit complete
30 product data, specific to this project, a minimum of 10 days prior to the bid date for engineer's consideration.
31

32
33 If boiler circulating pumps are recommended by the boiler manufacturer they shall be provided by this section
34 and shall be selected to provide the manufacturers recommended flow rate.
35

36 Provide units with capacity and operating characteristics indicated on schedules.
37

38 Boiler ASME stamped for 160 psig and designed per ASME section IV. Furnish a relief valve in compliance with
39 ASME section IV, and set at 100 psig. All internal combustion chamber, and internal burner components, shall
40 be manufactured with materials suitable to withstand constant operation under condensing conditions.
41 Combustion chamber shall have a condensate drain to discharge any condensate buildup.
42

43 Boiler efficiency 90%+ per ANSI Z21.13a, and operation in the condensing mode with inlet temperatures as low
44 as 90 F.
45

46 Combustion air intake capable of accepting either free mechanical room air, or direct outside air through a
47 sealed intake pipe of the length and diameter shown on drawings. Provide inlet/outlet combustion vent
48 temperature fittings with direct outside air application
49

50 Category IV flu vent connection, condensing positive pressure, for both horizontal sidewall and vertical venting.
51 The vent outlet shall be compatible with, and used only with, type AL29-4C vent material.
52

53 Baked enamel finish boiler sheet metal jacket with removal panels for maintenance access.
54

55 Inlet and outlet temperature gauge to monitor inlet and outlet water temperatures.
56

57 Provide a water temperature controller.

1
2 Provide each boiler with a low water cutout operationally testable, manually reset on loss of low-water and auto-
3 rest on loss of power in accordance with ASME Section IV and CSD-1.

4
5 Provide each boiler with dual over temperature protection, including manual reset, in accordance with ASME
6 Section IV and CSD-1.

7
8 Provide remote fault alarm contact for flame sensor and high temperature limit failure.

9
10 Provide single point wiring for controls and fan.

11
12 Natural gas-fired burners, forced draft power type with a positive pressure at the boiler discharge. Stainless
13 steel burner mixer. Maximum Nox emissions under 20 PPM.

14
15 Furnish units with fuel trains and operating controls conforming to the latest UL or equivalent agency approval,
16 CSD-1 requirements, (and FM requirements)(and IRI requirements) Boiler/burner package shall be factory
17 assembled, wired, mounted, and factory fire tested.

18
19 Provide a multiple boiler sequencing panel (BMS) capable of staging boilers to maintain peak seasonal
20 efficiency. BMS shall include a sensor to monitor main loop system temperature, and a sensor to monitor
21 outside air temperature. BMS shall be capable of outdoor reset, loop temperature span, and set loop
22 temperature. BMS shall have the capability to stage boilers based on loop temperature and outdoor reset for
23 highest operating seasonal efficiencies. BMS shall have the capability to stage a secondary pump for circulation
24 from the main piping through the boiler, if a circulator is provided. BMS shall be capable of starting and
25 stopping the system based on a remote contact closure provided by the temperature control contractor and
26 have the ability to change setpoint from a remote location. Manufactures: Honeywell, Heat Timer, Techmar,
27 BacNet or equivalent.

28
29 Boiler Capacities: Shall be as indicated in the equipment schedules.

30 31 **PART 3 - EXECUTION**

32 33 **INSTALLATION**

34 Install units as shown on plans, as detailed, and according to manufacturer's installation instructions.

35
36 Set units on concrete housekeeping pads.

37
38 Install all items shipped loose by equipment manufacturer under supervision of equipment manufacturer's field
39 service personnel.

40 41 **BOILERS**

42 After piping system has been flushed, boil out boilers using chemical and procedure as recommended by boiler
43 manufacturer. Perform boil-out under supervision of boiler manufacturer's representative.

44
45 Manufacturer shall verify in writing that boilers have been cleaned according to their recommendations and are
46 ready for operation.

47
48 Isolate boilers from piping system during boil-out.

49
50 Pipe vents from boiler gas train and to atmosphere. Size of each vent shall not be less than connection size to
51 device.

52
53 Fuel gas piping to boiler main fuel connection and boiler pilot will be by Heating Contractor.

54
55 Pipe all boiler and boiler vent stack drains to nearest floor drains.

56

1 Owner's representative and/or Engineer will observe boil-out. Contractor must notify Engineer at least 72 hours
2 prior to boil-out.

3
4 Install boiler vent stacks and combustion air intakes in accordance with the boiler manufacturers requirements.

5
6 Provide gas pressure gauges for installation downstream of gas pressure regulators to plumbing contractor for
7 installation.

8
9 If remote control panels are used, install all interconnecting wiring between panels and units.

10
11 **PERFORMANCE TESTING**

12 Contractor is responsible for functional performance test procedures.

13
14 **TRAINING**

15 All training provided for owner shall comply with the format, general content requirements and submission
16 guidelines specified in division 1.

17
18 Contractor to provide factory authorized representative and/or field personnel knowledgeable with the
19 operations, maintenance and troubleshooting of the system and/or components defined within this section for a
20 minimum period specified in Section 23 05 00.

21
22
23 END SECTION 23 52 00

1 **SECTION 23 73 13 - PACKAGED ROOF TOP UNITS**

2
3 **PART 1 - GENERAL**

4
5 **SCOPE**

6 This section includes specifications for outdoor packaged roof top units. Included are the following
7 topics:

8 **PART 1 - GENERAL**

9 Scope

10 Related Work

11 Reference

12 Quality Assurance

13 Submittals

14 Design Criteria

15 Delivery, Storage and Handling

16 Warranty

17 **PART 2 - PRODUCTS**

18 Manufacturers

19 Packaged Roof Top Heating and Cooling Unit

20 **PART 3 - EXECUTION**

21 Installation

22 Start Up

23
24 **RELATED WORK**

25 Section 23 05 13 – Common Motor Requirements for HVAC

26 Section 23 05 14 - Variable Frequency Drives

27 Section 23 41 00 – Particulate Air Filtration

28 Section 23 33 00 – Air Duct Accessories

29
30 **REFERENCE**

31 Applicable provisions of Division 1 govern work under this Section.

32
33 **QUALITY ASSURANCE**

34 Fabricate and label refrigeration system to comply with ASHRAE 15, "Safety Code for Mechanical
35 Refrigeration."

36 Energy Efficiency Ratio: Equal to or greater than prescribed by ASHRAE 90.1, "Energy Efficient Design
37 of New Buildings except Low-Rise Residential Buildings."

38 Listing and Labeling: Provide electrically operated components specified in this Section that are listed
39 and labeled.

40 The rooftop unit(s) shall be certified in accordance with UL Standard 1995 and ANSI Standard Z21.47

41 The rooftop unit(s) shall be safety certified by an accredited testing laboratory and the nameplate shall
42 carry the label of the certification agency.

43
44 **SUBMITTALS**

45 Refer to Division 1, General Conditions, Submittals

46 Product Data: Include manufacturer's technical data for each model indicated, including rated capacities
47 of selected model clearly indicated; dimensions; required clearances; shipping, installed, and operating
48 weights; furnished specialties; accessories; and installation and startup instructions.

49 Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loadings, required
50 clearances, method of field assembly, components, and location and size of each field connection. Detail

1 mounting, securing, and flashing of roof curb to roof structure. Indicate coordinating requirements with
2 roof membrane system.

3
4 Wiring Diagrams: Detail wiring for power, signal, and control systems and differentiate between
5 manufacturer-installed and field-installed wiring.

6 Commissioning Reports: Indicate results of startup and testing commissioning requirements. Submit
7 copies of checklists.

8 Maintenance Data: Maintenance manuals specified in Division 1.

9 Warranties: Special warranties specified in this Section.

10 11 **DESIGN CRITERIA**

12 Furnish factory fabricated packaged roof top units complete with fans, motors, compressors, drives,
13 coils, gas fired burner, drain pans, filter sections, access sections, damper sections, meeting the
14 configuration shown on drawings and/or as scheduled.

15
16 All material shall meet NFPA 90A flame spread and smoke develop rating requirements.

17
18 Each fan and motor combination shall be capable of delivering 110% of air quantity scheduled at
19 scheduled static pressure. The motor furnished with the fan shall not operate into the motor service
20 factor when operating under these conditions.

21
22 Consider drive efficiency in motor selection according to manufacturer's published recommendation or
23 according to AMCA Publication 203, Appendix L.

24
25 Where inlet and outlet ductwork at any fan is changed from that shown on the drawings, provide any
26 motor, drive and/or wiring changes required due to increased static pressure or baffling necessary to
27 prevent uneven airflow.

28 29 **DELIVERY, STORAGE, AND HANDLING**

30 Unit shall be shipped with doors bolted shut and outside air hood closed to prevent damage during
31 transport and thereafter while in storage awaiting installation.

32
33 Installation, Operation, and Maintenance manual instructions for rigging, moving, and unloading the unit
34 at its final location should be followed.

35
36 Unit shall be stored in a clean, dry place protected from construction traffic in accordance with the
37 Installation, Operation, and Maintenance manual.

38 39 **WARRANTY**

40 Manufacturer shall provide a "parts only" warranty for a period of 12 months from the date of equipment
41 startup or 18 months from the date of shipment, whichever is less. Warranty shall cover material and
42 workmanship that prove defective, within the specified warranty period, provided manufacturer's written
43 instructions for installation, operation, and maintenance have been followed. Warranty excludes parts
44 associated with routine maintenance, such as belts and air filters.

45
46 Compressor parts only non-prorated warranty – 5 years.

47
48 Heat exchanger parts only, non-prorated for 25 years.

49 50 **PART 2 - PRODUCTS**

51 52 **MANUFACTURERS**

53 Aaon or approve equal. All base bid numbers to include Aaon Roof Top Units.

54
55 All equipment substitutions to be listed separately.

56

1 Approved equal shall be acceptable if equipment includes

- 2 ▪ R-410A refrigerant
- 3 ▪ Direct drive supply blowers
- 4 ▪ Double wall cabinet construction
- 5 ▪ Insulation with an R-value of 13
- 6 ▪ Stainless steel drain pans
- 7 ▪ Hinged access doors with lockable handles
- 8 • Modulating compressor(s) (10-100% capacity)

9

10 **PACKAGED ROOF TOP HEATING AND COOLING UNIT**

11 Packaged rooftop unit shall include compressors, evaporator coils, filters, supply blowers, dampers,
12 condenser coils, condenser fans, gas heaters, return fans, and unit controls.

13

14 Unit shall be factory assembled and tested including helium leak testing of the coils, pressure testing of
15 the refrigeration circuit, and run testing of the completed unit. Run test report shall be supplied with the
16 unit in the controls compartment's literature pocket.

17

18 Unit shall have decals and tags to indicate lifting and rigging, service areas, and caution areas for safety
19 and to assist service personnel.

20

21 Unit components shall be labeled, including pipe stub outs, refrigeration system components, and
22 electrical and controls components.

23

24 Estimated sound power levels (dB) shall be shown on the unit ratings sheet.

25

26 Installation, Operation, and Maintenance manual shall be supplied within the unit.

27

28 Laminated color-coded wiring diagram shall match factory installed wiring and be provided in both point-
29 to-point and ladder form and affixed to the interior of the control compartment's hinged access door.

30

31 Unit nameplate shall be provided in two locations on the unit, affixed to the exterior of the unit and
32 affixed to the interior of the control compartment's hinged access door.

33

34 **CONSTRUCTION**

35 All cabinet walls, access doors and roof shall be fabricated of rigid, impact resistant, double wall, high
36 performance composite panels with G90 galvanized steel on both sides and a closed cell polyurethane
37 foam interior core.

38

39 Foam shall have a minimum density of 2 pounds/cubic foot and shall be tested in accordance with ASTM
40 D-1929 for a minimum flash ignition temperature of 610°F.

41

42 Panel deflection shall not exceed L/240 ratio at 125% of design static pressure, maximum 8 inches of
43 positive or negative static pressure. Deflection shall be measured at the midpoint of the panel height and
44 width.

45

46 Cabinet leakage rate shall not exceed 1% when tested at 6 inches of static pressure.

47

48 Insulation shall have an R-value of 13.

49

50 All cabinet walls, access doors and roof shall have a thermal break with no metal path to inside to
51 outside.

52

53 Units with cooling coils shall include double sloped 304 stainless steel drain pans and a factory provided
54 p-trap, for field installation.

55

56 Roof of the air tunnel shall be sloped to provide complete drainage.

1
2 Unit shall have rain break overhangs above access doors.
3
4 Exterior paint finish shall be capable of withstanding at least 2500 hours, with no visible corrosive effects,
5 when tested in a salt spray and fog atmosphere in accordance with ASTM B 117-95 test procedure.
6
7 Access to filters, dampers, economizers, cooling coils, and return blowers, controls, compressors, and
8 heaters shall be through hinged access doors with quarter turn, zinc cast, lockable handles. Full length
9 stainless steel piano hinges shall be included on the doors.
10
11 All openings through the base pan of the unit shall have upturned flanges of at least 0.5 inches in height
12 around the opening through the base pan.
13
14 Unit shall include lifting lugs on the top of the unit.
15
16 ELECTRICAL
17 Unit shall be provided with factory installed and factory wired, non-fused disconnect switch in the unit
18 control panel.
19
20 Unit shall be provided with factory installed and factory wired 115V, 13 amp GFI outlet with outlet
21 disconnect switch in the unit control panel.
22
23 SUPPLY BLOWERS
24 Unit shall include direct drive, unhooded, backward curved, plenum supply blower(s).
25
26 Blowers and motors shall be dynamically balanced and mounted on rubber isolators.
27
28 Motors shall be premium efficiency ODP with ball bearings rated for 200,000 hours service with external
29 lubrication points.
30
31 Variable frequency drive(s) shall be factory wired and mounted in the unit. Blower motor(s) shall be
32 premium efficiency.
33
34 RETURN BLOWERS
35 Unit shall include direct drive, axial flow return fan(s). Blades shall be adjustable pitch.
36
37 Unit shall include barometric relief dampers.
38
39 Blowers and motors shall be dynamically balanced.
40
41 Motors shall be premium efficiency ODP with ball bearings rated for 200,000 hours service with external
42 lubrication points.
43
44 Access to return blower(s) shall be through double wall, hinged access door with quarter turn handles.
45
46 Variable frequency drive(s) shall be factory wired and mounted in the unit. Blower motor(s) shall be
47 premium efficiency.
48
49 COOLING COILS
50 Evaporator Coil(s)
51 • Coils shall be designed for use with R-410A refrigerant and constructed of copper tubes with
52 aluminum fins mechanically bonded to the tubes and galvanized steel end casings. Fin design shall
53 be sine wave rippled.
54 • Coils shall have interlaced circuitry and shall be standard capacity.
55 • Coils shall be helium leak tested.

- Coil shall be furnished with a factory installed thermostatic expansion valve.

REFRIGERATION SYSTEM

Unit shall be factory charged with R-410A refrigerant.

Compressors shall be scroll type with thermal overload protection, independently circuited, and carry a 5 year non-prorated warranty.

Compressors shall be mounted in an isolated service compartment which can be accessed without affecting unit operation. Lockable hinged compressor access doors shall be fabricated of double wall, high performance composite panels with an R-value of 13 to prevent the transmission of noise outside the cabinet.

Compressors shall be isolated from the base pan with the compressor manufacturer's recommended rubber vibration isolators, to reduce any transmission of noise from the compressor into the building area.

Each refrigeration circuit shall be equipped with thermostatic expansion valve type refrigerant flow control.

Each refrigeration circuit shall be equipped with automatic reset low pressure and manual reset high pressure refrigerant safety controls, Schrader type service fittings on both the high pressure and low pressure sides, and factory installed liquid line filter driers.

Compressors shall include a modulating capacity scroll compressor on the first refrigeration circuit(s) which shall be capable of modulation from 10-100% of its capacity.

- Each capacity stage shall be equipped with a 5 minute off, delay timer to prevent compressor short cycling.
- Each capacity stage shall be equipped with an adjustable, 20 second delay timer to prevent multiple capacity stages from starting all at once.
- First capacity stage shall be provided with on/off condenser fan cycling and adjustable compressor lockout to allow cooling operation down to 35°F.

CONDENSERS

Air-Cooled Condenser

- Condenser fans shall be vertical discharge axial flow direct drive fans.
- Coils shall be designed for use with R-410A refrigerant and constructed of copper tubes with aluminum fins mechanically bonded to the tubes and aluminum end casings. Fin design shall be sine wave rippled
- Coils shall be designed for a minimum of 10 degrees of refrigerant sub-cooling.
- Coils shall be helium leak tested.

GAS HEATING

Unit shall include a natural gas furnace(s) with 4 stages of capacity.

Stainless steel heat exchanger furnaces shall carry a 25 year non-prorated warranty.

Gas furnace shall consist of stainless steel heat exchangers with multiple concavities, an induced draft blower, and an electronic pressure switch to lockout the gas valve until the combustion chamber is purged and combustion airflow is established.

Furnace shall include a gas ignition system consisting of an electronic igniter to a pilot system, which will be continuous when the heater is operating, but will shut off the pilot when heating is not required.

1 Unit shall have gas supply piping entrances in the unit base for through-the-curb gas piping and in the
2 outside cabinet wall for across the roof gas piping.

3 4 **FILTERS**

5 Unit shall include 2 inch thick, pleated panel filters with an ASHRAE efficiency of 30% and MERV rating
6 of 7, upstream of the cooling coil.

7
8 Unit shall include 1 inch aluminum mesh pre filters upstream of the outside air opening.

9 10 **OUTSIDE AIR/ECONOMIZER**

11 Unit shall include 0-100% economizer consisting of a motor operated outside air damper and return air
12 damper assembly constructed of extruded aluminum, hollow core, airfoil blades with rubber edge seals
13 and aluminum end seals. Damper blades shall be gear driven and designed to have no more than 15
14 CFM of leakage per sq. ft. of damper area when subjected to 2 inches w.g. air pressure differential
15 across the damper. Damper assembly shall be controlled by spring return enthalpy activated fully
16 modulating actuator. Unit shall include outside air opening bird screen, outside air hood with rain lip, and
17 barometric relief dampers.

18
19 Economizer shall be furnished with the Constant Volume Outside Air ventilation control assembly which
20 maintains a minimum amount of entering outside air. It shall measure the outside air velocity pressure
21 and adjust the economizer dampers to maintain a constant velocity pressure and thus a constant volume
22 of outside air.

23 24 **CONTROLS**

25 All roof top unit controls are to be provided by the temperature control contractor.

26 27 **ACCESSORIES**

28 Options:

- 29 • Unit shall be provided with a smoke detector(s) sensing the return air (return and supply air) of the
30 unit, wired to shut off the unit's control circuit.
- 31 • Unit shall be provided with a terminal block for field installation of a smoke detector which shuts off
32 the unit's control circuit.
- 33 • Unit shall be provided with a firestat sensing the return and supply air of the unit, wire to shut off the
34 unit's control circuit.

35 36 **CURBS**

37 Curbs shall to be fully gasketed between the curb top and unit bottom with the curb providing full
38 perimeter support, cross structure support and air seal for the unit. Curb gasket shall be furnished within
39 the control compartment of the rooftop unit to be mounted on the curb immediately before mounting of
40 the rooftop unit

41
42 Knockdown curbs (with duct support rails) shall be factory furnished for field assembly.

43
44 Solid bottom curb shall be factory assembled and fully lined with 1 inch neoprene coated fiberglass
45 insulation and include a wood nailer strip. (Curb shall be adjustable up to 3/4 inch per foot to allow for
46 sloped roof applications.)

47 48 **PART 3 - EXECUTION**

49 50 **INSTALLATION**

51 Install roof top units and accessories as indicated on drawings and/or as scheduled and according to
52 manufacturer's installation instructions. The unit shall be installed with a complete waterproof
53 installation. Coordinate with Roofing Contractor for proper flashing onto mounting curb.

54

1 Install roof top unit to provide for adequate service access. Coordinate with other trades to assure roof
2 top unit does not infringe upon access or service clearances of other equipment.

3
4 Lubricate fan bearings.

5
6 Coordinate with the General Contractor for exact location of roof penetrations and structural support.

7
8 **START UP**

9 Rooftop unit manufacturer shall check, test, and start each unit in accordance with manufacturer's
10 instructions and a copy of the completed check test and start up report for the unit shall be submitted to
11 A/E. The unit shall be started in the field by approved factory personnel for the cooling cycle and heating.
12 Check operation of all conditions and send report to the Architect/Engineer on the status of equipment
13 and control systems. Factory personnel shall further instruct the Owner maintenance personnel as to
14 preventative maintenance, normal and emergency operational procedures, and procedures for starting
15 equipment on the cooling cycle and heating. The unit manufacturer shall state in writing to the
16 Architect/Engineer that the equipment is approved for use for cooling and heating after the field check
17 tests and start up have been completed on the unit. The unit manufacturer representatives shall instruct
18 the Heating contractor in procedures in wiring the temperature control system for equipment and shall
19 inspect the entire temperature control installation and shall state in writing to the Architect/Engineer that
20 the system has been installed as recommended by the company.

21
22 END SECTION 23 73 13

1 **SECTION 23 82 00 - HEATING AND COOLING TERMINAL UNITS**

2
3 **PART 1 - GENERAL**

4
5 **SCOPE**

6 This section includes specification for heating and cooling terminal equipment using water as the source.
7 Included are the following topics:

8 **PART 1 - GENERAL**

9 Scope
10 Related Work
11 Reference
12 Reference Standards
13 Quality Assurance
14 Shop Drawings
15 Operation and Maintenance Data
16 Design Criteria

17 **PART 2 - PRODUCTS**

18 Reheat Coils
19 Cabinet Heaters
20 Convectors
21 Radiant Ceiling Panel

22 **PART 3 - EXECUTION**

23 Installation
24 Reheat Coils
25 Cabinet Heaters
26 Convectors
27 Radiant Ceiling Panel

28
29 **RELATED WORK**

30 Section 23 05 23 - General-Duty Valves for HVAC Piping
31 Section 23 05 13 - Common Motor Requirements for HVAC Equipment
32 Section 23 41 00 - Particulate Air Filtration
33 Section 23 36 00 - Air Duct Accessories

34
35 **REFERENCE**

36 Applicable provisions of Division 1 govern work under this Section.

37
38 **REFERENCE STANDARDS**

39 ARI 210 Standard for Unitary Air-Conditioning Equipment
40 ARI 410 Standard for Forced-Circulation Air-Cooling and Air-Heating Coils
41 CS 140

42
43 **QUALITY ASSURANCE**

44 Refer to Division 1, General Conditions, Equals and Substitutions

45
46 **SHOP DRAWINGS**

47 Refer to Division 1, General Conditions, Submittals.

48
49 Include dimensions, capacities, materials of construction, ratings, weights, wiring diagrams, and
50 appropriate identification for all equipment in this section. Include color selection chart where applicable.

51
52 **OPERATION AND MAINTENANCE DATA**

53 All operations and maintenance data shall comply with the submission and content requirements
54 specified under section Basic Requirements.

55
56 **DESIGN CRITERIA**

57 Forced Circulation Coils: Ratings certified in accordance with ARI 410.
58

1 Electrical Equipment and heaters shall be UL listed for the service specified.

2
3 Electrical components and work must be in accordance with National Electrical Code.

4
5 **PART 2 - PRODUCTS**

6
7 **REHEAT COILS**

8 Manufacturers: Carrier, Trane, McQuay, Marlo or approved equal.

9
10 Construct coils of copper tubes and aluminum fins in a serpentine arrangement with piping connections
11 on the same end. Provide galvanized steel casing, end supports, top and bottom channels to allowance
12 for expansion of finned tube section. Factory test coils at 200 psig.

13
14 Headers may be cast iron with tubes expanded into the header, steel pipe with tubes brazed to the
15 header, or seamless copper with tubes brazed to the header.

16
17 Frames to be flanged for a gasketed connection to adjacent ductwork or constructed for slip and drive
18 connection to the ductwork.

19
20 Minimum reheat coil size is 8 inches x 8 inches.

21
22 **CABINET HEATERS**

23 Manufacturers: American Air Filter, Sterling, McQuay, Trane, Airtherm, or approved equal.

24
25 Construct vertical unit casings with 16 gauge steel front panels and minimum 18 gauge steel end and
26 side panels. Horizontal units located in concealed spaces or mounted in ceiling to have minimum 18
27 gauge front, end, and side panels.

28
29 Furnish exposed cabinets in a baked enamel finish in one of the manufacturer's standard colors, selected
30 by the Architect.

31
32 Furnish ceiling mounted units with a hinged front panel to allow access to all internal components.

33
34 Construct heating elements of copper tubes with aluminum fins, tested at 200 psig.

35
36 Use centrifugal type fans, statically and dynamically balanced to operate without objectionable noise and
37 vibration.

38
39 Motors to be 120 volt, single phase, permanently lubricated, with thermal overload protection and
40 disconnect switch at unit.

41
42 Furnish each unit with filter rack and 1" panel filters as specified in Section 23 41 00.

43
44 **CONVECTORS**

45 Manufacturers: Modine, Sterling, Trane, Airtherm or approved equal.

46
47 Construct heating elements of copper tubes with aluminum fins expanded into cast iron or brass headers.
48 Support heating elements on adjustable brackets to allow for expansion and pitch. Certify coil ratings in
49 accordance with Commercial Standard CS 140.

50
51 Construct enclosures of 18 gauge steel back and end panels, and 16 gauge steel front and top panels.
52 Furnish in a baked enamel finish in one of the manufacturers' standard colors, selected by Architect.

53
54 **RADIANT CEILING PANELS**

55 Modular panels are a system of standard sized radiant panels which can be integrated into a suspended
56 ceiling to provide overhead radiant heating.

57
58 The system can be used with hot water at various temperatures; insulation blankets with a heat reflecting
59 foil backing are utilized to maintain heating efficiency.

60
61 The panels are fabricated from either 18 gauge aluminum sheet or 24 gauge steel sheet to which a

1 heating coil is mechanically fastened. Thermal contact between the coil and panel is maintained by an
2 aluminum heat saddle fastened with welded aluminum or steel studs. The coil is clipped to the heat
3 saddle using cadmium plated steel clips where heat transfer paste is used at the interface between the
4 aluminum heat saddle and both the face of the panel and the tubing.
5

6 Dimensions and weight:

- 7 • Modular panels are available in the following sizes: Imperial: 24" x 24", 24" x 48", 48" x 48", 24" x
8 60".
- 9 • The working weight for the aluminum panels is approximately 1.5 lb/ft².
- 10 • The working weight for the steel panels is approximately 2.2 lb/ft².

11
12 Materials of Construction:

- 13 • Pipework: Each panel has its own serpentine pipe coil of 5/8" O.D. tubing.
- 14 • Panels: 0.040" aluminum or 0.027" steel sheet with standard square edges or regular
15 edge detail.
- 16 • Paint finish: Standard finish is off-white or silk-screen printed to simulate adjacent acoustic
17 ceiling tiles.
- 18 • Contact strips: Aluminum heat saddle bolted to the back of the panel using steel or aluminum
19 studs which are welded to the panel.
- 20 • Insulation: As specified by consultant's specification, usually a minimum of 1" thick foil back
21 batt insulation.

22 **PART 3 - EXECUTION**

23 **INSTALLATION**

24 Install units in accordance with manufacturer's installation instructions.

25
26 Install branch water piping to each unit with a minimum of three elbows to allow for expansion and
27 contraction of the piping system.

28 Coordinate location of units with other trades to assure correct recess size for recessed units.

29 After installation, provide protective covers to prevent accumulation of dirt on units during balance of
30 construction.

31 **REHEAT COILS**

32 Comb bent or crushed fins and clean dust and debris from each coil before enclosing coils in ductwork.
33 Pitch coil casings in accordance with manufacturer's instructions. Install a drain valve on the coil side of
34 the shutoff valves for each reheat coil.

35 Pipe coils with multiple rows for counter flow arrangement.

36 **CABINET HEATERS**

37 Mount units in locations indicated on the drawings and as detailed. Install a drain valve on the coil side
38 of the shutoff valves for each hot water cabinet heater.

39 **CONVECTORS**

40 Mount units in locations indicated on the drawings and as detailed. Install a drain valve on the coil side
41 of the shutoff valves for each hot water cabinet heater.

42 **RADIANT CEILING PANELS**

43 Mount units in locations indicated on the drawings and as detailed.

44
45
46
47
48
49
50
51
52
53
54
55 END SECTION 23 82 00

1 **SECTION 26 00 00 - ELECTRICAL GENERAL PROVISIONS**

2
3 **PART 1 - GENERAL**

4
5 1.1 RELATED DOCUMENTS

- 6
7 A. Applicable provisions of Division 1 shall govern work under this section.
8
9 B. Refer to Division 7 – Through-Penetration Firestop Systems, for sealing requirements at
10 penetrations of fire rated surfaces.
11

12 1.2 CODES AND PERMITS

- 13
14 A. Perform all work in strict accordance with the requirements of the State of Wisconsin
15 Electrical Code and State of Wisconsin Energy Code. Requirements outlined therein shall
16 be minimum as related to this work.
17
18 B. Arrange for Code required inspections and pay for same if not covered by permit costs.
19
20 C. Arrange and pay for required utility costs.
21

22 1.3 WORK PRIORITY AND COORDINATION

- 23
24 A. Contractor, his mechanics and subcontractors shall cooperate with all others so
25 construction may proceed without hindrances and in all cases to the best interests of the
26 Owner. Confer with others regarding any work that may affect this work and arrange
27 piping, ductwork, equipment, etc. in proper relation to that of others. Coordinate prior to
28 installation the arrangement of HVAC work as related to plumbing, electrical and general
29 construction work.
30

31 1.4 DRAWINGS

- 32
33 A. The drawings are schematic in nature indicating the general location of all electrical
34 equipment and devices. While the sizes and locations have been indicated, the
35 Contractor shall properly adjust his work to meet conditions as they actually exist on the
36 premises. Equipment and devices shall provide adequate and acceptable clearance for
37 entry, servicing and maintenance. Minor adjustments shall be discussed with the
38 Engineer with the view to convenience of operation and noninterference with other work.
39 The Engineer reserves the right to change the location of any conduit, device or piece of
40 equipment to suit conditions, with no added cost to the Owner if the requested change
41 does not modify the scope of work. Should the particular equipment which any contractor
42 proposes to install require other space conditions, other utility service, or other structural
43 support than those indicated on the drawings, the Contractor shall arrange for such
44 changes with other affected Contractors and with the Architect. Required changes shall
45 be noted on the submittal cover sheet. Should changes become necessary the
46 Contractor shall make such changes at his expense.
47

48 1.5 SUBMITTALS

- 49
50 A. Furnish shop drawings on items as indicated in individual sections including switchboard,
51 panels, devices, fixtures, firestopping, fire alarm equipment, and other equipment. Submit
52 at least 6 copies for review which represents (2) copies for A/E, (1) copy for owner

1 review, (2) copies for O&M manuals, (0) copies for other Prime Contractors plus (1) copy
2 to be returned to contractor. Incomplete drawings will not be reviewed. Shop drawings for
3 equipment which are noted as being reviewed by Architect or his Engineer shall not
4 supersede Contract Documents or relieve Contractor from responsibility for deviations
5 from the Contract Documents.
6

- 7 B. Furnish 3 sets of standard operating instructions and complete repair parts lists for the
8 Owner for items of equipment and controls. Also include a summary of maintenance
9 procedures required monthly, yearly, etc. for all equipment. Submit in binders to Engineer
10 for approval.
11

12 1.6 REMODELING WORK
13

- 14 A. Wherever remodeling work or demolition of existing equipment, light fixtures, conduit, etc.
15 is a part of plans and specifications, Contractor shall visit the site and thoroughly examine
16 all existing conditions. Provide all required work necessary for interconnection of existing
17 services with new system and removal of existing unused components.
18

- 19 B. Contractors shall notify the Architect at least 10 days prior to the bid closing date of any
20 deviations or required changes that are noticed. No allowance for additional costs for
21 work related to existing conditions will be permitted after bidding unless proof of hidden
22 work, breakage or damage could not be determined by inspection or examination by the
23 Contractor.
24

- 25 C. In general the work of this project consists of installing a new electric service switchboard
26 along with other service modifications to accommodate the work of this project, the
27 removal, upgrade and reinstallation of existing lighting equipment to accommodate the
28 installation of the new mechanical system and new power connections for the new
29 mechanical equipment and other equipment being installed.
30

31 1.7 HOUSEKEEPING
32

- 33 A. This Contractor shall periodically remove debris caused by his operations. On completion
34 he shall remove all debris from his work and leave same neat and clean, ready for use by
35 the Owner.
36

37 1.8 PROTECTION OF MATERIALS AND EQUIPMENT
38

- 39 A. Materials and equipment shall be protected at all times. This Contractor shall be
40 responsible for all damage caused directly or indirectly by his workmen. Equipment shall
41 be tightly covered and protected against dirt, water, and chemical or mechanical injury. At
42 the completion of all work, the equipment shall be thoroughly cleaned and delivered to
43 the Owner in a condition satisfactory to the Engineer.
44

- 45 B. Equipment shall not be used during construction unless approved in writing by the
46 Engineer. Equipment used during construction shall be returned to the original condition,
47 which may include such items as replacing lamps, cleaning lenses, and replacing
48 damaged devices.
49

50 1.9 PAINTING
51

- 52 A. All equipment shall have manufacturer's standard baked enamel finish and shall not be
53 job painted "unless otherwise specified". Equipment in finished rooms shall have color
54 selected by Engineer from manufacturer's standard colors. All required touch up painting
55 of pre-finished surfaces by this Contractor.
56

1 1.10 ELECTRICAL IDENTIFICATION

- 2
- 3 A. Every piece of equipment, starters, disconnect, etc. shall be stenciled with identifying
- 4 number and area or rooms served, neatly printed and applied on or near item as
- 5 approved by Engineer. Motors and equipment nameplates and applicable UL labels shall
- 6 be in place, free from dirt, grease or paint when Project is turned over to Owner.
- 7
- 8 B. Panelboard directories shall be typed and shall indicate type of load and room numbers
- 9 for location(s). Panelboards shall have laminated, plastic, engraved nameplates. Existing
- 10 panelboards that are revised shall have new revised directories that reflect new
- 11 equipment leads.
- 12

13 1.11 INSTRUCTIONS

- 14
- 15 A. The Contractor shall review with the Owner's representative complete operating and
- 16 maintenance procedures for equipment and systems installed under this contract.
- 17 Provide 2 days of instructions during normal working hours when systems are fully
- 18 operational and before final payment.
- 19

20

21 **PART 2 - PRODUCTS**

22

23 2.1 QUALITY REQUIREMENTS

- 24
- 25 A. Items indicated on the drawings and in the specifications are listed by manufacturer in
- 26 order to describe minimum quality requirements.
- 27
- 28 B. Materials and equipment shall conform to requirements of Wisconsin Administrative
- 29 Code.
- 30
- 31 C. All materials and equipment furnished shall be new and shall be the standard products of
- 32 manufacturers regularly engaged in the production of Electrical and Fire Alarm materials
- 33 and equipment.
- 34

35

36 END SECTION 26 00 00

1 **SECTION 26 05 00 – COMMON WORK RESULTS FOR ELECTRICAL**
2

3 **PART 1 - GENERAL**
4

5 1.1 RELATED DOCUMENTS
6

- 7 A. Drawings and general provisions of the Contract, including applicable provisions of
8 Division 1 shall govern work under this section.
9

10 1.2 SUMMARY
11

- 12 A. This Section includes the following:
13
14 1. Raceways.
15 2. Building wire and connectors.
16 3. Supporting devices for electrical components.
17 4. Electrical identification.
18 5. Electricity-metering components.
19 6. Concrete equipment bases.
20 7. Electrical demolition.
21 8. Cutting and patching for electrical construction.
22 9. Touchup painting.
23

24 1.3 DEFINITIONS
25

- 26 A. EMT: Electrical metallic tubing.
27
28 B. FMC: Flexible metal conduit.
29
30 C. IMC: Intermediate metal conduit.
31
32 D. LFMC: Liquidtight flexible metal conduit.
33
34 E. RNC: Rigid nonmetallic conduit.
35

36 1.4 SUBMITTALS
37

- 38 A. Product Data: For electricity-metering equipment.
39
40 B. Shop Drawings: Dimensioned plans and sections or elevation layouts of electricity-
41 metering equipment.
42
43 C. Field Test Reports: Indicate and interpret test results for compliance with
44 performance requirements.
45

46 1.5 QUALITY ASSURANCE
47

- 48 A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in
49 NFPA 70, Article 100, by a testing agency acceptable to authorities having
50 jurisdiction, and marked for intended use.
51
52 B. Comply with NFPA 70.

1
2 1.6 COORDINATION
3

- 4 A. Coordinate chases, slots, inserts, sleeves, and openings with general construction work
5 and arrange in building structure during progress of construction to facilitate the electrical
6 installations that follow.
7
8 1. Set inserts and sleeves in poured-in-place concrete, masonry work, and other
9 structural components as they are constructed.
10
11 B. Sequence, coordinate, and integrate installing electrical materials and equipment for
12 efficient flow of the Work. Coordinate installing large equipment requiring positioning
13 before closing in the building.
14
15 C. Coordinate electrical service connections to components furnished by utility companies.
16
17 1. Coordinate installation and connection of utilities and services, including
18 provision for electricity-metering components for new switchboard being
19 installed.
20 2. Comply with requirements of authorities having jurisdiction and of utility
21 company providing electrical power and other services.
22
23 D. Coordinate location of access panels and doors for electrical items that are concealed by
24 finished surfaces. Access doors and panels are specified in Division 8 Section "Access
25 Doors and Frames."
26
27 E. Where electrical identification devices are applied to field-finished surfaces, coordinate
28 installation of identification devices with completion of finished surface.
29
30 F. Where electrical identification markings and devices will be concealed by acoustical
31 ceilings and similar finishes, coordinate installation of these items before ceiling
32 installation.
33
34

35 **PART 2 - PRODUCTS**
36

37 2.1 RACEWAYS
38

- 39 A. EMT: ANSI C80.3, zinc-coated steel, with set-screw or compression fittings.
40
41 B. FMC: Zinc-coated steel.
42
43 C. IMC: ANSI C80.6, zinc-coated steel, with threaded fittings.
44
45 D. LFMC: Zinc-coated steel with sunlight-resistant and mineral-oil-resistant plastic jacket.
46
47 E. RNC: NEMA TC 2, Schedule 40 PVC, with NEMA TC3 fittings.
48
49 F. Raceway Fittings: Specifically designed for the raceway type with which used.
50

51 2.2 CONDUCTORS
52

- 53 A. Conductors, No. 10 AWG and Smaller: Solid or stranded copper.
54
55 B. Conductors, Larger Than No. 10 AWG: Stranded copper.
56

- 1 C. Insulation: Thermoplastic, rated at 75 deg C minimum.
2
3 D. Wire Connectors and Splices: Units of size, ampacity rating, material, type, and class
4 suitable for service indicated. Compression type for stranded conductors.
5

6 2.3 SUPPORTING DEVICES
7

- 8 A. Material: Cold-formed steel, with corrosion-resistant coating acceptable to authorities
9 having jurisdiction.
10
11 B. Metal Items for Use Outdoors or in Damp Locations: Hot-dip galvanized steel.
12
13 C. Slotted-Steel Channel Supports: Flange edges turned toward web, and 9/16-inch-
14 diameter slotted holes at a maximum of 2 inches o.c., in webs.
15
16 D. Slotted-Steel Channel Supports: Comply with Division 5 Section "Metal Fabrications" for
17 slotted channel framing.
18
19 1. Channel Thickness: Selected to suit structural loading.
20 2. Fittings and Accessories: Products of the same manufacturer as channel
21 supports.
22
23 E. Nonmetallic Channel and Angle Systems: Structural-grade, factory-formed, glass-fiber-
24 resin channels and angles with 9/16-inch-diameter holes at a maximum of 8 inches, in at
25 least one surface.
26
27 1. Fittings and Accessories: Products of the same manufacturer as channels and
28 angles.
29 2. Fittings and Accessory Materials: Same as channels and angles, except metal
30 items may be stainless steel.
31
32 F. Raceway and Cable Supports: Manufactured clevis hangers, riser clamps, straps,
33 threaded C-clamps with retainers, ceiling trapeze hangers, wall brackets, and spring-
34 steel clamps or click-type hangers.
35
36 G. Pipe Sleeves: ASTM A 53, Type E, Grade A, Schedule 40, galvanized steel, plain ends.
37
38 H. Expansion Anchors: Carbon-steel wedge or sleeve type.
39
40 I. Toggle Bolts: All-steel springhead type.
41
42 J. Powder-Driven Threaded Studs: Heat-treated steel.
43

44 2.4 ELECTRICAL IDENTIFICATION
45

- 46 A. Identification Devices: A single type of identification product for each application
47 category. Use colors prescribed by ANSI A13.1, NFPA 70, and these Specifications.
48
49 B. Raceway and Cable Labels: Comply with ANSI A13.1, Table 3, for minimum size of
50 letters for legend and minimum length of color field for each raceway and cable size.
51
52 1. Type: Pretensioned, wraparound plastic sleeves. Flexible, preprinted, color-
53 coded, acrylic band sized to suit the diameter of the item it identifies.
54 2. Type: Preprinted, flexible, self-adhesive, vinyl. Legend is overlaminated with a
55 clear, weather- and chemical-resistant coating.
56 3. Color: Black letters on orange background.

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
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

- 4. Legend: Indicates voltage.
- C. Colored Adhesive Marking Tape for Raceways, Wires, and Cables: Self-adhesive vinyl tape, not less than 1 inch wide by 3 mils thick.
- D. Tape Markers for Wire: Vinyl or vinyl-cloth, self-adhesive, wraparound type with preprinted numbers and letters.
- E. Color-Coding Cable Ties: Type 6/6 nylon, self-locking type. Colors to suit coding scheme.
- F. Engraved-Plastic Labels, Signs, and Instruction Plates: Engraving stock, melamine plastic laminate punched or drilled for mechanical fasteners 1/16-inch minimum thickness for signs up to 20 sq. in. and 1/8-inch minimum thickness for larger sizes. Engraved legend in black letters on white background.
- G. Interior Warning and Caution Signs: Comply with 29 CFR, Chapter XVII, Part 1910.145. Preprinted, aluminum, baked-enamel-finish signs, punched or drilled for mechanical fasteners, with colors, legend, and size appropriate to the application.
- H. Exterior Warning and Caution Signs: Comply with 29 CFR, Chapter XVII, Part 1910.145. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396-inch, galvanized-steel backing, with colors, legend, and size appropriate to the application. 1/4-inch grommets in corners for mounting.
- I. Fasteners for Nameplates and Signs: Self-tapping, stainless-steel screws or No. 10/32 stainless-steel machine screws with nuts and flat and lock washers.

2.5 EQUIPMENT FOR UTILITY COMPANY'S ELECTRICITY METERING

- A. Current-Transformer Cabinets: Comply with requirements of electrical power utility company. Note, switchboard with metering section is being provided directly by Owner but installed by EC.
- B. Meter Sockets: Comply with requirements of electrical power utility company.

2.6 TOUCHUP PAINT

- A. For Equipment: Equipment manufacturer's paint selected to match installed equipment finish.
- B. Galvanized Surfaces: Zinc-rich paint recommended by item manufacturer.

PART 3 - EXECUTION

3.1 ELECTRICAL EQUIPMENT INSTALLATION

- A. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide the maximum possible headroom.
- B. Materials and Components: Install level, plumb, and parallel and perpendicular to other building systems and components, unless otherwise indicated.

1 C. Equipment: Install to facilitate service, maintenance, and repair or replacement of
2 components. Connect for ease of disconnecting, with minimum interference with other
3 installations.

4
5 D. Right of Way: Give to raceways and piping systems installed at a required slope.
6

7 3.2 RACEWAY APPLICATION

8
9 A. Use the following raceways for outdoor installations:

- 10 1. Exposed: IMC.
- 11 2. Concealed: IMC.
- 12 3. Underground, Single Run: RNC.
- 13 4. Underground, Grouped: RNC.
- 14 5. Connection to Vibrating Equipment: LFMC.
- 15 6. Boxes and Enclosures: NEMA 250, Type 3R or Type 4.

16
17
18 B. Use the following raceways for indoor installations:

- 19 1. Exposed: EMT.
- 20 2. Concealed: EMT.
- 21 3. Connection to Vibrating Equipment: FMC; except in wet or damp locations, use
22 LFMC.
- 23 4. Damp or Wet Locations: IMC.
- 24 5. Boxes and Enclosures: NEMA 250, Type 1, unless otherwise indicated.

25 26 27 3.3 RACEWAY AND CABLE INSTALLATION

28
29 A. Conceal raceways and cables, unless otherwise indicated, within finished walls, ceilings,
30 and floors.

31
32 B. Install raceways and cables at least 6 inches away from parallel runs of flues and steam
33 or hot-water pipes. Locate horizontal raceway runs above water and steam piping.

34
35 C. Use temporary raceway caps to prevent foreign matter from entering.

36
37 D. Make conduit bends and offsets so ID is not reduced. Keep legs of bends in the same
38 plane and straight legs of offsets parallel, unless otherwise indicated.

39
40 E. Use raceway and cable fittings compatible with raceways and cables and suitable for use
41 and location.

42
43 F. Install raceways embedded in slabs in middle third of slab thickness where practical, and
44 leave at least 1-inch concrete cover.

- 45 1. Secure raceways to reinforcing rods to prevent sagging or shifting during
46 concrete placement.
 - 47 2. Space raceways laterally to prevent voids in concrete.
 - 48 3. Install conduit larger than 1-inch trade size parallel to or at right angles to main
49 reinforcement. Where conduit is at right angles to reinforcement, place conduit
50 close to slab support.
 - 51 4. Transition from nonmetallic tubing to Schedule 80 nonmetallic conduit, rigid
52 steel conduit, or IMC before rising above floor.
 - 53 5. Make bends in exposed parallel or banked runs from same centerline to make
54 bends parallel. Use factory elbows only where elbows can be installed parallel;
55 otherwise, provide field bends for exposed parallel raceways.
- 56

- 1
2 G. Install pull wires in empty raceways. Use No. 14 AWG zinc-coated steel or
3 monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12
4 inches of slack at each end of the pull wire.
5
6 H. Connect motors and equipment subject to vibration, noise transmission, or movement
7 with a maximum of 72-inch flexible conduit. Install LFMC in wet or damp locations.
8 Install separate ground conductor across flexible connections.
9

10 3.4 WIRING METHODS FOR POWER, LIGHTING, AND CONTROL CIRCUITS

- 11
12 A. Feeders: **Type THHN/THWN insulated conductors in raceway.**
13
14 B. Underground Feeders and Branch Circuits: Type THWN or single-wire, Type UF
15 insulated conductors in raceway.
16
17 C. Branch Circuits: Type THHN/THWN insulated conductors in raceway.
18
19 D. Branch Circuits: Type THW or THHN/THWN insulated conductors in raceway where
20 exposed. Metal-clad cable where concealed in ceilings and gypsum board partitions.
21
22 E. Remote-Control Signaling and Power-Limited Circuits: Type THHN/THWN insulated
23 conductors in raceway for Classes 1, 2, and 3, unless otherwise indicated.
24

25 3.5 WIRING INSTALLATION

- 26
27 A. Install splices and taps that are compatible with conductor material and that possess
28 equivalent or better mechanical strength and insulation ratings than unspliced
29 conductors.
30
31 B. Install wiring at outlets with at least 12 inches of slack conductor at each outlet.
32
33 C. Connect outlet and component connections to wiring systems and to ground. Tighten
34 electrical connectors and terminals, according to manufacturer's published torque-
35 tightening values. If manufacturer's torque values are not indicated, use those specified
36 in UL 486A.
37
38 D. Existing wiring may be reused if found to be in good condition, properly sized, supported
39 and installed per code otherwise new wiring shall be installed.
40

41 3.6 ELECTRICAL SUPPORTING DEVICE APPLICATION

- 42
43 A. Damp Locations and Outdoors: Hot-dip galvanized materials or nonmetallic, U-channel
44 system components.
45
46 B. Dry Locations: Steel materials.
47
48 C. Support Clamps for PVC Raceways: Click-type clamp system.
49
50 D. Selection of Supports: Comply with manufacturer's written instructions.
51
52 E. Strength of Supports: Adequate to carry present and future loads, times a safety factor
53 of at least four; minimum of 200-lb design load.
54
55
56

1
2 3.7 SUPPORT INSTALLATION
3

- 4 A. Install support devices to securely and permanently fasten and support electrical
5 components.
6
7 B. Install individual and multiple raceway hangers and riser clamps to support raceways.
8 Provide U-bolts, clamps, attachments, and other hardware necessary for hanger
9 assemblies and for securing hanger rods and conduits.
10
11 C. Support parallel runs of horizontal raceways together on trapeze- or bracket-type
12 hangers.
13
14 D. Size supports for multiple raceway installations so capacity can be increased by a 25
15 percent minimum in the future.
16
17 E. Support individual horizontal raceways with separate, malleable-iron pipe hangers or
18 clamps.
19
20 F. Install 1/4-inch-diameter or larger threaded steel hanger rods, unless otherwise indicated.
21
22 G. Spring-steel fasteners specifically designed for supporting single conduits or tubing may
23 be used instead of malleable-iron hangers for 1-1/2-inch and smaller raceways serving
24 lighting and receptacle branch circuits above suspended ceilings and for fastening
25 raceways to slotted channel and angle supports.
26
27 H. Arrange supports in vertical runs so the weight of raceways and enclosed conductors is
28 carried entirely by raceway supports, with no weight load on raceway terminals.
29
30 I. Simultaneously install vertical conductor supports with conductors.
31
32 J. Separately support cast boxes that are threaded to raceways and used for fixture
33 support. Support sheet-metal boxes directly from the building structure or by bar
34 hangers. If bar hangers are used, attach bar to raceways on opposite sides of the box
35 and support the raceway with an approved fastener not more than 24 inches from the
36 box.
37
38 K. Install metal channel racks for mounting cabinets, panelboards, disconnect switches,
39 control enclosures, pull and junction boxes, transformers, and other devices unless
40 components are mounted directly to structural elements of adequate strength.
41
42 L. Install sleeves for cable and raceway penetrations of concrete slabs and walls unless
43 core-drilled holes are used. Install sleeves for cable and raceway penetrations of
44 masonry and fire-rated gypsum walls and of all other fire-rated floor and wall assemblies.
45 Install sleeves during erection of concrete and masonry walls.
46
47 M. Securely fasten electrical items and their supports to the building structure, unless
48 otherwise indicated. Perform fastening according to the following unless other fastening
49 methods are indicated:
50
51 1. Wood: Fasten with wood screws or screw-type nails.
52 2. Masonry: Toggle bolts on hollow masonry units and expansion bolts on solid
53 masonry units.
54 3. New Concrete: Concrete inserts with machine screws and bolts.
55 4. Existing Concrete: Expansion bolts.

5. Instead of expansion bolts, threaded studs driven by a powder charge and provided with lock washers may be used in existing concrete.
6. Steel: Welded threaded studs or spring-tension clamps on steel.
7. Field Welding: Comply with AWS D1.1.
8. Welding to steel structure may be used only for threaded studs, not for conduits, pipe straps, or other items.
9. Light Steel: Sheet-metal screws.
10. Fasteners: Select so the load applied to each fastener does not exceed 25 percent of its proof-test load.

3.8 IDENTIFICATION MATERIALS AND DEVICES

- A. Install at locations for most convenient viewing without interference with operation and maintenance of equipment.
- B. Coordinate names, abbreviations, colors, and other designations used for electrical identification with corresponding designations indicated in the Contract Documents or required by codes and standards. Use consistent designations throughout Project.
- C. Self-Adhesive Identification Products: Clean surfaces before applying.
- D. Identify raceways and cables with color banding as follows:
 1. Bands: Pretensioned, snap-around, colored plastic sleeves or colored adhesive marking tape. Make each color band 2 inches wide, completely encircling conduit, and place adjacent bands of two-color markings in contact, side by side.
 2. Band Locations: At changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.
 3. Colors: As follows:
 - a. Fire Alarm System: Red.
 - b. Security System: Blue and yellow.
 - c. Telecommunication System: Green and yellow.
- E. Tag and label circuits designated to be extended in the future. Identify source and circuit numbers in each cabinet, pull and junction box, and outlet box. Color-coding may be used for voltage and phase identification.
- F. Install continuous underground plastic markers during trench backfilling, for exterior underground power, control, signal, and communication lines located directly above power and communication lines. Locate 6 to 8 inches below finished grade. If width of multiple lines installed in a common trench or concrete envelope does not exceed 16 inches, overall, use a single line marker.
- G. Color-code 208/120-V system secondary service, feeder, and branch-circuit conductors throughout the secondary electrical system as follows:
 1. Phase A: Black.
 2. Phase B: Red.
 3. Phase C: Blue.
- H. Install warning, caution, and instruction signs where required to comply with 29 CFR, Chapter XVII, Part 1910.145, and where needed to ensure safe operation and maintenance of electrical systems and of items to which they connect. Install engraved plastic-laminated instruction signs with approved legend where instructions are needed

1 for system or equipment operation. For this project provide signage on the new and
2 existing service entrance equipment indicating that there are multiple service
3 disconnects for this facility.
4
5
6

7 3.9 UTILITY COMPANY ELECTRICITY-METERING EQUIPMENT

- 8
9 A. Install equipment according to utility company's written requirements. Provide grounding
10 and empty conduits as required by utility company.
11

12 3.10 FIRESTOPPING

- 13
14 A. Apply firestopping to cable and raceway penetrations of fire-rated floor and wall
15 assemblies to achieve fire-resistance rating of the assembly. Firestopping materials and
16 installation requirements are specified in Division 7 Section "Firestopping."
17

18 3.11 DEMOLITION

- 19
20 A. Protect existing electrical equipment and installations indicated to remain. If damaged
21 or disturbed in the course of the Work, remove damaged portions and install new
22 products of equal capacity, quality, and functionality. Any demolition that will require any
23 disruption of the electric service must be done on non business hours at a time approved
24 by the Owner.
25
26 B. Accessible Work: Remove exposed electrical equipment and installations, indicated to
27 be demolished, in their entirety.
28
29 C. Abandoned Work: Cut and remove buried raceway and wiring, indicated to be
30 abandoned in place, 2 inches below the surface of adjacent construction. Cap raceways
31 and patch surface to match existing finish.
32
33 D. Remove demolished material from Project site.
34
35 E. Remove, store, clean, reinstall, reconnect, and make operational components indicated
36 for relocation and/or reuse.
37
38 F. Remove all conduits, wiring, boxes, disconnects for all mechanical equipment and any
39 other equipment being removed. Verify all existing conditions on site before beginning
40 any work.
41

42 3.12 CUTTING AND PATCHING

- 43
44 A. Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces
45 required to permit electrical installations. Perform cutting by skilled mechanics of trades
46 involved.
47
48 B. Repair and refinish disturbed finish materials and other surfaces to match adjacent
49 undisturbed surfaces. Install new fireproofing where existing firestopping has been
50 disturbed. Repair and refinish materials and other surfaces by skilled mechanics of
51 trades involved.
52

53 3.13 FIELD QUALITY CONTROL

- 54
55 A. Inspect installed components for damage and faulty work, including the following:
56

- 1
 - 2
 - 3
 - 4
 - 5
 - 6
 - 7
 - 8
 - 9
1. Raceways.
 2. Building wire and connectors.
 3. Supporting devices for electrical components.
 4. Electrical identification.
 5. Electricity-metering components.
 6. Concrete bases.
 7. Electrical demolition.
 8. Cutting and patching for electrical construction.
 9. Touchup painting.

10
11 3.14 REFINISHING AND TOUCHUP PAINTING

- 12
13 A. Refinish and touch up paint. Paint materials and application requirements are specified
14 in Division 9 Section "Painting."
15
- 16 1. Clean damaged and disturbed areas and apply primer, intermediate, and finish
17 coats to suit the degree of damage at each location.
 - 18 2. Follow paint manufacturer's written instructions for surface preparation and for
19 timing and application of successive coats.
 - 20 3. Repair damage to galvanized finishes with zinc-rich paint recommended by
21 manufacturer.
 - 22 4. Repair damage to PVC or paint finishes with matching touchup coating
23 recommended by manufacturer.
24

25 3.15 CLEANING AND PROTECTION

- 26
27 A. On completion of installation, including outlets, fittings, and devices, inspect exposed
28 finish. Remove burrs, dirt, paint spots, and construction debris.
29
- 30 B. Protect equipment and installations and maintain conditions to ensure that coatings,
31 finishes, and cabinets are without damage or deterioration at time of Substantial
32 Completion.
33

34
35 END OF SECTION 26 05 00

SECTION 26 05 19 – LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes building wires and cables and associated connectors, splices, and terminations for wiring systems rated 600 V and less.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Qualification Data: For testing agency.
- C. Field Quality-Control Test Reports: From Contractor.

1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
- B. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers specified.
- C. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 CONDUCTORS AND CABLES

- A. Manufacturers:
 - 1. Alcan Aluminum Corporation; Alcan Cable Div.
 - 2. American Insulated Wire Corp.; a Leviton Company.
 - 3. General Cable Corporation.

- 1 4. Senator Wire & Cable Company.
2 5. Southwire Company.
3
4 B. Refer to Part 3 "Conductor and Insulation Applications" Article for insulation type, cable
5 construction, and ratings.
6
7 C. Conductor Material: Copper, except feeders No. 4 AWG and larger may be aluminum]
8 complying with NEMA WC 70; solid conductor for No. 10 AWG and smaller, stranded
9 for No. 8 AWG and larger.
10
11 D. Conductor Insulation Types: Type THW THHN-THWN complying with NEMA WC 70.
12
13 E. Multiconductor Cable: Metal-clad cable, Type MC with ground wire.
14

15 2.3 CONNECTORS AND SPLICES

- 16
17 A. Manufacturers:
18
19 1. AFC Cable Systems, Inc.
20 2. AMP Incorporated/Tyco International.
21 3. Hubbell/Anderson.
22 4. O-Z/Gedney; EGS Electrical Group LLC.
23 5. 3M Company; Electrical Products Division.
24
25 B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material,
26 type, and class for application and service indicated.
27
28 C. Insulation displacement and spring type connectors shall be limited to composite factory
29 products (ex. light fixtures) where maximum current shall be 5 amps or less or where
30 indicated on plans.
31
32

33 **PART 3 - EXECUTION**

34 3.1 CONDUCTOR AND INSULATION APPLICATIONS

- 35
36 A. Service Entrance: Type THHN-THWN, single conductors in raceway.
37
38 B. Exposed Feeders: Type THHN-THWN, single conductors in raceway.
39
40 C. Feeders Concealed in Ceilings, Walls, and Partitions: Type THHN-THWN, single
41 conductors in raceway.
42
43 D. Exposed Branch Circuits, including in Crawlspace: Type THHN-THWN, single
44 conductors in raceway.
45
46 E. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN-THWN, single
47 conductors in raceway Metal-clad cable, Type MC.
48
49 F. Fire Alarm Circuits: Type THHN-THWN, in raceway Power-limited, fire-protective,
50 signaling circuit cable.
51
52

53 3.2 INSTALLATION

- 54 A. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.
55
56

- 1 B. Use manufacturer-approved pulling compound or lubricant where necessary; compound
2 used must not deteriorate conductor or insulation. Do not exceed manufacturer's
3 recommended maximum pulling tensions and sidewall pressure values.
4
5 C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips,
6 that will not damage cables or raceway.
7
8 D. Install exposed cables parallel and perpendicular to surfaces of exposed structural
9 members, and follow surface contours where possible.
10
11 E. Support cables according to Division 26 Section "Common Work Results for Electrical."
12
13 F. Seal around cables penetrating fire-rated elements according to Division 7 Section
14 "Through-Penetration Firestop Systems."
15
16 G. Identify and color-code conductors and cables according to Division 26 Section
17 "[Common Work Results for Electrical] [Identification for Electrical Systems]."
18

19 3.3 CONNECTIONS

- 20
21 A. Tighten electrical connectors and terminals according to manufacturer's published
22 torque-tightening values. If manufacturer's torque values are not indicated, use those
23 specified in UL 486A and UL 486B.
24
25 B. Make splices and taps that are compatible with conductor material and that possess
26 equivalent or better mechanical strength and insulation ratings than unspliced
27 conductors.
28
29 1. Use oxide inhibitor in each splice and tap conductor for aluminum conductors.
30
31 C. Wiring at Outlets: Install conductor at each outlet, with at least [6 inches (150 mm)] [12
32 inches (300 mm)] of slack.
33

34 3.4 FIELD QUALITY CONTROL

- 35
36 A. Testing: Perform the following field quality-control testing:
37
38 1. After installing conductors and cables and before electrical circuitry has been
39 energized, test for compliance with requirements.
40 2. Perform each electrical test and visual and mechanical inspection stated in
41 NETA ATS, Section 7.3.1. Certify compliance with test parameters.
42
43 B. Test Reports: Prepare a written report to record the following:
44
45 1. Test procedures used.
46 2. Test results that comply with requirements.
47 3. Test results that do not comply with requirements and corrective action taken to
48 achieve compliance with requirements.
49
50

51 END OF SECTION 26 05 19

1 **SECTION 26 05 26 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS**

2
3 **PART 1 - GENERAL**

4
5 1.1 RELATED DOCUMENTS

- 6
7 A. Drawings and general provisions of the Contract, including General and Supplementary
8 Conditions and Division 1 Specification Sections, apply to this Section.
9

10 1.2 SUMMARY

- 11
12 A. This Section includes grounding of electrical systems and equipment. Grounding
13 requirements specified in this Section may be supplemented by special requirements of
14 systems described in other Sections. Include grounding as required by code for new
15 service switchboard and new mechanical equipment .
16

17 1.3 SUBMITTALS

- 18
19 A. Product Data: For each type of product indicated.
20
21 B. Product Data: For the following:
22
23 1. Not applicable.
24
25 C. Qualification Data: For firms and persons specified in "Quality Assurance" Article.
26
27 D. Field Test Reports: Submit written test reports to include the following:
28
29 1. Test procedures used.
30 2. Test results that comply with requirements.
31 3. Results of failed tests and corrective action taken to achieve test results that
32 comply with requirements.
33

34 1.4 QUALITY ASSURANCE

- 35
36 A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in
37 NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction,
38 and marked for intended use.
39
40 1. Comply with UL 467.
41
42 B. Comply with NFPA 70; for overhead-line construction and medium-voltage underground
43 construction, comply with IEEE C2.
44
45 C. Comply with NFPA 780 and UL 96 when interconnecting with lightning protection
46 system.
47
48

1 **PART 2 - PRODUCTS**

2
3 2.1 **MANUFACTURERS**

- 4
5 A. Available Manufacturers: Subject to compliance with requirements, manufacturers
6 offering products that may be incorporated into the Work include, but are not limited to,
7 the following:
8
9 B. Manufacturers: Subject to compliance with requirements, provide products by one of the
10 following:
11
12 1. Grounding Conductors, Cables, Connectors, and Rods:
13
14 a. Apache Grounding/Erico Inc.
15 b. Boggs, Inc.
16 c. Chance/Hubbell.
17 d. Copperweld Corp.
18 e. Dossert Corp.
19 f. Erico Inc.; Electrical Products Group.
20 g. Framatome Connectors/Burndy Electrical.
21 h. Galvan Industries, Inc.
22 i. Harger Lightning Protection, Inc.
23 j. Hastings Fiber Glass Products, Inc.
24 k. Heary Brothers Lightning Protection Co.
25 l. Ideal Industries, Inc.
26 m. ILSCO.
27 n. Kearney/Cooper Power Systems.
28 o. Korns: C. C. Korns Co.; Division of Robroy Industries.
29 p. Lightning Master Corp.
30 q. Lyncole XIT Grounding.
31 r. O-Z/Gedney Co.; a business of the EGS Electrical Group.
32 s. Raco, Inc.; Division of Hubbell.
33 t. Robbins Lightning, Inc.
34 u. Salisbury: W. H. Salisbury & Co.
35 v. Superior Grounding Systems, Inc.
36 w. Thomas & Betts, Electrical.

37
38 2.2 **GROUNDING CONDUCTORS**

- 39
40 A. For insulated conductors, comply with Division 26 Section "Low Voltage Electrical Power
41 Conductors and Cables."
42
43 B. Material: Aluminum, copper-clad aluminum, and copper.
44
45 C. Equipment Grounding Conductors: Insulated with green-colored insulation.
46
47 D. Isolated Ground Conductors: Insulated with green-colored insulation with yellow stripe.
48 On feeders with isolated ground, use colored tape, alternating bands of green and yellow
49 tape to provide a minimum of three bands of green and two bands of yellow.
50
51 E. Grounding Electrode Conductors: Stranded cable.
52
53 F. Underground Conductors: Bare, tinned, stranded, unless otherwise indicated.
54
55 G. Bare Copper Conductors: Comply with the following:
56

1. Solid Conductors: ASTM B 3.
 2. Assembly of Stranded Conductors: ASTM B 8.
 3. Tinned Conductors: ASTM B 33.
- H. Copper Bonding Conductors: As follows:
1. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG copper conductor, 1/4 inch (6.4 mm) in diameter.
 2. Bonding Conductor: No. 4 or No. 6 AWG, stranded copper conductor.
 3. Bonding Jumper: Bare copper tape, braided bare copper conductors, terminated with copper ferrules; 1-5/8 inches (42 mm) wide and 1/16 inch (1.5 mm) thick.
 4. Tinned Bonding Jumper: Tinned-copper tape, braided copper conductors, terminated with copper ferrules; 1-5/8 inches (42 mm) wide and 1/16 inch (1.5 mm) thick.
- I. Aluminum Bonding Conductors: As follows:
1. Bonding Cable: 10 strands of No. 14 AWG aluminum conductor, 1/4 inch (6.4 mm) in diameter.
 2. Bonding Conductor: No. 4 or No. 6 AWG, stranded aluminum conductor.
 3. Bonding Jumper: Aluminum tape, braided bare aluminum conductors, terminated with aluminum ferrules; 1-5/8 inches (42 mm) wide and 1/16 inch (1.5 mm) thick.

2.3 CONNECTOR PRODUCTS

- A. Comply with IEEE 837 and UL 467; listed for use for specific types, sizes, and combinations of conductors and connected items.
- B. Bolted Connectors: Bolted-pressure-type connectors, or compression type.
- C. Welded Connectors: Exothermic-welded type, in kit form, and selected per manufacturer's written instructions.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Use only copper conductors for both insulated and bare grounding conductors in direct contact with earth, concrete, masonry, crushed stone, and similar materials.
- B. In raceways, use insulated equipment grounding conductors.
- C. Equipment Grounding Conductor Terminations: Use bolted pressure clamps.
- D. Grounding Bus: Install in electrical and telephone equipment rooms, in rooms housing service equipment, and elsewhere as indicated.
 1. Use insulated spacer; space 1 inch (25.4 mm) from wall and support from wall 6 inches (150 mm) above finished floor, unless otherwise indicated.
 2. At doors, route the bus up to the top of the door frame, across the top of the doorway, and down to the specified height above the floor.

1 3.2 EQUIPMENT GROUNDING CONDUCTORS

- 2
- 3 A. Comply with NFPA 70, Article 250, for types, sizes, and quantities of equipment
- 4 grounding conductors, unless specific types, larger sizes, or more conductors than
- 5 required by NFPA 70 are indicated.
- 6
- 7 B. Install equipment grounding conductors in all feeders and circuits.
- 8
- 9 C. Install insulated equipment grounding conductor with circuit conductors for the following
- 10 items, in addition to those required by NEC:
- 11
- 12 1. Feeders and branch circuits.
- 13 2. Lighting circuits.
- 14 3. Receptacle circuits.
- 15 4. Single-phase motor and appliance branch circuits.
- 16 5. Three-phase motor and appliance branch circuits.
- 17 6. Flexible raceway runs.
- 18 7. Armored and metal-clad cable runs.
- 19
- 20 D. Nonmetallic Raceways: Install an equipment grounding conductor in nonmetallic
- 21 raceways unless they are designated for telephone or data cables.
- 22
- 23 E. Air-Duct Equipment Circuits: Install an equipment grounding conductor to duct-mounted
- 24 electrical devices operating at 120 V and more, including air cleaners and heaters. Bond
- 25 conductor to each unit and to air duct.
- 26

27 3.3 INSTALLATION

- 28
- 29 A. Grounding Conductors: Route along shortest and straightest paths possible, unless
- 30 otherwise indicated. Avoid obstructing access or placing conductors where they may be
- 31 subjected to strain, impact, or damage.
- 32
- 33 B. Bonding Straps and Jumpers: Install so vibration by equipment mounted on vibration
- 34 isolation hangers and supports is not transmitted to rigidly mounted equipment. Use
- 35 exothermic-welded connectors for outdoor locations, unless a disconnect-type
- 36 connection is required; then, use a bolted clamp. Bond straps directly to the basic
- 37 structure taking care not to penetrate any adjacent parts. Install straps only in locations
- 38 accessible for maintenance.
- 39
- 40 C. Bond interior metal piping systems and metal air ducts to equipment grounding
- 41 conductors of associated pumps, fans, blowers, electric heaters, and air cleaners. Use
- 42 braided-type bonding straps.
- 43

44 3.4 CONNECTIONS

- 45
- 46 A. General: Make connections so galvanic action or electrolysis possibility is minimized.
- 47 Select connectors, connection hardware, conductors, and connection methods so metals
- 48 in direct contact will be galvanically compatible.
- 49
- 50 1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to
- 51 make contact points closer to order of galvanic series.
- 52 2. Make connections with clean, bare metal at points of contact.
- 53 3. Make aluminum-to-steel connections with stainless-steel separators and
- 54 mechanical clamps.
- 55 4. Make aluminum-to-galvanized steel connections with tin-plated copper jumpers
- 56 and mechanical clamps.

- 1 5. Coat and seal connections having dissimilar metals with inert material to prevent
2 future penetration of moisture to contact surfaces.
3
4 B. Equipment Grounding Conductor Terminations: For No. 8 AWG and larger, use
5 pressure-type grounding lugs. No. 10 AWG and smaller grounding conductors may be
6 terminated with winged pressure-type connectors.
7
8 C. Noncontact Metal Raceway Terminations: If metallic raceways terminate at metal
9 housings without mechanical and electrical connection to housing, terminate each
10 conduit with a grounding bushing. Connect grounding bushings with a bare grounding
11 conductor to grounding bus or terminal in housing. Bond electrically noncontinuous
12 conduits at entrances and exits with grounding bushings and bare grounding conductors,
13 unless otherwise indicated.
14
15 D. Tighten screws and bolts for grounding and bonding connectors and terminals according
16 to manufacturer's published torque-tightening values. If manufacturer's torque values
17 are not indicated, use those specified in UL 486A [and UL 486B].
18
19 E. Compression-Type Connections: Use hydraulic compression tools to provide correct
20 circumferential pressure for compression connectors. Use tools and dies recommended
21 by connector manufacturer. Provide embossing die code or other standard method to
22 make a visible indication that a connector has been adequately compressed on
23 grounding conductor.
24

25 3.5 FIELD QUALITY CONTROL
26

- 27 A. Testing: Perform the following field quality-control testing:
28
29 1. After installing grounding system but before permanent electrical circuitry has
30 been energized, test for compliance with requirements.
31 2. Test completed grounding system at each location where a maximum ground-
32 resistance level is specified, at service disconnect enclosure grounding terminal,
33 and at ground test wells. Measure ground resistance not less than two full days
34 after the last trace of precipitation, and without the soil being moistened by any
35 means other than natural drainage or seepage and without chemical treatment
36 or other artificial means of reducing natural ground resistance. Perform tests, by
37 the fall-of-potential method according to IEEE 81.
38 3. Excessive Ground Resistance: If resistance to ground exceeds specified values,
39 notify Architect promptly and include recommendations to reduce ground
40 resistance.
41

42
43 END OF SECTION 26 05 26

1 **SECTION 26 05 33 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS**

2
3 **PART 1 - GENERAL**

4
5 1.1 RELATED DOCUMENTS

- 6
7 A. Drawings and general provisions of the Contract, including General and Supplementary
8 Conditions and Division 1 Specification Sections, apply to this Section.
9

10 1.2 SUMMARY

- 11
12 A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical
13 wiring.
14
15 B. Related Sections include the following:
16
17 1. Division 7 Section "Through-Penetration Firestop Systems" for firestopping
18 materials and installation at penetrations through walls, ceilings, and other fire-
19 rated elements.
20 2. Division 26 Section "Common Work Results for Electrical" for supports, anchors,
21 and identification products.
22 3. Division 26 Section "Wiring Devices" for devices installed in boxes and for floor-
23 box service fittings.
24

25 1.3 DEFINITIONS

- 26
27 A. EMT: Electrical metallic tubing.
28
29 B. ENT: Electrical nonmetallic tubing.
30
31 C. FMC: Flexible metal conduit.
32
33 D. IMC: Intermediate metal conduit.
34
35 E. LFMC: Liquidtight flexible metal conduit.
36
37 F. LFNC: Liquidtight flexible nonmetallic conduit.
38
39 G. RNC: Rigid nonmetallic conduit.
40

41 1.4 SUBMITTALS

- 42
43 A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover
44 enclosures, and cabinets.
45
46 B. Shop Drawings: Show fabrication and installation details of components for raceways,
47 fittings, boxes, enclosures, and cabinets.
48
49 C. Shop Drawings: Signed and sealed by a qualified professional engineer.
50

- 1 1. Detail assemblies and indicate dimensions, weights, loads, required clearances,
2 method of field assembly, components, and location and size of each field
3 connection.
4
5 D. Coordination Drawings: Reflected ceiling plans drawn to scale and coordinating
6 penetrations and ceiling-mounted items. Show the following:
7
8 1. Ceiling suspension assembly members.
9 2. Method of attaching hangers to building structure.
10 3. Size and location of initial access modules for acoustical tile.
11 4. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers,
12 sprinklers, access panels, and special moldings.
13
14 1.5 QUALITY ASSURANCE
15
16 A. Comply with NFPA 70.
17
18 1.6 COORDINATION
19
20 A. Coordinate layout and installation of raceways, boxes, enclosures, cabinets, and
21 suspension system with other construction that penetrates ceilings or is supported by
22 them, including light fixtures, HVAC equipment, fire-suppression system, and partition
23 assemblies.
24
25

26 **PART 2 - PRODUCTS**

- 27
28 2.1 MANUFACTURERS
29
30 A. In other Part 2 articles where subparagraph titles below introduce lists, the following
31 requirements apply for product selection:
32
33 1. Available Manufacturers: Subject to compliance with requirements,
34 manufacturers offering products that may be incorporated into the Work include,
35 but are not limited to, the manufacturers specified.
36 2. Manufacturers: Subject to compliance with requirements, provide products by
37 the manufacturers specified.
38
39 2.2 METAL CONDUIT AND TUBING
40
41 A. Manufacturers:
42
43 1. AFC Cable Systems, Inc.
44 2. Alflex Inc.
45 3. Anamet Electrical, Inc.; Anaconda Metal Hose.
46 4. Electri-Flex Co.
47 5. Grinnell Co./Tyco International; Allied Tube and Conduit Div.
48 6. LTV Steel Tubular Products Company.
49 7. Manhattan/CDT/Cole-Flex.
50 8. O-Z Gedney; Unit of General Signal.
51 9. Wheatland Tube Co.
52
53 B. Rigid Steel Conduit: ANSI C80.1.
54
55 C. Aluminum Rigid Conduit: ANSI C80.5.
56

- 1 D. IMC: ANSI C80.6.
- 2
- 3 E. Plastic-Coated Steel Conduit and Fittings: NEMA RN 1.
- 4
- 5 F. Plastic-Coated IMC and Fittings: NEMA RN 1.
- 6
- 7 G. EMT and Fittings: ANSI C80.3.
- 8
- 9 1. Fittings: Set-screw or compression type.
- 10 2. Fittings: All steel, set screw, water tight, concrete tight. Insulated throat
- 11 connectors. No push-on or indenter types permitted. Conduit Bodies: All steel
- 12 threaded conduit bodies.
- 13
- 14 H. FMC: Zinc-coated steel.
- 15
- 16 I. LFMC: Flexible steel conduit with PVC jacket.
- 17
- 18 J. Fittings: NEMA FB 1; compatible with conduit and tubing materials.
- 19

20 2.3 NONMETALLIC CONDUIT AND TUBING

- 21 A. Manufacturers:
- 22
- 23 1. American International.
- 24 2. Anamet Electrical, Inc.; Anaconda Metal Hose.
- 25 3. Arnco Corp.
- 26 4. Cantex Inc.
- 27 5. Certainteed Corp.; Pipe & Plastics Group.
- 28 6. Condux International.
- 29 7. ElecSYS, Inc.
- 30 8. Electri-Flex Co.
- 31 9. Lamson & Sessions; Carlon Electrical Products.
- 32 10. Manhattan/CDT/Cole-Flex.
- 33 11. RACO; Division of Hubbell, Inc.
- 34 12. Spiralduct, Inc./AFC Cable Systems, Inc.
- 35 13. Thomas & Betts Corporation.
- 36

- 37 B. ENT: NEMA TC 13.
- 38
- 39 C. RNC: NEMA TC 2, Schedule 40 and Schedule 80 PVC.
- 40
- 41 D. ENT and RNC Fittings: NEMA TC 3; match to conduit or tubing type and material.
- 42
- 43 E. LFNC: UL 1660.
- 44

45 2.4 METAL WIREWAYS

- 46 A. Manufacturers:
- 47
- 48 1. Hoffman.
- 49 2. Square D.
- 50
- 51 B. Material and Construction: Sheet metal sized and shaped as indicated, NEMA [1] [3R].
- 52
- 53
- 54

- 1 C. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters,
2 hold-down straps, end caps, and other fittings to match and mate with wireways as
3 required for complete system.
4
5 D. Select features, unless otherwise indicated, as required to complete wiring system and to
6 comply with NFPA 70.
7
8 E. Wireway Covers: [Hinged type] [Screw-cover type] [Flanged-and-gasketed type] [As
9 indicated].
10
11 F. Finish: Manufacturer's standard enamel finish.

12
13 2.5 SURFACE RACEWAYS

- 14
15 A. Surface Metal Raceways: Galvanized steel with snap-on covers. Finish with
16 manufacturer's standard prime coating .
17
18 1. Manufacturers:
19
20 a. Airey-Thompson Sentinel Lighting; Wiremold Company (The).
21 b. Thomas & Betts Corporation.
22 c. Walker Systems, Inc.; Wiremold Company (The).
23 d. Wiremold Company (The); Electrical Sales Division.
24
25 B. Types, sizes, and channels as indicated and required for each application, with fittings
26 that match and mate with raceways.
27

28 2.6 BOXES, ENCLOSURES, AND CABINETS

- 29
30 A. Manufacturers:
31
32 1. Cooper Crouse-Hinds; Div. of Cooper Industries, Inc.
33 2. Emerson/General Signal; Appleton Electric Company.
34 3. Erickson Electrical Equipment Co.
35 4. Hoffman.
36 5. Hubbell, Inc.; Killark Electric Manufacturing Co.
37 6. O-Z/Gedney; Unit of General Signal.
38 7. RACO; Division of Hubbell, Inc.
39 8. Robroy Industries, Inc.; Enclosure Division.
40 9. Scott Fetzer Co.; Adalet-PLM Division.
41 10. Spring City Electrical Manufacturing Co.
42 11. Thomas & Betts Corporation.
43 12. Walker Systems, Inc.; Wiremold Company (The).
44 13. Woodhead, Daniel Company; Woodhead Industries, Inc. Subsidiary.
45 14. Strongwell Corp.
46
47 B. Sheet Metal Outlet and Device Boxes: NEMA OS 1.
48
49 C. Cast-Metal Outlet and Device Boxes: NEMA FB 1, Type FD, with gasketed cover.
50
51 D. Nonmetallic Outlet and Device Boxes: NEMA OS 2.
52
53 E. Floor Boxes: Cast metal, fully adjustable, rectangular.
54
55 F. Floor Boxes: Nonmetallic, nonadjustable, round.
56

1 G. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

2
3 2.7 FACTORY FINISHES

4
5 A. Finish: For raceway, enclosure, or cabinet components, provide manufacturer's
6 standard prime-coat finish ready for field painting.

7
8 B. Finish: For raceway, enclosure, or cabinet components, provide manufacturer's
9 standard paint applied to factory-assembled surface raceways, enclosures, and cabinets
10 before shipping.

11
12
13 **PART 3 - EXECUTION**

14
15 3.1 RACEWAY APPLICATION

16
17 A. Outdoors:

- 18
19 1. Exposed: Rigid steel or IMC.
20 2. Concealed: Rigid steel or IMC.
21 3. Underground, Single Run: RNC.
22 4. Underground, Grouped: RNC.
23 5. Connection to Vibrating Equipment (Including Transformers and Hydraulic,
24 Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
25 6. Boxes and Enclosures: NEMA 250, Type **3R**.

26
27 B. Indoors:

- 28
29 1. Exposed: EMT.
30 2. Concealed: EMT.
31 3. Connection to Vibrating Equipment (Including Transformers and Hydraulic,
32 Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC; except use
33 LFMC in damp or wet locations.
34 4. Damp or Wet Locations: Rigid steel conduit.
35 5. Boxes and Enclosures: NEMA 250, Type 1, except as follows:

36
37 a. Damp or Wet Locations: NEMA 250, Type 4, nonmetallic.

38
39 C. Minimum Raceway Size: 1/2-inch trade size (DN 16).

40
41 D. Raceway Fittings: Compatible with raceways and suitable for use and location.

- 42
43 1. Intermediate Steel Conduit: Use threaded rigid steel conduit fittings, unless
44 otherwise indicated.
45 2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings approved for use
46 with that material. Patch all nicks and scrapes in PVC coating after installing
47 conduits.

48
49 E. Install nonferrous conduit or tubing for circuits operating above 60 Hz. Where aluminum
50 raceways are installed for such circuits and pass through concrete, install in nonmetallic
51 sleeve.

52
53 F. Do not install aluminum conduits embedded in or in contact with concrete.
54
55
56

1 3.2 INSTALLATION

- 2
- 3 A. Keep raceways at least 6 inches (150 mm) away from parallel runs of flues and steam or
- 4 hot-water pipes. Install horizontal raceway runs above water and steam piping.
- 5
- 6 B. Complete raceway installation before starting conductor installation.
- 7
- 8 C. Support raceways as specified in Division 26 Section "Common Work Results for
- 9 Electrical." Provide new supports from the structure for any existing raceways that are
- 10 presently supported by any existing ceiling system components that is being removed to
- 11 accommodate the installation of the new mechanical systems.
- 12
- 13 D. Provide new heavywall galvanized steel conduits in the new postlight concrete bases
- 14 being installed.
- 15
- 16 E. Install temporary closures to prevent foreign matter from entering raceways.
- 17
- 18 F. Protect stub-ups from damage where conduits rise through floor slabs. Arrange so
- 19 curved portions of bends are not visible above the finished slab.
- 20
- 21 G. Make bends and offsets so ID is not reduced. Keep legs of bends in the same plane and
- 22 keep straight legs of offsets parallel, unless otherwise indicated.
- 23
- 24 H. Conceal conduit and EMT within finished walls, ceilings, and floors, unless otherwise
- 25 indicated.
- 26
- 27 1. Install concealed raceways with a minimum of bends in the shortest practical
- 28 distance, considering type of building construction and obstructions, unless
- 29 otherwise indicated.
- 30
- 31 I. Install exposed raceways parallel or at right angles to nearby surfaces or structural
- 32 members and follow surface contours as much as possible.
- 33
- 34 1. Run parallel or banked raceways together on common supports.
- 35 2. Make parallel bends in parallel or banked runs. Use factory elbows only where
- 36 elbows can be installed parallel; otherwise, provide field bends for parallel
- 37 raceways.
- 38
- 39 J. Join raceways with fittings designed and approved for that purpose and make joints tight.
- 40
- 41 1. Use insulating bushings to protect conductors.
- 42
- 43 K. Tighten set screws of threadless fittings with suitable tools.
- 44
- 45 L. Terminations:
- 46
- 47 1. Where raceways are terminated with locknuts and bushings, align raceways to
- 48 enter squarely and install locknuts with dished part against box. Use two
- 49 locknuts, one inside and one outside box.
- 50 2. Where raceways are terminated with threaded hubs, screw raceways or fittings
- 51 tightly into hub so end bears against wire protection shoulder. Where chase
- 52 nipples are used, align raceways so coupling is square to box; tighten chase
- 53 nipple so no threads are exposed.
- 54

- 1 M. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with
2 not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack
3 at each end of pull wire.
4
- 5 N. Install raceway sealing fittings at suitable, approved, and accessible locations and fill
6 them with UL-listed sealing compound. For concealed raceways, install each fitting in a
7 flush steel box with a blank cover plate having a finish similar to that of adjacent plates
8 or surfaces. Install raceway sealing fittings at the following points:
9
- 10 1. Where conduits pass from warm to cold locations, such as boundaries of
11 refrigerated spaces.
12 2. Where otherwise required by NFPA 70.
13
- 14 O. Stub-up Connections: Extend conduits through concrete floor for connection to
15 freestanding equipment. Install with an adjustable top or coupling threaded inside for
16 plugs set flush with finished floor. Extend conductors to equipment with rigid steel
17 conduit; FMC may be used 6 inches (150 mm) above the floor. Install screwdriver-
18 operated, threaded plugs flush with floor for future equipment connections.
19
- 20 P. Flexible Connections: Use maximum of 72 inches (1830 mm) of flexible conduit for
21 recessed and semirecessed lighting fixtures; for equipment subject to vibration, noise
22 transmission, or movement; and for all motors. Use LFMC in damp or wet locations.
23 Install separate ground conductor across flexible connections.
24
- 25 Q. Surface Raceways: Install a separate, green, ground conductor in raceways from
26 junction box supplying raceways to receptacle or fixture ground terminals.
27
- 28 R. Set floor boxes level and flush with finished floor surface.
29
- 30 S. Set floor boxes level. Trim after installation to fit flush with finished floor surface.
31
- 32 T. Install hinged-cover enclosures and cabinets plumb. Support at each corner.
33
- 34 U. Existing conduits. Where existing unused conduits are found to be in good condition,
35 properly supported and of code complying size they may be reused.
36
37

38 3.3 PROTECTION

- 39 A. Provide final protection and maintain conditions that ensure coatings, finishes, and
40 cabinets are without damage or deterioration at time of Substantial Completion.
41
- 42 1. Repair damage to galvanized finishes with zinc-rich paint recommended by
43 manufacturer.
44 2. Repair damage to PVC or paint finishes with matching touchup coating
45 recommended by manufacturer.
46
47

48 3.4 CLEANING

- 49 A. After completing installation of exposed, factory-finished raceways and boxes, inspect
50 exposed finishes and repair damaged finishes.
51
52
53

54 END OF SECTION 26 05 33

1 **SECTION 26 24 13 - SWITCHBOARDS**

2
3 **PART 1 - GENERAL**

4
5 1.1 RELATED DOCUMENTS

- 6
7 A. Drawings and general provisions of the Contract, including General and Supplementary
8 Conditions and Division 1 Specification Sections, apply to this Section.
9

10 1.2 SUMMARY

- 11
12 A. This Section includes service and distribution switchboards rated 600 V and less. The
13 new switchboard will be purchased directly by Owner who will have it delivered to the
14 site where the EC will install in place and complete the installation including all
15 connections, grounding etc.
16 B. Related Sections include the following:
17
18 1. Division 26 Section "Fuses."
19 2. Division 26 Section "Electrical Power Monitoring and Control."
20

21 1.3 DEFINITIONS

- 22
23 A. EMI: Electromagnetic interference.
24
25 B. GFCI: Ground-fault circuit interrupter.
26
27 C. RFI: Radio-frequency interference.
28
29 D. RMS: Root mean square.
30
31 E. SPDT: Single pole, double throw.
32
33 F. TVSS: Transient voltage surge suppressor.
34

35 1.4 SUBMITTALS

- 36
37 A. Product Data: To be provided by Owners equipment supplier. For switchboard,
38 overcurrent protective devices, TVSS device, and components indicated. Include
39 dimensions and manufacturers' technical data on features, performance, electrical
40 characteristics, ratings, and finishes.
41
42 B. Shop Drawings: For each switchboard and related equipment. To be provided by the
43 Owner.
44
45 1. Dimensioned plans, elevations, sections, and details, including required
46 clearances and service space around equipment. Show tabulations of installed
47 devices, equipment features, and ratings. Include the following:
48
49 a. Enclosure types and details for types other than NEMA 250, Type 1.
50 b. Bus configuration, current, and voltage ratings.
51 c. Short-circuit current rating of switchboards and overcurrent protective
52 devices.

- 1 d. Descriptive documentation of optional barriers specified for electrical
2 insulation and isolation.
- 3 e. Utility company's metering provisions with indication of approval by
4 utility company.
- 5 f. UL listing for series rating of installed devices.
- 6 g. Features, characteristics, ratings, and factory settings of individual
7 overcurrent protective devices and auxiliary components.
- 8
- 9 2. Wiring Diagrams: Diagram power, signal, and control wiring and differentiate
10 between manufacturer-installed and field-installed wiring.
- 11
- 12 C. Maintenance Data: For switchboards and components to include in maintenance
13 manuals specified in Division 1. In addition to requirements specified in Division 1
14 Section Operation and Maintenance Data," include the following:
- 15
- 16 1. Routine maintenance requirements for switchboards and all installed
17 components.
- 18 2. Manufacturer's written instructions for testing and adjusting overcurrent
19 protective devices.
- 20 3. Time-current curves, including selectable ranges for each type of overcurrent
21 protective device.
- 22
- 23 1.5 QUALITY ASSURANCE
- 24
- 25 A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in
26 NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction,
27 and marked for intended use.
- 28
- 29 B. Comply with NEMA PB 2.
- 30
- 31 C. Comply with NFPA 70.
- 32
- 33 D. Product Selection for Restricted Space: Drawings indicate maximum dimensions for
34 switchboards, including clearances between switchboards, and adjacent surfaces and
35 other items. Comply with indicated maximum dimensions.
- 36
- 37 1.6 DELIVERY, STORAGE, AND HANDLING
- 38
- 39 A. Deliver in sections of lengths that can be moved past obstructions in delivery path.
- 40
- 41 B. Store indoors in clean dry space with uniform temperature to prevent condensation.
42 Protect from exposure to dirt, fumes, water, corrosive substances, and physical damage.
- 43
- 44 C. If stored in areas subjected to weather, cover switchboards to provide protection from
45 weather, dirt, dust, corrosive substances, and physical damage. Remove loose packing
46 and flammable materials from inside switchboards; install electric heating (250-W per
47 section) to prevent condensation.
- 48
- 49 D. Handle switchboards according to NEMA PB 2.1.
- 50
- 51 1.7 PROJECT CONDITIONS
- 52
- 53 A. Installation Pathway: Remove and replace access fencing, doors, lift-out panels, and
54 structures to provide pathway for moving switchboards into place.
- 55

1 B. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others
2 unless permitted under the following conditions and then only after arranging to provide
3 temporary utility services according to requirements indicated:
4

- 5 1. Notify Architect not less than seven days in advance of proposed utility
6 interruptions. Identify extent and duration of utility interruptions.
- 7 2. Indicate method of providing temporary utilities.
- 8 3. Proceed with utility interruptions only after receiving Architect's written
9 authorizations.
- 10 4. Installation of new switchboard shall be done on non-business hours so that
11 building is kept in operation during regular business hours. All work shall be
12 scheduled at times approved by Owner.

13 14 1.8 COORDINATION

15
16 A. Coordinate layout and installation of switchboards and components with other
17 construction, including conduit, piping, equipment, and adjacent surfaces. Maintain
18 required workspace clearances and required clearances for equipment access doors and
19 panels. Existing switchboard being replaced shall be removed and new switchboard
20 installed with all work and material required for a complete installation shall be included.
21

22 B. Install new switchboard on existing concrete base, modify as required.
23
24

25 **PART 2 - PRODUCT**

26 27 2.1 MANUFACTURERS

28 A. To be determined by the Owner
29
30

31 2.2 MANUFACTURED UNITS

32
33 A. Front-Connected, Front-Accessible Switchboard: Panel-mounted main device, panel-
34 mounted branches, and sections rear aligned.
35

- 36 1. Main Devices: Fixed, individually mounted.
- 37 2. Branch Devices: Panel and fixed, individually mounted.
38

39 B. Nominal System Voltage: 208 Y/120 V.
40

41 C. Main-Bus Continuous: 2000 amp.
42

43 2.3 FABRICATION AND FEATURES

44
45 A. Enclosure Finish for Indoor Units: Factory-applied finish in manufacturer's standard gray
46 finish over a rust-inhibiting primer on treated metal surface.
47

48 B. Barriers: Between adjacent switchboard sections.
49

50 C. Utility Metering Compartment: Fabricated compartment and section complying with
51 utility company's requirements. If separate vertical section is required for utility
52 metering, match and align with basic switchboard.
53

54 D. Bus Transition and Incoming Pull Sections: Matched and aligned with basic switchboard.
55

- 1 E. Hinged Front Panels: Allow access to circuit-breaker, metering, accessory, and blank
2 compartments.
3
- 4 F. Pull Box on Top of Switchboard: Include the following features:
5
6 1. Adequate ventilation to maintain temperature in pull box within same limits as
7 switchboard.
8 2. Set back from front to clear circuit-breaker removal mechanism.
9 3. Removable covers shall form top, front, and sides. Top covers at rear shall be
10 easily removable for drilling and cutting.
11 4. Bottom shall be insulating, fire-resistive material with separate holes for cable
12 drops into switchboard.
13 5. Cable supports shall be arranged to facilitate cabling and adequate to support
14 cables indicated, including those for future installation.
15
- 16 G. Buses and Connections: Three phase, four wire, unless otherwise indicated. Include the
17 following features:
18
19 1. Phase- and Neutral-Bus Material: Hard-drawn copper of 98 percent conductivity
20 with feeder circuit-breaker line connections.
21 2. Phase- and Neutral-Bus Material: Tin-plated, high-strength, electrical-grade
22 aluminum alloy with copper or tin-plated, aluminum circuit-breaker line
23 connections.
24 3. Phase- and Neutral-Bus Material: Hard-drawn copper of 98 percent conductivity
25 or tin-plated, high-strength, electrical-grade aluminum alloy.
26
27 a. If bus is aluminum, use copper or tin-plated aluminum for circuit-breaker
28 line connections.
29 b. If bus is copper, use copper for feeder circuit-breaker line connections.
30
31 4. Load Terminals: Insulated, rigidly braced, silver-plated, copper runback bus
32 extensions equipped with pressure connectors for outgoing circuit conductors.
33 Provide load terminals for future circuit-breaker positions at full ampere rating of
34 circuit-breaker position.
35 5. Ground Bus: 1/4-by-2-inch minimum size, drawn-temper copper of 98 percent
36 conductivity, equipped with pressure connectors for feeder and branch-circuit
37 ground conductors. For busway feeders, extend insulated equipment grounding
38 cable to busway ground connection and support cable at intervals in vertical run.
39 6. Contact Surfaces of Buses: Silver plated.
40 7. Main Phase Buses, Neutral Buses, and Equipment Ground Buses: Uniform
41 capacity for entire length of switchboard's main and distribution sections.
42 Provide for future extensions from both ends.
43 8. Isolation Barrier Access Provisions: Permit checking of bus-bolt tightness.
44 9. Neutral Buses: 50 percent of the ampacity of the phase buses, unless otherwise
45 indicated, equipped with pressure connectors for outgoing circuit neutral cables.
46 Bus extensions for busway feeder neutral bus is braced.
47 10. Neutral Buses: 100 percent of the ampacity of the phase buses, unless
48 otherwise indicated, equipped with pressure connectors for outgoing circuit
49 neutral cables. Bus extensions for busway feeder neutral bus is braced.
50
- 51 H. Future Devices: Equip compartments with mounting brackets, supports, bus
52 connections, and appurtenances at full rating of circuit-breaker compartment.
53
- 54 I. Bus-Bar Insulation: Factory-applied, flame-retardant, 105 deg C minimum tape
55 wrapping of individual bus bars or flame-retardant, spray-applied insulation of same
56 temperature rating.

1
2 2.4 TVSS DEVICES
3

- 4 A. IEEE C62.41, integrally mounted, plug-in style, solid-state, parallel-connected, sine-wave
5 tracking suppression and filtering modules.
6
7 B. Minimum single-impulse current rating shall be as follows:
8
9 1. Line to Neutral: 100,000 A.
10 2. Line to Ground: 100,000 A.
11 3. Neutral to Ground: 50,000 A.
12
13 C. Protection modes shall be as follows:
14
15 1. Line to neutral.
16 2. Line to ground.
17 3. Neutral to ground.
18
19 D. EMI/RFI Noise Attenuation Using 50-ohm Insertion Loss Test: 55 dB at 100 kHz.
20
21 E. Category C combination wave clamping voltage shall not exceed [600 V, line to neutral
22 and line to ground on 120/208 V systems] [1000 V, line to neutral and line to ground on
23 277/480 V systems].
24
25 F. UL 1449 clamping levels shall not exceed [400 V, line to neutral and line to ground on
26 120/208 V systems] [800 V, line to neutral and line to ground on 277/480 V systems].
27
28 G. Withstand Capabilities: 1000 Category C surges with less than 5 percent change in
29 clamping voltage.
30
31 H. Accessories shall include the following:
32
33 1. Form-C contacts, one normally open and one normally closed, for remote
34 monitoring of system operation. Contacts to reverse position on failure of any
35 surge diversion module.
36 2. Audible alarm activated on failure of any surge diversion module.
37 3. Six-digit transient-counter set to totalize transient surges that deviate from the
38 sine-wave envelope by more than 125 V.
39

40 2.5 OVERCURRENT PROTECTIVE DEVICES
41

- 42 A. Molded-Case Circuit Breaker: NEMA AB 1, with interrupting capacity to meet available
43 fault currents.
44
45 1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level
46 overloads, and instantaneous magnetic trip element for short circuits.
47 Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
48
49 B. Molded-Case Circuit-Breaker Features and Accessories: Standard frame sizes, trip
50 ratings, and number of poles.
51
52 1. Lugs: Compression style, suitable for number, size, trip ratings, and material of
53 conductors.
54 2. Application Listing: Appropriate for application; Type SWD for switching
55 fluorescent lighting loads; Type HACR for heating, air-conditioning, and
56 refrigerating equipment.

- 1 3. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage [without
2 intentional] [with field-adjustable 0.1- to 0.6-second] time delay.

3
4 2.6 IDENTIFICATION

- 5
6 A. Provide engraved nameplates for each breaker to identify load served.
7

8
9 **PART 3 - EXECUTION**

10
11 3.1 PROTECTION

- 12
13 A. Temporary Heating: Apply temporary heat to maintain temperature according to
14 manufacturer's written instructions.

15
16 3.2 EXAMINATION

- 17
18 A. Examine elements and surfaces to receive switchboards for compliance with installation
19 tolerances and other conditions affecting performance.

- 20
21 1. Proceed with installation only after unsatisfactory conditions have been
22 corrected.

23
24 3.3 INSTALLATION

- 25
26 A. Remove existing switchboard equipment after new equipment is on site and at a time
27 when installation can be done without interruption to the normal working hours.
28 Coordinate and schedule all work with Owner and Architect.

- 29
30 B. Install switchboards and accessories according to NEMA PB 2.1.

- 31
32 C. Support switchboards on concrete bases, 4-inch nominal thickness. Modify existing base
33 as required. Verify that existing base is adequate to accept the new switchboard. Modify
34 or replace existing base as required.

- 35
36 D. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets
37 and temporary blocking of moving parts from switchboard units and components.

- 38
39 E. Operating Instructions: Frame and mount the printed basic operating instructions for
40 switchboards, including control and key interlocking sequences and emergency
41 procedures. Fabricate frame of finished wood or metal and cover instructions with clear
42 acrylic plastic. Mount on front of switchboards.
43

44 3.4 IDENTIFICATION

- 45
46 A. Identify field-installed conductors, interconnecting wiring, and components; provide
47 warning signs as specified in Division 16 Section "Common Work Results for Electrical."

- 48
49 B. Switchboard Nameplates: Label each switchboard compartment with engraved metal or
50 laminated-plastic nameplate mounted with corrosion-resistant screws.

51
52 3.5 CONNECTIONS

- 53
54 A. Install equipment grounding connections for switchboards with ground continuity to main
55 electrical ground bus.
56

- 1 B. Tighten electrical connectors and terminals according to manufacturer's published
2 torque-tightening values. If manufacturer's torque values are not indicated, use those
3 specified in UL 486A and UL 486B.
4

5 3.6 FIELD QUALITY CONTROL
6

- 7 A. Prepare for acceptance tests as follows:
8

- 9 1. Test insulation resistance for each switchboard bus, component, connecting
10 supply, feeder, and control circuit.
11 2. Test continuity of each circuit.
12

- 13 B. Testing: After installing switchboards and after electrical circuitry has been energized,
14 demonstrate product capability and compliance with requirements.
15

- 16 1. Procedures: Perform each visual and mechanical inspection and electrical test
17 indicated in NETA ATS, Sections 7.1, 7.5, 7.6, 7.9, 7.10, 7.11, and 7.14 as
18 appropriate. Certify compliance with test parameters.
19 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate
20 compliance; otherwise, replace with new units and retest.
21

- 22 C. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final
23 Acceptance, perform an infrared scan of each switchboard. Remove [front] [front and
24 rear] panels so joints and connections are accessible to portable scanner.
25

- 26 1. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of
27 each switchboard 11 months after date of Substantial Completion.
28 2. Instrument: Use an infrared scanning device designed to measure temperature
29 or to detect significant deviations from normal values. Provide calibration record
30 for device.
31 3. Record of Infrared Scanning: Prepare a certified report that identifies
32 switchboards checked and that describes scanning results. Include notation of
33 deficiencies detected, remedial action taken, and observations after remedial
34 action.
35

36 3.7 ADJUSTING
37

- 38 A. Set field-adjustable switches and circuit-breaker trip ranges.
39

40 3.8 CLEANING
41

- 42 A. On completion of installation, inspect interior and exterior of switchboards. Remove
43 paint splatters and other spots. Vacuum dirt and debris; do not use compressed air to
44 assist in cleaning. Repair exposed surfaces to match original finish.
45

46
47 END OF SECTION 26 24 13

1 **SECTION 26 24 16 - PANELBOARDS**

2
3 **PART 1 - GENERAL**

4
5 1.1 RELATED DOCUMENTS

- 6
7 A. Drawings and general provisions of the Contract, including General and Supplementary
8 Conditions and Division 1 Specification Sections, apply to this Section.
9

10 1.2 SUMMARY

- 11
12 A. This Section includes the revisions to existing panelboards to accommodate the work for
13 this project.
14

15 1.3 DEFINITIONS

- 16
17 A. EMI: Electromagnetic interference.
18
19 B. GFCI: Ground-fault circuit interrupter.
20
21 C. RFI: Radio-frequency interference.
22
23 D. RMS: Root mean square.
24
25 E. SPDT: Single pole, double throw.
26
27 F. TVSS: Transient voltage surge suppressor.
28

29 1.4 SUBMITTALS

- 30
31 A. Product Data: For each type of panelboard overcurrent protective device, TVSS device,
32 accessory, and component indicated. Include dimensions and manufacturers' technical
33 data on features, performance, electrical characteristics, ratings, and finishes.
34
35 B. Shop Drawings: For each panelboard and related equipment.
36
37 a. Circuit breakers that match existing equipment on site.
38
39 C. Panelboard Schedules: For installation in panelboards. Provide new schedules that
40 reflect all of the revisions done for this project.
41

42
43 1.5 QUALITY ASSURANCE

- 44
45 A. Comply with NFPA 70.
46

47 1.6 COORDINATION

- 48
49 A. Coordinate layout and installation of panelboards and components with other
50 construction that penetrates walls or is supported by them, including electrical and other
51 types of equipment, raceways, piping, and encumbrances to workspace clearance
52 requirements.
53

1
2 **PART 2 - PRODUCTS**
3

4 2.1 MANUFACTURERS
5

- 6 A. Match existing equipment on site.
7

8 2.2 PANELBOARD SHORT-CIRCUIT RATING
9

- 10 A. Fully rated to interrupt symmetrical short-circuit current available at terminals.
11

12 2.3 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS
13

- 14 A. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without
15 disturbing adjacent units. Match existing.
16

17 2.4 OVERCURRENT PROTECTIVE DEVICES
18

- 19 A. Molded-Case Circuit Breaker: NEMA AB 1, with interrupting capacity to meet available
20 fault currents. Match existing equipment on site.
21
22

23 **PART 3 - EXECUTION**
24

25 3.1 INSTALLATION
26

- 27 A. Install panelboards and accessories according to NEMA PB 1.1.
28
29 B. Mounting Heights: Top of trim 74 inches above finished floor, unless otherwise
30 indicated.
31
32 C. Circuit Directory: Create a new directory to indicate installed circuit loads after balancing
33 panelboard loads. Replace existing. Obtain approval before installing. Use a computer
34 or typewriter to create directory; handwritten directories are not acceptable.
35
36 D. Install filler plates in unused spaces.
37
38 E. Revised existing panelboards to accommodate new equipment being added. Provide
39 new circuit breakers as required that match existing equipment.
40

41 3.2 IDENTIFICATION
42

- 43 A. Identify field-installed conductors, interconnecting wiring, and components; provide
44 warning signs as specified in Division 26 Section "[Common Work Results for Electrical]
45 [Identification for Electrical Systems]."
46
47 B. Panelboard Nameplates: Label each panelboard with engraved metal or laminated-
48 plastic nameplate mounted with corrosion-resistant screws. Revise circuit directories
49 and provide new typed directories in each existing panel affected by remodeling.
50

51 3.3 CONNECTIONS
52

- 53 A. Identify field-installed conductors, interconnecting wiring, and components; provide
54 warning signs as specified in Division 26 Section "[Common Work Results for Electrical]
55 [Identification for Electrical Systems]."
56

1
2 3.4 FIELD QUALITY CONTROL
3

- 4 A. Prepare for acceptance tests as follows:
5
6 1. Test insulation resistance for each panelboard bus, component, connecting
7 supply, feeder, and control circuit.
8 2. Test continuity of each circuit.
9
10 B. Testing: After installing panelboards and after electrical circuitry has been energized,
11 demonstrate product capability and compliance with requirements.
12
13 C. Procedures: Perform each visual and mechanical inspection and electrical test indicated
14 in NETA ATS, Section 7.5 for switches and Section 7.6 for molded-case circuit breakers.
15 Certify compliance with test parameters.
16 D. Correct malfunctioning units on-site, where possible, and retest to demonstrate
17 compliance; otherwise, replace with new units and retest.
18
19 E. Balancing Loads: After Substantial Completion, but not more than 60 days after Final
20 Acceptance, measure load balancing and make circuit changes as follows:
21
22 F. Measure as directed during period of normal system loading.
23
24 G. Perform load-balancing circuit changes outside normal occupancy/working schedule of
25 the facility and at time directed. Avoid disrupting critical 24-hour services such as fax
26 machines and on-line data-processing, computing, transmitting, and receiving
27 equipment.
28
29 H. After circuit changes, recheck loads during normal load period. Record all load readings
30 before and after changes and submit test records.
31
32 I. Tolerance: Difference exceeding 20 percent between phase loads, within a panelboard,
33 is not acceptable. Rebalance and recheck as necessary to meet this minimum
34 requirement.
35
36 J. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final
37 Acceptance, perform an infrared scan of each panelboard. Remove panel fronts so
38 joints and connections are accessible to portable scanner.
39
40 K. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each
41 panelboard 11 months after date of Substantial Completion.
42

43 3.5 ADJUSTING
44

- 45 A. Set field-adjustable switches and circuit-breaker trip ranges.
46

47 3.6 CLEANING
48

- 49 A. On completion of installation, inspect interior and exterior of panelboards. Remove paint
50 splatters and other spots. Vacuum dirt and debris; do not use compressed air to assist in
51 cleaning. Repair exposed surfaces to match original finish.
52
53

54 END OF SECTION 26 24 16

1 **SECTION 26 28 13 - FUSES**

2
3 **PART 1 - GENERAL**

4
5 1.1 RELATED DOCUMENTS

- 6
7 A. Drawings and general provisions of the Contract, including General and Supplementary
8 Conditions and Division 1 Specification Sections, apply to this Section.
9

10 1.2 SUMMARY

- 11
12 A. This Section includes cartridge fuses, rated 600 V and less, for use in switches,
13 panelboards, switchboards including existing switchboards, controllers, and motor-control
14 centers; and spare fuse cabinets. Match existing equipment being used. Provide new
15 fuses sized to accommodate new equipment.
16

17 1.3 SUBMITTALS

- 18
19 A. Product Data: Include dimensions and manufacturer's technical data on features,
20 performance, electrical characteristics, and ratings for each fuse type indicated.
21

- 22 B. Product Data: Include the following for each fuse type indicated:
23

- 24 1. Dimensions and manufacturer's technical data on features, performance,
25 electrical characteristics, and ratings.
26 2. Let-through current curves for fuses with current-limiting characteristics.
27 3. Time-current curves, coordination charts and tables, and related data.
28 4. Fuse size for elevator feeders and elevator disconnect switches.
29

- 30 C. Ambient Temperature Adjustment Information. If ratings of fuses have been adjusted to
31 accommodate ambient temperatures, provide list of fuses adjusted.
32

- 33 1. For each adjusted fuse, include location of fuse, original fuse rating, local
34 ambient temperature, and adjusted fuse rating.
35 2. Provide manufacturer's technical data on which ambient temperature adjustment
36 calculations are based.
37

- 38 D. Maintenance Data: For tripping devices to include in maintenance manuals specified in
39 Division 1.
40

41 1.4 QUALITY ASSURANCE

- 42
43 A. Source Limitations: Provide fuses from a single manufacturer.
44

- 45 B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in
46 NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction,
47 and marked for intended use.
48

- 49 C. Comply with NEMA FU 1.

- 50
51 D. Comply with NFPA 70.
52

1 1.5 PROJECT CONDITIONS

- 2
3 A. Where ambient temperature to which fuses are directly exposed is less than 40 deg F or
4 more than 100 deg F, apply manufacturer's ambient temperature adjustment factors to
5 fuse ratings.
6

7 1.6 COORDINATION

- 8
9 A. Coordinate fuse ratings with HVAC and refrigeration equipment nameplate limitations of
10 maximum fuse size.
11

12
13 **PART 2 - PRODUCTS**

14
15 2.1 MANUFACTURERS

- 16
17 A. Available Manufacturers: Subject to compliance with requirements, manufacturers
18 offering products that may be incorporated into the Work include, but are not limited to,
19 the following:
20

- 21 B. Manufacturers: Subject to compliance with requirements, provide products by one of the
22 following:
23

- 24 1. Cooper Industries, Inc.; Bussmann Div.
25 2. Eagle Electric Mfg. Co., Inc.
26 3. Ferraz Corp.
27 4. General Electric Co.; Wiring Devices Div.
28 5. Gould Shawmut.
29 6. Tracor, Inc.; Littelfuse, Inc. Subsidiary.
30

31 2.2 CARTRIDGE FUSES

- 32
33 A. Characteristics: NEMA FU 1, nonrenewable cartridge fuse; class and current rating
34 indicated; voltage rating consistent with circuit voltage.
35
36

37 **PART 3 - EXECUTION**

38
39 3.1 FUSE APPLICATIONS

- 40
41 A. Motor Branch Circuits: Class RK1, time delay.
42
43 B. Other Branch Circuits: Class RK1, time delay.
44

45 3.2 INSTALLATION

- 46
47 A. Install fuses in fusible devices. Arrange fuses so rating information is readable without
48 removing fuse.
49
50 B. Install spare fuse cabinet[s].
51

52 3.3 IDENTIFICATION

- 53
54 A. Install labels indicating fuse replacement information on inside door of each fused
55 switch.
56

1 END OF SECTION 26 28 13

BID NO. 109001
FUSES
26 28 13 - 3

1 **SECTION 26 29 13 - ENCLOSED CONTROLLERS**

2
3 **PART 1 - GENERAL**

4
5 1.1 RELATED DOCUMENTS

- 6
7 A. Drawings and general provisions of the Contract, including General and Supplementary
8 Conditions and Division 1 Specification Sections, apply to this Section.
9

10 1.2 SUMMARY

- 11
12 A. This Section includes ac general-purpose controllers rated 600 V and less that are
13 supplied as enclosed units. Provide starters for all equipment that do not come with
14 starters as a packaged equipment. Coordinate and verify requirements with other
15 contractors furnishing equipment.
16

- 17 B. Related Sections include the following:

- 18
19 1. Division 26 Section "Fuses" for fuses in fusible switches.
20

21 1.3 SUBMITTALS

- 22
23 A. Product Data: For each type of enclosed controller. Include dimensions and
24 manufacturer's technical data on features, performance, electrical characteristics,
25 ratings, and finishes.
26

- 27 B. Shop Drawings: For each enclosed controller.

- 28
29 1. Dimensioned plans, elevations, sections, and details, including required
30 clearances and service space around equipment. Show tabulations of installed
31 devices, equipment features, and ratings. Include the following:
32

- 33 a. Enclosure types and details.
34 b. Nameplate legends.
35 c. Short-circuit current rating of integrated unit.
36 d. UL listing for series rating of overcurrent protective devices in
37 combination controllers.
38 e. Features, characteristics, ratings, and factory settings of individual
39 overcurrent protective devices in combination controllers.
40

- 41 2. Wiring Diagrams: Power, signal, and control wiring. Differentiate between
42 manufacturer-installed and field-installed wiring.
43

- 44 C. Maintenance Data: For enclosed controllers and components to include in maintenance
45 manuals specified in Division 1. In addition to requirements specified in Division 1
46 Section "Operation and Maintenance Data," include the following:
47

- 48 1. Routine maintenance requirements for enclosed controllers and all installed
49 components.
50 2. Manufacturer's written instructions for testing and adjusting overcurrent
51 protective devices.
52

- 1 D. Load-Current and Overload-Relay Heater List: Compile after motors have been installed
2 and arrange to demonstrate that selection of heaters suits actual motor nameplate full-
3 load currents.
4
5 E. Load-Current and List of Settings of Adjustable Overload Relays: Compile after motors
6 have been installed and arrange to demonstrate that dip switch settings for motor
7 running overload protection suit actual motor to be protected.
8

9 1.4 QUALITY ASSURANCE

- 10
11 A. Manufacturer Qualifications: Maintain, within 100 miles of Project site, a service center
12 capable of providing training, parts, and emergency maintenance and repairs.
13
14 B. Testing Agency Qualifications: An independent testing agency with the experience and
15 capability to satisfactorily conduct the testing indicated, as documented according to
16 ASTM E 548.
17
18 C. Source Limitations: Obtain enclosed controllers of a single type through one source
19 from a single manufacturer.
20
21 D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in
22 NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction,
23 and marked for intended use.
24
25 E. Comply with NFPA 70.
26
27 F. Product Selection for Restricted Space: Drawings indicate maximum dimensions for
28 enclosed controllers, including clearances between enclosed controllers, and for adjacent
29 surfaces and other items. Comply with indicated maximum dimensions.
30

31 1.5 DELIVERY, STORAGE, AND HANDLING

- 32
33 A. Store enclosed controllers indoors in clean, dry space with uniform temperature to
34 prevent condensation. Protect enclosed controllers from exposure to dirt, fumes, water,
35 corrosive substances, and physical damage.
36
37 B. If stored in areas subjected to weather, cover enclosed controllers to protect from
38 weather, dirt, dust, corrosive substances, and physical damage. Remove loose packing
39 and flammable materials from inside controllers; install electric heating of sufficient
40 wattage to prevent condensation.
41

42 1.6 COORDINATION

- 43
44 A. Coordinate layout and installation of enclosed controllers with other construction
45 including conduit, piping, equipment, and adjacent surfaces. Maintain required
46 workspace clearances and required clearances for equipment access doors and panels.
47
48 B. Coordinate features of enclosed controllers and accessory devices with pilot devices and
49 control circuits to which they connect.
50
51 C. Coordinate features, accessories, and functions of each enclosed controller with ratings
52 and characteristics of supply circuit, motor, required control sequence, and duty cycle of
53 motor and load.
54
55

1 **PART 2 - PRODUCTS**

2
3 2.1 **MANUFACTURERS**

- 4
5 A. Available Manufacturers: Subject to compliance with requirements, manufacturers
6 offering products that may be incorporated into the Work include, but are not limited to,
7 the following:
8
9 B. Manufacturers: Subject to compliance with requirements, provide products by one of the
10 following:
11
12 1. Manual and Magnetic Enclosed Controllers:
13
14 a. ABB Power Distribution, Inc.; ABB Control, Inc. Subsidiary.
15 b. Eaton Corp.; Cutler-Hammer Products.
16 c. General Electrical Distribution & Control.
17 d. Rockwell Automation Allen-Bradley Co.; Industrial Control Group.
18 e. Siemens/Furnas Controls.
19 f. Square D Co.
20

21 2.2 **MANUAL ENCLOSED CONTROLLERS**

- 22
23 A. Description: NEMA ICS 2, general purpose, Class A, with toggle action and overload
24 element.
25

26 2.3 **MAGNETIC ENCLOSED CONTROLLERS**

- 27
28 A. Description: NEMA ICS 2, Class A, full voltage, nonreversing, across the line, unless
29 otherwise indicated.
30
31 B. Control Circuit: 120 V; obtained from integral control power transformer of sufficient
32 capacity to operate connected pilot, indicating and control devices, plus 100 percent
33 spare capacity.
34
35 C. Combination Controller: Factory-assembled combination controller and disconnect
36 switch.
37
38 1. Fusible Disconnecting Means: NEMA KS 1, heavy-duty, fusible switch with
39 rejection-type fuse clips rated for fuses. Select and size fuses to provide Type 2
40 protection according to IEC 947-4-1, as certified by a nationally recognized
41 testing laboratory.
42 2. Nonfusible Disconnecting Means: NEMA KS 1, heavy-duty, nonfusible switch.
43 3. Circuit-Breaker Disconnecting Means: NEMA AB 1, motor-circuit protector with
44 field-adjustable, short-circuit trip coordinated with motor locked-rotor amperes.
45
46 D. Overload Relay: Ambient-compensated type with inverse-time-current characteristic and
47 NEMA ICS 2, Class 10 20 30 tripping characteristic as required by equipment. Provide
48 with heaters or sensors in each phase matched to nameplate full-load current of specific
49 motor to which they connect and with appropriate adjustment for duty cycle.
50
51 E. Adjustable Overload Relay: Dip switch selectable for motor running overload protection
52 with NEMA ICS 2, Class 10 20 30 tripping characteristic as required by equipment, and
53 selected to protect motor against voltage and current unbalance and single phasing.
54 Provide relay with Class II ground-fault protection, with start and run delays to prevent
55 nuisance trip on starting.
56

1 F. Autotransformer Reduced-Voltage Controller: NEMA ICS 2, closed transition.

2
3 2.4 ENCLOSURES

4
5 A. Description: Flush- or surface-mounted cabinets as indicated. NEMA 250, Type 1,
6 unless otherwise indicated to comply with environmental conditions at installed location.

7
8 1. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.

9
10 2.5 ACCESSORIES

11 A. Devices shall be factory installed in controller enclosure, unless otherwise indicated.

12 B. Push-Button Stations, Pilot Lights, and Selector Switches: NEMA ICS 2, heavy-duty
13 type.

14 C. Stop and Lockout Push-Button Station: Momentary-break, push-button station with a
15 factory-applied hasp arranged so padlock can be used to lock push button in depressed
16 position with control circuit open.

17 D. Control Relays: Auxiliary and adjustable time-delay relays.

18 E. Phase-Failure and Undervoltage Relays: Solid-state sensing circuit with isolated output
19 contacts for hard-wired connection. Provide adjustable undervoltage setting.

20
21 F. Current-Sensing, Phase-Failure Relays: Solid-state sensing circuit with isolated output
22 contacts for hard-wired connection; arranged to operate on phase failure, phase reversal,
23 current unbalance of from 30 to 40 percent, or loss of supply voltage; with adjustable
24 response delay.

25
26
27
28
29
30
31 2.6 FACTORY FINISHES

32 A. Manufacturer's standard prime-coat finish ready for field painting.

33 B. Finish: Manufacturer's standard <Insert color> paint applied to factory-assembled and -
34 tested enclosed controllers before shipping.

35
36
37
38 **PART 3 - EXECUTION**

39
40 3.1 EXAMINATION

41 A. Examine areas to receive enclosed controllers for compliance with requirements,
42 installation tolerances, and other conditions affecting performance. Verify all
43 requirements for starters with contractor providing the equipment.

44 B. Proceed with installation only after unsatisfactory conditions have been corrected.

45
46
47 3.2 APPLICATIONS

48 A. Select features of each enclosed controller to coordinate with ratings and characteristics
49 of supply circuit and motor; required control sequence; duty cycle of motor, drive, and
50 load; and configuration of pilot device and control circuit affecting controller functions.

51 B. Select horsepower rating of controllers to suit motor controlled.

- 1 3.3 INSTALLATION
2
3 A. See Division 26 Section "Common Work Results for Electrical" for general installation
4 requirements.
5
6 B. For control equipment at walls, bolt units to wall or mount on lightweight structural-steel
7 channels bolted to wall. For controllers not at walls, provide freestanding racks
8 complying with Division 26 Section "Common Work Results for Electrical."
9
10 C. Enclosed Controller Fuses: Install fuses in each fusible switch. Comply with
11 requirements in Division 26 Section "Fuses."
12
- 13 3.4 IDENTIFICATION
14
15 A. Identify enclosed controller components and control wiring according to Division 26
16 Section "Common Work Results for Electrical."
17
- 18 3.5 CONTROL WIRING INSTALLATION
19
20 A. Control wiring shall be provided by HVAC Contractor.
21
22 B. Connect hand-off-automatic switch and other automatic-control devices where
23 applicable.
24
25 1. Connect selector switches to bypass only manual- and automatic-control devices
26 that have no safety functions when switch is in hand position.
27 2. Connect selector switches with enclosed controller circuit in both hand and
28 automatic positions for safety-type control devices such as low- and high-
29 pressure cutouts, high-temperature cutouts, and motor overload protectors.
30
- 31 3.6 CONNECTIONS
32
33 A. Conduit installation requirements are specified in other Division 26 Sections. Drawings
34 indicate general arrangement of conduit, fittings, and specialties.
35
36 B. Ground equipment.
37
38 C. Tighten electrical connectors and terminals according to manufacturer's published
39 torque-tightening values. If manufacturer's torque values are not indicated, use those
40 specified in UL 486A and UL 486B.
41
- 42 3.7 FIELD QUALITY CONTROL
43
44 A. Prepare for acceptance tests as follows:
45
46 1. Test insulation resistance for each enclosed controller bus, component,
47 connecting supply, feeder, and control circuit.
48 2. Test continuity of each circuit.
49
50 B. Testing: Perform the following field quality-control testing:
51
52 1. Perform each electrical test and visual and mechanical inspection indicated in
53 NETA ATS, Sections 7.5, 7.6, and 7.16.
54 2. Certify compliance with test parameters.
55 3. Correct malfunctioning units on-site, where possible, and retest to demonstrate
56 compliance; otherwise, replace with new units and retest.

- 1
2 3.8 ADJUSTING
3
4 A. Set field-adjustable switches and circuit-breaker trip ranges.
5
6 3.9 CLEANING
7
8 A. Clean enclosed controllers internally, on completion of installation, according to
9 manufacturer's written instructions. Vacuum dirt and debris; do not use compressed air
10 to assist in cleaning.
11
12 3.10 STARTUP SERVICE
13
14 A. Engage a factory-authorized service representative to perform startup service.
15
16 B. Verify that enclosed controllers are installed and connected according to the Contract
17 Documents.
18
19 C. Verify that electrical wiring installation complies with manufacturer's submittal and
20 installation requirements in Division 26 Sections.
21
22 D. Complete installation and startup checks according to manufacturer's written instructions.
23
24 3.11 DEMONSTRATION
25
26 A. Engage a factory-authorized service representative to train Owner's maintenance
27 personnel to adjust, operate, and maintain enclosed controllers [and variable-frequency
28 drives].
29
30 1. Train Owner's maintenance personnel on procedures and schedules for starting
31 and stopping, troubleshooting, servicing, and maintaining equipment and
32 schedules.
33 2. Review data in maintenance manuals. Refer to Division 1 Section "Closeout
34 Procedures."
35 3. Review data in maintenance manuals. Refer to Division 1 Section "Operation
36 and Maintenance Data."
37 4. Schedule training with Owner, through Architect, with at least seven days'
38 advance notice.
39
40
41 END OF SECTION 26 29 13

1 **SECTION 26 51 00 - LIGHTING**

2
3 **PART 1 - GENERAL**

4
5 1.1 RELATED DOCUMENTS

- 6
7 A. Drawings and general provisions of the Contract, including General and Supplementary
8 Conditions and Division 1 Specification Sections, apply to this Section.
9

10 1.2 SUMMARY

- 11 A. This Section includes the following:
12
13 1. Interior lighting fixtures with lamps and ballasts.
14 2. Lighting fixtures mounted on exterior building surfaces.
15 3. Accessories, including lighting fixture retrofitting.
16
17

18 1.3 DEFINITIONS

- 19
20 A. BF: Ballast factor. Ratio of light output of a given lamp(s) operated by the subject
21 ballast to the light output of the same lamp(s) when operated on an ANSI reference
22 circuit.
23
24 B. CRI: Color rendering index.
25
26 C. CU: Coefficient of utilization.
27
28 D. LER: Luminaire efficiency rating, which is calculated according to NEMA LE 5. This
29 value can be estimated from photometric data using the following formula:
30
31 1. LER is equal to the product of total rated lamp lumens times BF times luminaire
32 efficiency, divided by input watts.
33
34 E. RCR: Room cavity ratio.
35

36 1.4 SUBMITTALS

- 37
38 A. Product Data: For each type of lighting fixture scheduled, arranged in order of fixture
39 designation. Include data on features, accessories, finishes, and the following:
40
41 1. Physical description of fixture, including dimensions and verification of indicated
42 parameters.
43 2. Fluorescent and high-intensity-discharge ballasts. Verify type being used by
44 Owner.
45 3. Lamps. Verify color temperature and type being used by Owner.
46
47 B. Shop Drawings:
48
49 1. Indicate dimensions, weights, methods of field assembly, components, features,
50 and accessories.
51

- 1 C. Samples for Verification: For interior lighting fixtures designated for sample submission
2 in the Interior Lighting Fixture Schedule.
3
4 1. Lamps: Specified units installed.
5 2. Ballast: 120-V models of specified ballast types.
6 3. Accessories: Cords and plugs.
7
8 D. Operation and Maintenance Data: For lighting equipment and fixtures to include in
9 operation, and maintenance manuals. In addition to items specified in Division 1 Section
10 "Operation and Maintenance Data," include the following:
11
12 1. Catalog data for each fixture. Include the diffuser, ballast, and lamps installed in
13 that fixture.
14
15 E. Warranties: Special warranties specified in this Section.
16
17 1.5 QUALITY ASSURANCE
18
19 A. Comply with NFPA 70.
20
21 1.6 COORDINATION
22
23 A. Coordinate layout and installation of lighting fixtures and suspension system with other
24 construction that penetrates ceilings or is supported by them, including HVAC
25 equipment, fire-suppression system, and partition assemblies.
26
27 1.7 WARRANTY
28
29 A. Special Warranty for Fluorescent Ballasts: Manufacturer's standard form in which ballast
30 manufacturer agrees to repair or replace ballasts that fail in materials or workmanship
31 within specified warranty period.
32
33 1. Warranty Period for Electronic Ballasts: Five years from date of Substantial
34 Completion.
35 2. Warranty Period for Electromagnetic Ballasts: Three years from date of
36 Substantial Completion.
37
38 B. Manufacturer's Special Warranty for T8 Fluorescent Lamps: Manufacturer's standard
39 form, made out to Owner and signed by lamp manufacturer agreeing to replace lamps
40 that fail in materials or workmanship, f.o.b. the nearest shipping point to Project site,
41 within specified warranty period indicated below.
42
43 1. Warranty Period: One year from date of Substantial Completion.
44
45 1.8 EXTRA MATERIALS
46
47 A. Furnish extra materials described below that match products installed and that are
48 packaged with protective covering for storage and identified with labels describing
49 contents.
50
51 1. Lamps: 10 for every 100 of each type and rating installed. Furnish at least one
52 of each type.
53
54

1 **PART 2 - PRODUCTS**

2
3 2.1 **MANUFACTURERS**

4
5 A. In other Part 2 articles where titles below introduce lists, the following requirements apply
6 to product selection:

- 7
8 1. Available Products: Subject to compliance with requirements, products that may
9 be incorporated into the Work include, but are not limited to, products specified.
10 2. Products: Subject to compliance with requirements, provide one of the products
11 specified.

12
13 2.2 **FIXTURES AND COMPONENTS, GENERAL**

14
15 A. Recessed Fixtures: Comply with NEMA LE 4 for ceiling compatibility for recessed
16 fixtures.

17
18 B. Fluorescent Fixtures: Comply with UL 1598. Where LER is specified, test according to
19 NEMA LE 5 and NEMA LE 5A as applicable.

20
21 C. HID Fixtures: Comply with UL 1598. Where LER is specified, test according to
22 NEMA LE 5B.

23
24 D. Metal Parts: Free of burrs and sharp corners and edges.

25
26 E. Sheet Metal Components: Steel, unless otherwise indicated. Form and support to
27 prevent warping and sagging.

28
29 F. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage
30 under operating conditions, and designed to permit relamping without use of tools.
31 Designed to prevent doors, frames, lenses, diffusers, and other components from falling
32 accidentally during relamping and when secured in operating position.

33
34 G. Reflecting surfaces shall have minimum reflectance as follows, unless otherwise
35 indicated:

- 36
37 1. White Surfaces: 85 percent.
38 2. Specular Surfaces: 83 percent.
39 3. Diffusing Specular Surfaces: 75 percent.
40 4. Laminated Silver Metallized Film: 90 percent.

41
42 H. Plastic Diffusers, Covers, and Globes:

43
44 1. Acrylic Lighting Diffusers: 100 percent virgin acrylic plastic. High resistance to
45 yellowing and other changes due to aging, exposure to heat, and UV radiation.

- 46
47 a. Lens Thickness: At least 0.125 minimum unless different thickness is
48 scheduled.
49 b. UV stabilized.

50
51 2. Glass: Annealed crystal glass, unless otherwise indicated.

52
53 2.3 **LIGHTING FIXTURES**

54
55 A. Provide lighting fixtures as detailed on drawings. Project includes the removal,
56 relamping, reballastinng, repair as required and the reinstallation of existing lighting

1 equipment which shall be done on a area by area basis as required by the mechanical
2 and ceiling work. Schedule of work in the various areas shall be as required by the work
3 of other trades and must be coordinated and approved by the Architect and Owner.
4

5 B. There is also new lighting equipment being installed that will replace existing equipment.
6 Existing equipment will be removed and disposed of properly. New lighting will then be
7 installed complete including any mounting accessories required for a complete
8 installation. New equipment shall be connected to existing circuits and control. Verify
9 condition and capacity of existing wiring and circuits and report any unsafe or inadequate
10 conditions.

11
12 C. There are three existing pole mounted area lights located in the existing parking lot.
13 These poles are to be replaced entirely including the concrete support bases. Existing
14 equipment is to be removed carefully so that existing wiring is not damaged and can be
15 used to serve new postlights. This work shall be an alternate bid item.
16

17 18 2.4 FLUORESCENT LAMP BALLASTS 19

20 A. Description: Include the following features, unless otherwise indicated:
21

22 1. Designed for type and quantity of lamps indicated at full light output. Match
23 equipment being used by Owner at site.
24

25 B. Electronic ballasts for linear lamps shall include the following features, unless otherwise
26 indicated:
27

- 28 1. Comply with NEMA C82.11.
- 29 2. Ballast Type: Instant start, unless otherwise indicated.
- 30 3. Programmed Start: Ballasts with two-step lamp starting to extend life of
31 frequently started lamps.
- 32 4. Sound Rating: A.
- 33 5. Total harmonic distortion rating of less than 10 percent according to
34 NEMA C82.11.
- 35 6. Transient Voltage Protection: IEEE 587, Category A.
- 36 7. Operating Frequency: 20 kHz or higher.
- 37 8. Lamp Current Crest Factor: Less than 1.7.
- 38 9. Parallel Lamp Circuits: Multiple lamp ballasts connected to maintain full light
39 output on surviving lamps if one or more lamps fail.
40

41 C. Ballasts for compact lamps in recessed fixtures shall have the following features, unless
42 otherwise indicated:
43

- 44 1. Type: Electronic.
- 45 2. Power Factor: 90 percent, minimum.
- 46 3. Flicker: Less than 5 percent.
- 47 4. Lamp Current Crest Factor: Less than 1.7.
- 48 5. Electronic Ballast Operating Frequency: 20 kHz or higher.
- 49 6. Lamp end-of-life detection and shutdown circuit.
- 50 7. Transient Protection: Comply with IEEE 587 for Category A1 locations.
- 51 8. Interference: Comply with 47 CFR, Chapter 1, Part 18, Subpart C, for limitations
52 on electromagnetic and radio-frequency interference for nonconsumer
53 equipment.
54

55 D. Ballasts for compact lamps in nonrecessed fixtures shall include the following features,
56 unless otherwise indicated:

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
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

1. Power Factor: 90 percent, minimum.
2. Ballast Coil Temperature: 65 deg C, maximum.
3. Transient Protection: Comply with IEEE 587 for Category A1 locations.
4. Interference: Comply with 47 CFR, Chapter 1, Part 18, Subpart C, for limitations on electromagnetic and radio-frequency interference for nonconsumer equipment.

E. Ballasts for Low-Temperature Environments:

1. Temperatures 0 deg F and Higher: Electronic or electromagnetic type rated for 0 deg F starting temperature.
2. Temperatures Minus 20 deg F and Higher: Electromagnetic type designed for use with high-output lamps.

2.5 HIGH-INTENSITY-DISCHARGE LAMP BALLASTS

A. General: Comply with NEMA C82.4 and UL 1029. Shall include the following features, unless otherwise indicated.

1. Type: Constant-wattage autotransformer or regulating high-power-factor type.
2. Minimum Starting Temperature: Minus 22 deg F for single-lamp ballasts.
3. Normal Ambient Operating Temperature: 104 deg F.
4. Open-circuit operation that will not reduce average life.

B. Low-Noise Ballasts: Manufacturers' standard epoxy-encapsulated models designed to minimize audible fixture noise.

2.6 FLUORESCENT LAMPS

A. Match lamp types and colors that are presently being used by the Owner on site. Low-Mercury Lamps: Comply with Federal toxic characteristic leaching procedure test, and yield less than 0.2 mg of mercury per liter, when tested according to NEMA LL 1.

B. T8 rapid-start low-mercury lamps, rated 32 W maximum, 2800 initial lumens (minimum), CRI of 75 (minimum), color temperature of 3500 K, and average rated life of 20,000 hours, unless otherwise indicated. Verify with Owner.

C. T8 rapid-start low-mercury lamps, rated 17 W maximum, nominal length of 24 inches, 1300 initial lumens (minimum), CRI of 75 (minimum), color temperature of 3500 K, and average rated life of 20,000 hours, unless otherwise indicated. Verify with Owner.

D. Compact Fluorescent Lamps: CRI 80 (minimum), color temperature 3500 average rated life of 10,000 hours at 3 hours operation per start, unless otherwise indicated.

1. T4, Twin Tube: Rated 5 W, 250 initial lumens (minimum).
2. T4, Twin Tube: Rated 7 W, 400 initial lumens (minimum).
3. T4, Twin Tube: Rated 9 W, 600 initial lumens (minimum).
4. T4, Twin Tube: Rated 13 W, 825 initial lumens (minimum).
5. T4, Double-Twin Tube: Rated 13 W, 900 initial lumens (minimum).
6. T4, Double-Twin Tube: Rated 18 W, 1200 initial lumens (minimum).
7. T4, Double-Twin Tube: Rated 26 W, 1800 initial lumens (minimum).

2.7 HIGH-INTENSITY-DISCHARGE LAMPS

- 1 A. Metal-Halide Lamps: ANSI C78.1372, wattage and burning position as scheduled,
2 CRI 65 (minimum), and color temperature 4000.

3
4 2.8 FIXTURE SUPPORT COMPONENTS

- 5
6 A. Comply with Division 26 Section "Common work Results for Electrical" for channel- and
7 angle-iron supports and nonmetallic channel and angle supports.
8
9 B. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy.
10 Finish same as fixture.
11
12 C. Twin-Stem Hangers: Two, 1/2-inch steel tubes with single canopy designed to mount a
13 single fixture. Finish same as fixture.
14
15 D. Wires: ASTM A 641/A 641M, Class 3, soft temper, zinc-coated, 12 gage.
16
17 E. Wires For Humid Spaces: ASTM A 580/A 580M, Composition 302 or 304, annealed
18 stainless steel, 12 gage.
19
20 F. Rod Hangers: 3/16-inch-minimum diameter, cadmium-plated, threaded steel rod.
21
22 G. Hook Hangers: Integrated assembly matched to fixture and line voltage and equipped
23 with threaded attachment, cord, and locking-type plug.
24
25 H. Aircraft Cable Support: Use cable, anchorages, and intermediate supports
26 recommended by fixture manufacturer.
27

28 2.9 FINISHES

- 29
30 A. Fixtures: Manufacturers' standard, unless otherwise indicated.
31
32 1. Paint Finish: Applied over corrosion-resistant treatment or primer, free of
33 defects.
34 2. Metallic Finish: Corrosion resistant.
35

36 2.10 FLUORESCENT FIXTURE RETROFIT MATERIALS

- 37
38 A. Comply with UL **1598** listing requirements.
39
40 1. Ballast and Lamp Change Kit: UL **1598**, Type II. Suitable for changing existing
41 ballast, lamps, and sockets as scheduled.
42
43

44 **PART 3 - EXECUTION**

45
46 3.1 INSTALLATION

- 47
48 A. Fixtures: Set level, plumb, and square with ceilings and walls. Install lamps in each
49 fixture.
50
51 B. Support for Fixtures in or on Grid-Type Suspended Ceilings: Use grid for support.
52
53 1. Install a minimum of four ceiling support system rods or wires for each fixture.
54 Locate not more than 6 inches from fixture corners.
55 2. Support Clips: Fasten to fixtures and to ceiling grid members at or near each
56 fixture corner with clips that are UL listed for the application.

- 1 3. Fixtures of Sizes Less Than Ceiling Grid: Install as indicated on reflected ceiling
2 plans or center in acoustical panel, and support fixtures independently with at
3 least two 3/4-inch metal channels spanning and secured to ceiling tees.

4
5 3.2 CONNECTIONS

- 6
7 A. Tighten electrical connectors and terminals according to manufacturer's published
8 torque-tightening values. If manufacturer's torque values are not indicated, use those
9 specified in UL 486A and UL 486B.

10
11 3.3 FORMS

- 12
13 A. Contractor shall provide documentation on lamps and ballast purchases and shall fill out
14 the Wisconsin Focus on Energy Forms for Owner Rebates.

15
16 3.4 FIELD QUALITY CONTROL

- 17
18 A. Inspect each installed fixture for damage. Replace damaged fixtures and components.
19
20 B. Verify normal operation of each fixture after installation.
21
22 C. Corroded Fixtures: Replace fixtures that show any signs of corrosion.

23
24
25 END OF SECTION 26 51 00

