**RFB NO. 320030**

# CONSTRUCTION DOCUMENTS
# PROJECT MANUAL

DANE COUNTY DEPARTMENT OF PUBLIC WORKS,
HIGHWAY AND TRANSPORTATION

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

## REQUEST FOR BIDS NO. 320030
## 911 CENTER DATA ROOM BACKUP COOLING
## CITY COUNTY BUILDING
## 210 MARTIN LUTHER KING JR BLVD
## MADISON, WISCONSIN

Due Date / Time: **TUESDAY, OCTOBER 6th, 2020 / 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:

TODD DRAPER, PROJECT MANAGER
TELEPHONE NO.: 608/267-0119
FAX NO.: 608/267-1533
E-MAIL: DRAPER@COUNTYOFDANE.COM

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INVITATION TO BID

**LEGAL NOTICE**

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

**2:00 P.M., TUESDAY, OCTOBER 6, 2020**

**RFB NO. 320030**

**911 CENTER DATA ROOM BACKUP COOLING**

**CITY-COUNTY BUILDING**

**210 MARTIN LUTHER KING JR BLVD, MADISON, WI**

Dane County is inviting Bids for construction. The project involves installing backup cooling units in our Public Safety Communications Center at the City-County Building. Only firms with capabilities, experience & expertise with similar projects should obtain this Request for Bids (RFB) document & submit Bids.

RFB document may be obtained after **2:00 p.m. on September 1, 2020** by downloading it from bids-pwht.countyofdane.com. Please call Todd Draper, Project Mgr., at 608/267-0119, or our office at 608/266-4018, for any questions or additional information.

All Bidders must be qualified as, or apply to be a Best Value Contractor before Bid Due Date. Complete Pre-qualification Application for Contractors at publicworks.countyofdane.com/bvc or obtain one by calling 608/267-0119.

A pre-bid site tour will be held Thursday, September 17 at 10:00 a.m. at the City County Building, starting in Room 109. Bidders are strongly encouraged to attend this tour.

**PUBLISH: SEPTEMBER 1 & SEPTEMBER 8, 2020 - WISCONSIN STATE JOURNAL**

**AUGUST 31 & SEPTEMBER 7, 2020 - THE DAILY REPORTER**

END OF SECTION

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INSTRUCTIONS TO BIDDERS

**911 Center Data Room Backup Cooling Units**
**City-County Buildng**
**210 Martin Luther King Jr. Blvd.**
**Madison, Wisconsin**

## 1. SECURING DOCUMENTS

A. Construction Documents may be obtained at bids-pwht.countyofdane.com.

B. Bidder is responsible to check Public Works website regularly for Addenda.

## 2. BID REQUIREMENTS

A. Bidder shall submit lump sum bid for providing all labor, equipment, tools and materials necessary to perform all Work described in Construction Documents. Only firms with capabilities, experience and expertise with similar projects should submit Bids.

B. Envelope containing Bid shall be clearly marked as for this project (note title at top of page). Bids shall be delivered to:

Dane County Department of Public Works, Highway & Transportation
1919 Alliant Energy Center Way
Madison, Wisconsin 53713

C. One (1) Bid Form shall be submitted with your Bid. Bid Form is provided with Construction Documents; no other form or letter shall be accepted.

D. Wisconsin Statute 77.54 (9m) allows building materials that become part of local unit government facilities to be exempt from sales & use tax. Vendors & materials suppliers may not charge Bidders sales & use tax on these purchases. This does not include highways, streets or roads.

E. Bidders shall not add any conditions, escalator clauses of qualifying statements to Bid Form.

F. Erasures or other changes to Bid must be explained or noted, and shall be accompanied by initials of bidder.

G. Legally authorized official of bidder's organization shall sign Bids.

H. Bidder's organization shall submit completed Fair Labor Practices Certification Form, included in these Construction Documents.

I. Bid Bond shall be made payable to Dane County in amount of five percent (5%) of bid amount. Bid Bond shall be either certified check or bid bond issued by surety licensed to conduct business in the State of Wisconsin. Successful bidder's Bid Bond shall be retained until Contract is signed and required Performance / Payment Bond is submitted. Bids shall be binding on bidder for sixty (60) calendar days after Bid Due Date. Bid Bond must be submitted with Bid.

J. Successful bidder shall furnish and pay for Performance / Payment Bond as called for in Conditions of Contract.

## 3. INQUIRIES

A. Written inquiries regarding intent of Construction Documents should be directed to:

Todd Draper, Public Works Project Manager
Dane County Department of Public Works, Highway & Transportation
1919 Alliant Energy Center Way, Madison, Wisconsin 53713
Fax: 608/267-1533
Email: draper@countyofdane.com

B. Bidders shall bring questions, discrepancies, omissions, conflicts or doubt as to meaning of any part of Construction Documents to attention of Department of Public Works, Highway & Transportation at least ten (10) business days before due date for Bids. Prompt clarification of intent of Construction Documents shall be made available to bidders in form of Addendum. Bidder shall acknowledge all Addenda on Bid Form.

C. Failure to request clarification of interpretation of Construction Documents shall not relieve bidders of their responsibilities to perform Work.

## 4. EXAMINATION OF SITE

A. Coordinate site access activities with Facilities Manager, Mike Collins, 608/267-8828.

B. A bidders facility tour will be held on September 17, 2020 at 10:00 a.m. at the City-County Building, 210 Martin Luther King Jr. Blvd, Madison, WI, starting in Room 109. This tour will go until approximately 11:00 a.m. Bidders are strongly encouraged to attend this tour, however attendance is optional.

C. Safe distancing & face masks are required for all tour attendees. Tours will be limited to 10 people; please limit number of attending staff & subcontractors. If there are more than 10 people, group will be split & there will be two or more tours. Allow sufficient time if you do not make it in to first tour group.

## 5. ALTERNATES

A. Not used.

## 6. WITHDRAWAL OF BIDS

A. Any bidder may withdraw their Bid any time prior to Bid Due Date. Withdrawn Bids shall be returned unopened.

## 7. BID DUE DATE

A. See Legal Notice (advertisement).

## 8. COMMENCEMENT AND COMPLETION OF WORK

A. Work shall commence by November 30, 2020.

B. Work shall be completed by February 19, 2020.

## 9. RESERVATION

A. Dane County reserves right to reject any or all Bids, to waive any informalities in Bid, and to accept any Bid which shall be in Dane County's best interest.

Name of Bidding Firm: _____

SECTION 00 41 13

BID FORM

**BID NO. 320030**
**PROJECT: 911 CENTER DATA ROOM BACKUP COOLING**
**CITY-COUNTY BUILDING**

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

**NOTE: WISCONSIN STATUTE 77.54 (9M) ALLOWS FOR NO SALES & USE TAX ON THE PURCHASE OF MATERIALS FOR COUNTY PUBLIC WORKS PROJECTS.**

**BASE BID - LUMP SUM:**
Dane County is inviting Bids for construction. The project involves installing backup cooling units in our Public Safety Communications Center at the City-County Building. 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 expertise, 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

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

Addendum No(s). _____ through _____

Dated _____

Dane County Public Works, Highway & Transportation must have this project completed by February 19, 2020. Assuming this Work can be started by November 30, 2020, what dates can you commence and complete this job?

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

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

_____
(Name of Corporation, Partnership or Person submitting Bid)

Select one of the following:
1. A corporation organized and existing under the laws of the State of _____, or

2. A partnership consisting of _____, or

3. A person conducting business as _____;

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

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

The undersigned agrees to be qualified as a Best Value Contractor or will prove their exemption. New or updated applications are due on or before Bid Due Date / Time; qualification or rejection will be complete within five (5) business days after Bid Due Date.

The undersigned further agrees to honor the Base Bid and the Alternate Bid(s) for sixty (60) calendar days from date of Award of Contract.

**SIGNATURE:** _____
(Bid is invalid without signature)

Print Name: _____ Date: _____

Title: _____

Address: _____

Telephone No.: _____ Fax No.: _____

Email Address: _____

Contact Person: _____

END OF SECTION

**THIS PAGE IS FOR BIDDERS' REFERENCE**

## DO NOT SUBMIT WITH BID FORM.

**BID CHECK LIST:**
These items **must** be included with Bid:
☐ Bid Form ☐ Bid Bond ☐ Fair Labor Practices Certification

**DANE COUNTY BEST VALUE CONTRACTING QUALIFICATION**

General Contractors & all Subcontractors must be qualified as a Best Value Contractor with the Dane County Public Works Engineering Division. Qualification & listing is not permanent & must be renewed every 24 months. Complete a *Best Value Contracting Application* online at:
pwht.countyofdane.com/bvc_application.aspx

**DANE COUNTY VENDOR REGISTRATION PROGRAM**

All bidders are strongly encouraged to be a registered vendor with Dane County. Registering allows vendors an opportunity to receive notifications for RFBs & RFPs issued by the County and provides the County with up-to-date company contact information. Complete a new form or renewal online at:
danepurchasing.com/Account/Login?

**COUNTY OF DANE**

**PUBLIC WORKS CONSTRUCTION CONTRACT**

Contract No. _____ Bid No. 320030

Authority: 2020 RES -_____

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

**W I T N E S S E T H :**

**WHEREAS,** COUNTY, whose address is c/o Deputy Public Works Director, 1919 Alliant Energy Center Way, Madison, WI 53713, desires to have CONTRACTOR install 911 Center Data Room Backup Cooling at the City-County Building ("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, 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 Tailored Engineering (hereinafter referred to as "the Architect / Engineer"), and as enumerated in the Project Manual Table of Contents, all of which are made a part hereof and collectively evidence and constitute the Contract.

**2.** COUNTY agrees to pay the CONTRACTOR in current funds for the performance of the Contract subject to additions and deductions, as provided in the Conditions of Contract, and to make payments on account thereof as provided in Article entitled, "Payments to Contractor" of the 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 Specialist in accord with Chapter 19 of the Dane County Code of Ordinances. CONTRACTOR must file such plan within fifteen (15) business 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 Office of Equity & Inclusion, 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 furnish all information and reports required by COUNTY'S Contract Compliance Specialist 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.

**7.** 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.

**8.** 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.

**9.** CONTRACTOR and subcontractors must be qualified as, or apply to be a Best Value Contractor with Dane County Public Works Engineering Division before Bid Due Date. All contractors must be qualified as a Best Value Contractor to perform any work under this Contract.

Sample

**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.

* * * * * * *

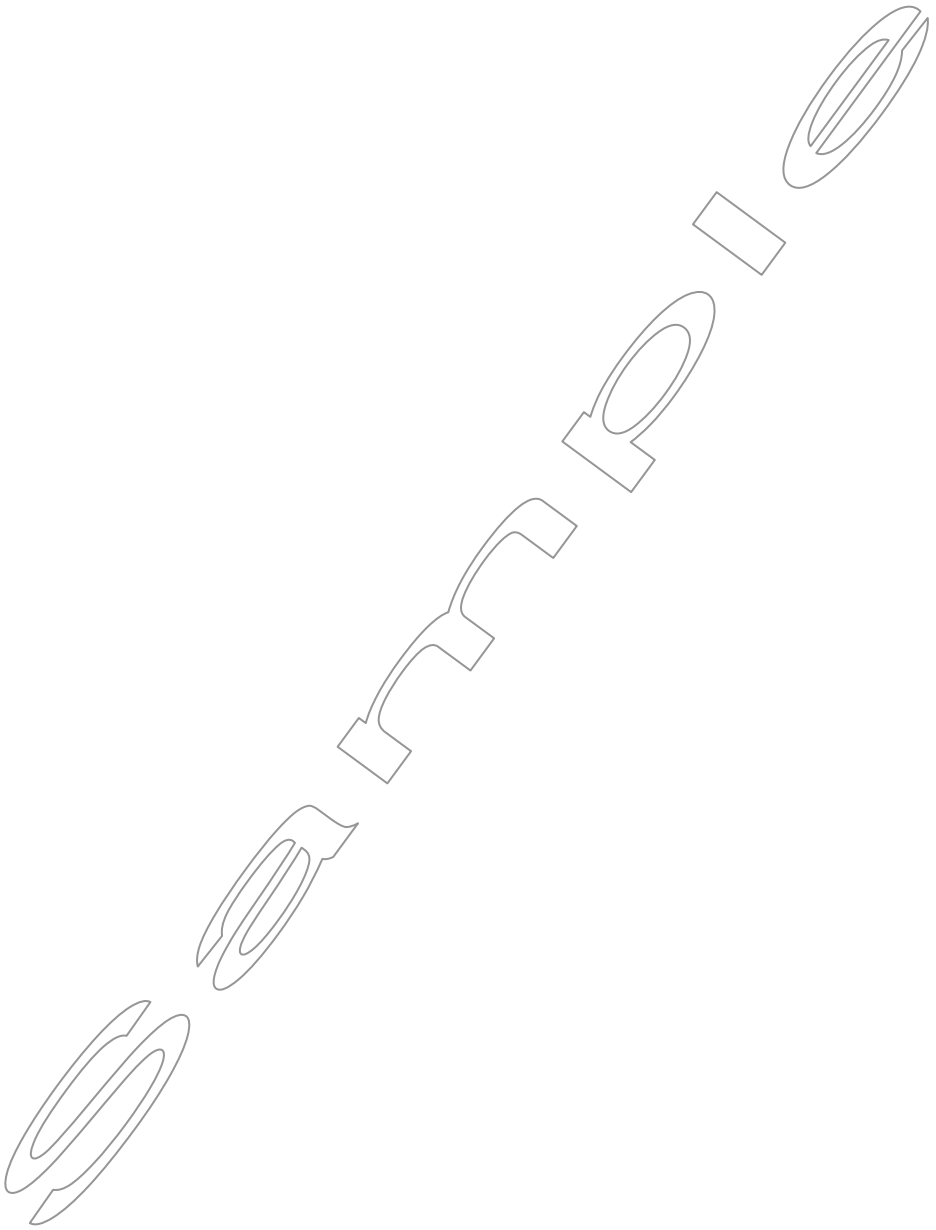
This Contract is not valid or effectual for any purpose until approved by the appropriate authority designated below, and no work is authorized until the CONTRACTOR has been given notice to proceed by COUNTY'S Deputy Public Works Director.

**FOR COUNTY:**

Joseph T. Parisi, County Executive Date

Scott McDonell, County Clerk Date

Draft



# AIA® Document A310™ – 2010

## *Bid Bond*

**CONTRACTOR:**
*(Name, legal status and address)*

**SURETY:**
*(Name, legal status and principal place of business)*

**OWNER:**
*(Name, legal status and address)*

**BOND AMOUNT:**

**PROJECT:**
*(Name, location or address, and Project number, if any)*

This document has important legal consequences. Consultation with an attorney is encouraged with respect to its completion or modification.

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

The Contractor and Surety are bound to the Owner in the amount set forth above, for the payment of which the Contractor and Surety bind themselves, their heirs, executors, administrators, successors and assigns, jointly and severally, as provided herein. The conditions of this Bond are such that if the Owner accepts the bid of the Contractor within the time specified in the bid documents, or within such time period as may be agreed to by the Owner and Contractor, and the Contractor either (1) enters into a contract with the Owner in accordance with the terms of such bid, and gives such bond or bonds as may be specified in the bidding or Contract Documents, with a surety admitted in the jurisdiction of the Project and otherwise acceptable to the Owner, for the faithful performance of such Contract and for the prompt payment of labor and material furnished in the prosecution thereof; or (2) pays to the Owner the difference, not to exceed the amount of this Bond, between the amount specified in said bid and such larger amount for which the Owner 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. The Surety hereby waives any notice of an agreement between the Owner and Contractor to extend the time in which the Owner may accept the bid. Waiver of notice by the Surety shall not apply to any extension exceeding sixty (60) days in the aggregate beyond the time for acceptance of bids specified in the bid documents, and the Owner and Contractor shall obtain the Surety's consent for an extension beyond sixty (60) days.

If this Bond is issued in connection with a subcontractor's bid to a Contractor, the term Contractor in this Bond shall be deemed to be Subcontractor and the term Owner shall be deemed to be Contractor.

When this Bond has been furnished to comply with a statutory or other legal requirement in the location of the Project, 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. When so furnished, the intent is that this Bond shall be construed as a statutory bond and not as a common law bond.

Signed and sealed this day of

| | |
|---|---|
| *(Witness)* | *(Contractor as Principal)* *(Seal)* |
| | *(Title)* |
| *(Witness)* | *(Surety)* *(Seal)* |
| | *(Title)* |

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Init.
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ACD43070810

# AIA® Document A312™ – 2010

## *Performance Bond*

**CONTRACTOR:**
*(Name, legal status and address)*

**SURETY:**
*(Name, legal status and principal place of business)*

**OWNER:**
*(Name, legal status and address)*

This document has important legal consequences. Consultation with an attorney is encouraged with respect to its completion or modification.

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

AIA Document A312–2010 combines two separate bonds, a Performance Bond and a Payment Bond, into one form. This is not a single combined Performance and Payment Bond.

**CONSTRUCTION CONTRACT**
Date:

Amount:

Description:
*(Name and location)*

**BOND**
Date:
*(Not earlier than Construction Contract Date)*

Amount:

Modifications to this Bond: ☐ None ☐ See Section 16

| **CONTRACTOR AS PRINCIPAL** | | **SURETY** | |
|---|---|---|---|
| Company: | *(Corporate Seal)* | Company: | *(Corporate Seal)* |
| Signature: | | Signature: | |
| Name and Title: | Name | Name and Title: | |

*(Any additional signatures appear on the last page of this Performance Bond.)*

*(FOR INFORMATION ONLY — Name, address and telephone)*

**AGENT** or **BROKER:**

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

Sample

**§ 1** The Contractor and 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 when applicable to participate in a conference as provided in Section 3.

**§ 3** If there is no Owner Default under the Construction Contract, the Surety's obligation under this Bond shall arise after

.1 the Owner first provides notice to the Contractor and the Surety that the Owner is considering declaring a Contractor Default. Such notice shall indicate whether the Owner is requesting a conference among the Owner, Contractor and Surety to discuss the Contractor's performance. If the Owner does not request a conference, the Surety may, within five (5) business days after receipt of the Owner's notice, request such a conference. If the Surety timely requests a conference, the Owner shall attend. Unless the Owner agrees otherwise, any conference requested under this Section 3.1 shall be held within ten (10) business days of the Surety's receipt of the Owner's notice. 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;

.2 the Owner declares a Contractor Default, terminates the Construction Contract and notifies the Surety; and

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

**§ 4** Failure on the part of the Owner to comply with the notice requirement in Section 3.1 shall not constitute a failure to comply with a condition precedent to the Surety's obligations, or release the Surety from its obligations, except to the extent the Surety demonstrates actual prejudice.

**§ 5** When the Owner has satisfied the conditions of Section 3, the Surety shall promptly and at the Surety's expense take one of the following actions:

**§ 5.1** Arrange for the Contractor, with the consent of the Owner, to perform and complete the Construction Contract;

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

**§ 5.3** 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 a 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 Section 7 in excess of the Balance of the Contract Price incurred by the Owner as a result of the Contractor Default; or

**§ 5.4** Waive its right 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, make payment to the Owner; or

.2 Deny liability in whole or in part and notify the Owner, citing the reasons for denial.

**§ 6** If the Surety does not proceed as provided in Section 5 with reasonable promptness, the Surety shall be deemed to be in default on this Bond seven 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 Section 5.4, and the Owner refuses the payment 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.

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**§ 7** If the Surety elects to act under Section 5.1, 5.2 or 5.3, 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. Subject to the commitment by the Owner to pay the Balance of the Contract Price, the Surety is obligated, without duplication, for

.1 the responsibilities of the Contractor for correction of defective work and completion of the Construction Contract;

.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 Section 5; and

.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.

**§ 8** If the Surety elects to act under Section 5.1, 5.3 or 5.4, the Surety's liability is limited to the amount of this Bond.

**§ 9** 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, successors and assigns.

**§ 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** 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 a declaration of 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.

**§ 12** Notice to the Surety, the Owner or the Contractor shall be mailed or delivered to the address shown on the page on which their signature appears.

**§ 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. When so furnished, the intent is that this Bond shall be construed as a statutory bond and not as a common law bond.

**§ 14 Definitions**

**§ 14.1 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.

**§ 14.2 Construction Contract.** The agreement between the Owner and Contractor identified on the cover page, including all Contract Documents and changes made to the agreement and the Contract Documents.

**§ 14.3 Contractor Default.** Failure of the Contractor, which has not been remedied or waived, to perform or otherwise to comply with a material term of the Construction Contract.

**§ 14.4 Owner Default.** Failure of the Owner, which has not been remedied or waived, to pay the Contractor as required under the Construction Contract or to perform and complete or comply with the other material terms of the Construction Contract.

**§ 14.5 Contract Documents.** All the documents that comprise the agreement between the Owner and Contractor.

**§ 15** If this Bond is issued for an agreement between a Contractor and subcontractor, the term Contractor in this Bond shall be deemed to be Subcontractor and the term Owner shall be deemed to be Contractor.

**§ 16** 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** | | **SURETY** | |
|---|---|---|---|
| Company: | *(Corporate Seal)* | Company: | *(Corporate Seal)* |
| Signature: | | Signature: | |
| Name and Title: | | Name and Title: | |
| Address | | Address | |

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 A312™ – 2010

## *Payment Bond*

**CONTRACTOR:**
*(Name, legal status and address)*

**SURETY:**
*(Name, legal status and principal place of business)*

**OWNER:**
*(Name, legal status 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 Section 18

| **CONTRACTOR AS PRINCIPAL** | | **SURETY** | |
|---|---|---|---|
| Company: | *(Corporate Seal)* | Company: | *(Corporate Seal)* |
| Signature: | | Signature: | |
| Name and Title: | Name | Name and Title: | |

*(Any additional signatures appear on the last page of this Payment Bond.)*

*(FOR INFORMATION ONLY — Name, address and telephone)*
**AGENT** or **BROKER:**

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

This document has important legal consequences. Consultation with an attorney is encouraged with respect to its completion or modification.

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

AIA Document A312–2010 combines two separate bonds, a Performance Bond and a Payment Bond, into one form. This is not a single combined Performance and Payment Bond.

Sample

**§ 1** The Contractor and 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, subject to the following terms.

**§ 2** If the Contractor promptly makes payment of all sums due to Claimants, and defends, indemnifies and holds harmless the Owner from claims, demands, liens or suits by any person or entity seeking payment for labor, materials or equipment furnished for use in the performance of the Construction Contract, then the Surety and the Contractor shall have no obligation under this Bond.

**§ 3** If there is no Owner Default under the Construction Contract, the Surety's obligation to the Owner under this Bond shall arise after the Owner has promptly notified the Contractor and the Surety (at the address described in Section 13) of claims, demands, liens or suits against the Owner or the Owner's property by any person or entity seeking payment for labor, materials or equipment furnished for use in the performance of the Construction Contract and tendered defense of such claims, demands, liens or suits to the Contractor and the Surety.

**§ 4** When the Owner has satisfied the conditions in Section 3, the Surety shall promptly and at the Surety's expense defend, indemnify and hold harmless the Owner against a duly tendered claim, demand, lien or suit.

**§ 5** The Surety's obligations to a Claimant under this Bond shall arise after the following:

**§ 5.1** Claimants, who do not have a direct contract with the Contractor,

**.1** have furnished a written notice of non-payment to the Contractor, stating with substantial accuracy the amount claimed and the name of the party to whom the materials were, or equipment was, furnished or supplied or for whom the labor was done or performed, within ninety (90) days after having last performed labor or last furnished materials or equipment included in the Claim; and

**.2** have sent a Claim to the Surety (at the address described in Section 13).

**§ 5.2** Claimants, who are employed by or have a direct contract with the Contractor, have sent a Claim to the Surety (at the address described in Section 13).

**§ 6** If a notice of non-payment required by Section 5.1.1 is given by the Owner to the Contractor, that is sufficient to satisfy a Claimant's obligation to furnish a written notice of non-payment under Section 5.1.1.

**§ 7** When a Claimant has satisfied the conditions of Sections 5.1 or 5.2, whichever is applicable, the Surety shall promptly and at the Surety's expense take the following actions:

**§ 7.1** Send an answer to the Claimant, with a copy to the Owner, within sixty (60) days after receipt of the Claim, stating the amounts that are undisputed and the basis for challenging any amounts that are disputed; and

**§ 7.2** Pay or arrange for payment of any undisputed amounts.

**§ 7.3** The Surety's failure to discharge its obligations under Section 7.1 or Section 7.2 shall not be deemed to constitute a waiver of defenses the Surety or Contractor may have or acquire as to a Claim, except as to undisputed amounts for which the Surety and Claimant have reached agreement. If, however, the Surety fails to discharge its obligations under Section 7.1 or Section 7.2, the Surety shall indemnify the Claimant for the reasonable attorney's fees the Claimant incurs thereafter to recover any sums found to be due and owing to the Claimant.

**§ 8** The Surety's total obligation shall not exceed the amount of this Bond, plus the amount of reasonable attorney's fees provided under Section 7.3, and the amount of this Bond shall be credited for any payments made in good faith by the Surety.

**§ 9** 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 Surety under this Bond, subject to the Owner's priority to use the funds for the completion of the work.

**§ 10** 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 the payment of any costs or expenses of any Claimant under this Bond, and shall have under this Bond no obligation to make payments to, or give notice on behalf of, Claimants or otherwise have any obligations to Claimants under this Bond.

**§ 11** 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.

**§ 12** No suit or action shall be commenced by a Claimant under this Bond other than in a court of competent jurisdiction in the state in which the project that is the subject of the Construction Contract is located or after the expiration of one year from the date (1) on which the Claimant sent a Claim to the Surety pursuant to Section 5.1.2 or 5.2, 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.

**§ 13** Notice and Claims to the Surety, the Owner or the Contractor shall be mailed or delivered to the address shown on the page on which their signature appears. Actual receipt of notice or Claims, however accomplished, shall be sufficient compliance as of the date received.

**§ 14** 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. When so furnished, the intent is that this Bond shall be construed as a statutory bond and not as a common law bond.

**§ 15** Upon request by any person or entity appearing to be a potential beneficiary of this Bond, the Contractor and Owner shall promptly furnish a copy of this Bond or shall permit a copy to be made.

**§ 16 Definitions**

**§ 16.1 Claim.** A written statement by the Claimant including at a minimum:

- **.1** the name of the Claimant;
- **.2** the name of the person for whom the labor was done, or materials or equipment furnished;
- **.3** a copy of the agreement or purchase order pursuant to which labor, materials or equipment was furnished for use in the performance of the Construction Contract;
- **.4** a brief description of the labor, materials or equipment furnished;
- **.5** the date on which the Claimant last performed labor or last furnished materials or equipment for use in the performance of the Construction Contract;
- **.6** the total amount earned by the Claimant for labor, materials or equipment furnished as of the date of the Claim;
- **.7** the total amount of previous payments received by the Claimant; and
- **.8** the total amount due and unpaid to the Claimant for labor, materials or equipment furnished as of the date of the Claim.

**§ 16.2 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 Construction Contract. The term Claimant also includes any individual or entity that has rightfully asserted a claim under an applicable mechanic's lien or similar statute against the real property upon which the Project is located. 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.

**§ 16.3 Construction Contract.** The agreement between the Owner and Contractor identified on the cover page, including all Contract Documents and all changes made to the agreement and the Contract Documents.

**§ 16.4 Owner Default.** Failure of the Owner, which has not been remedied or waived, to pay the Contractor as required under the Construction Contract or to perform and complete or comply with the other material terms of the Construction Contract.

**§ 16.5 Contract Documents.** All the documents that comprise the agreement between the Owner and Contractor.

**§ 17** If this Bond is issued for an agreement between a Contractor and subcontractor, the term Contractor in this Bond shall be deemed to be Subcontractor and the term Owner shall be deemed to be Contractor.

**§ 18** 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** | | **SURETY** | |
|---|---|---|---|
| Company: | *(Corporate Seal)* | Company: | *(Corporate Seal)* |
| Signature: | | Signature: | |
| Name and Title: | | Name and Title: | |
| Address | | Address | |

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.

SECTION 00 72 12

CONDITIONS OF CONTRACT

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## 1. BIDS AND QUOTATIONS

A. **Addressing of Bids.** Bids shall be addressed to attention of Public Works Project Manager and received at Dane County Department of Public Works, Highway & Transportation, 1919 Alliant Energy Center Way, Madison, WI 53713, on or before local time and date specified herein for Bid Due Date. Seal all bids in envelopes and clearly mark front with bid number and reference to specified contents of bid. All uses of term "County" in Construction Documents shall mean Dane County.

B. **Only One Copy Required.** Unless otherwise specified, only one copy of bid or quotation on prescribed Bid Form will be required.

C. **Additional Data with Bid.** Bidder may submit, on firm's letterhead only, additional data and information deemed advantageous to County. County shall hold optional consideration of such data and information.

D. **More than One Bid.** Bidders desiring to submit more than one bid may do so provided such additional bid or bids are properly submitted on Dane County Department of Public Works, Highway & Transportation's Bid Form. Obtain extra sets of Construction Documents from Dane County Department of Public Works, Highway & Transportation. All uses of term "Department" in Construction Documents shall mean Department of Public Works, Highway & Transportation, which is Dane County government unit.

E. **Withdrawal or Late Bids.** County will not accept formal bids, amendments thereto, or requests for withdrawal of bid or any part thereof, after time of Bid Due Date.

F. **Preparation and Submission.** All written bids, unless otherwise provided for, must be submitted on and in accordance with forms provided by County properly signed in ink. Bids not signed by hand are not accepted. Bidders must register in advance with Purchasing Division.

G. **Products by Name.** Intention of Specifications of products by name is to be descriptive of quality, workmanship, finish, function and approximate characteristics desired; intention is not necessarily restriction. Consideration of products substitution for those named is possible, provided substitute offered is, in opinion of Dane County Public Works Project

Manager, equal or superior in quality, workmanship, finish, function and approximate characteristics to that specified in Project Manual Specifications listed herein.

H. **Visitation of Sites.** Bidder shall visit site(s) that will receive intended work or installation, and in so doing, be held responsible for job deemed satisfactory by County after completion of the Work or installation. No additional compensation shall be allowed for any condition of which bidder could have been informed.

I. **Completeness.** Supply all information required by Construction Documents to constitute regular bid. This shall include:
   1. Completed Bid Form.
   2. Completed Fair Labor Practices Certification.
   3. Completed Bid Bond.

J. **Bids Binding Sixty (60) Calendar Days.** Unless otherwise specified all formal bids submitted shall be binding for sixty (60) calendar days following Bid Due Date.

K. **Conditional Bids.** Qualified bids are subject to complete rejection, or partial rejection.

L. **All or Part.** Bids or quotations may be considered and award made for all or any part of total quantities as specified in Construction Documents.

M. **Errors.** Unit bid price shall govern when extending total prices has errors. Carelessness in quoting prices or in preparation of bid otherwise, will not relieve bidder. Explain all erasures in bids and include signature of bidder.

N. **Regulation by State Statutes.** Bidding and letting of contracts are subject to provisions of Wisconsin Statutes 59.52(29) and 66.0901 and all subsequent sections and amendments thereof.

O. **Bidders Present.** Bid Due Date is time fixed for opening of formal bids. Bids' contents will be made public for information of bidders and others properly interested, who may be present either in person or by representative. Bidders are encouraged to attend all openings, and to offer constructive suggestions for improvements to bid format or ways in which County can realize greater savings.

P. **Taxes.** Contractor does not need to pay State and local sales & use taxes. See Wisconsin Statute 77.54 (9m).

## 2. GUARANTEE AND BOND

A. **Bid Bond / Guarantee.** Bid Bond shall accompany Bids, which shall be either flat sum or percentage figure as shown on Project Manual Cover. This Bid Bond shall serve as warrant that successful bidder will fulfill terms of bid within time limit as indicated in bid after notice of award by Dane County. Bid Bond may be certified bank check (note: uncertified checks will not be acceptable), cashier's check or United State money order payable to Treasurer of Dane County; or on Bid Bond with corporate surety authorized to do business in State of Wisconsin and warranty of attorney to confess judgment thereon attached thereto. County will return negotiable Bid Bonds to unsuccessful bidders after awarding of bid. County shall return check held from Contractor after satisfactory completion of Contract or after receipt by

County of Performance Bond from Contractor, if one is required. Surety Bid Bonds will not be returned unless specifically requested by individual bidders.

B. **Guarantor Liability.** When guarantee is required, failure of bidder to furnish acceptable Performance Bond (Article 2.C.) within twenty (20) business days after receipt of notice of award shall render guarantor liable to County. Bids covered by certified check or bond such security shall become absolute property of County and shall be deposited with County Treasurer for benefit of County as liquidated damages. County shall forthwith proceed to collect on Bid Bond.

C. **Performance / Payment Bond.** When required, file guarantee that successful bidder will faithfully perform obligations of bid as accepted. Such guarantee must be bond complying with Wisconsin Statute 779.14 with corporate surety authorized to do business in this State, and that Contractor or subcontractors will be responsible for all claims for injuries to persons or damages to property or premises arising out of or in connection with their operations prior to acceptance of finished work or supplies, and that they will promptly make payments to all persons supplying them with labor or materials in execution of the Work provided for in Contract; guarantee to indemnify, hold harmless and defend Dane County, its boards, commissions, agencies, officers, employees and representatives from all costs, damages and expenses growing out of or by reason of successful bidder's failure to comply and perform the Work and complete Contract in accordance with Construction Documents; attach thereto a warrant of attorney authorizing confession of judgment thereon for benefit of County.

## 3. SHOP DRAWINGS, PRODUCT DATA AND SAMPLES

A. Shop Drawings are drawings, diagrams, schedules and other data specially prepared for the Work by Contractor or subcontractor, sub-subcontractor, manufacturer, supplier or distributor to illustrate some portion of the Work.

B. Product Data are illustrations, standard schedules, performance charts, instructions, brochures, diagrams and other information furnished by Contractor to illustrate materials or equipment for some portion of the Work.

C. Samples are physical examples that illustrate materials, equipment or workmanship and establish standards to compare the Work.

D. Shop Drawings, Product Data, Samples and similar submittals are not Construction Documents. Purpose of their submittal is to demonstrate for those portions of the Work for which submittals are required how Contractor proposes to conform to information given and design concept expressed in Construction Documents.

E. Contractor shall review, approve and submit to Public Works Project Manager Shop Drawings, Product Data, Samples and similar submittals required by Construction Documents with reasonable promptness and in such sequence as to cause no delay in the Work or in activities of County or of separate contractors. Submittals made by Contractor not required by Construction Documents, may be returned without action.

F. Contractor shall perform no portion of the Work requiring submittal and review of Shop Drawings, Product Data, Samples or similar submittals until Public Works Project Manager has approved respective submittal. Such Work shall be in accordance with approved submittals.

G. By approving and submitting, Shop Drawings, Product Data, Samples and similar submittals, Contractor represents that Contractor has determined and verified materials, field measurements and field construction criteria related thereto, or will do so, and has checked and coordinated information contained within such submittals with requirements of the Work and of Construction Documents.

H. Contractor shall not be relieved of responsibility for deviations from requirements of Construction Documents by Public Works Project Manager's approval of Shop Drawings, Product Data, Samples and similar submittals unless Contractor has specifically informed Public Works Project Manager in writing of such deviation at time of submittal and Public Works Project Manager has given written approval to specific deviation. Contractor shall not be relieved of responsibility for errors or omissions in Shop Drawings, Product Data, Sample or similar submittals by Public Works Project Manager's approval thereof.

I. Contractor shall in writing direct specific attention to revised and / or resubmitted Shop Drawings, Product Data, Samples or similar submittals that were not requested by Engineer or Public Works Project Manager on previous submittals.

J. Unless specified otherwise, Contractor shall submit three (3) copies of all Shop Drawings, Product Data, Samples or similar submittals 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.

**4. AWARDS**

A. **Lowest Responsible Bidder.** Award will be to lowest responsible bidder conforming to Construction Documents or on most advantageous bid to County.

B. **Other Considerations.** Quantities involved, time of delivery, purpose for which required, competency of bidder, ability to render satisfactory service and past performance will be considered in determining responsibility.

C. **Rejection of Bids.** County reserves right to reject any or all bids or quotations in whole or in part and to award by items, parts of items, or by any aggregate group of items specified. County also reserves right to waive technical defects when in its judgment best interests of County thereby will be served.

D. **Notice of Acceptance.** Sufficient notification of acceptance of bid will be written notice of award to bidder in form of Purchase Order or similar, mailed or delivered to address shown on Bid Form.

E. **Tie Bids.** If two or more bidders submit identical bids, decision of County to make award to one or more of such bidders shall be final. Cash discount will be taken into consideration in determining award. Also, see Article 7.A. IDENTICAL BIDDING, Antitrust Laws.

F. **Qualifying Bidders.** Prior to solicitation and / or awarding of bid, County may require submission by bidder of complete financial statement and questionnaire describing bidder's financial ability and experience in performance of similar work. Refer to Instructions to Bidders.

G. **Disqualification.** Awards will not be made to any person, firm or company in default of Contract with County, or to any bidder having as its sales agent or representative or as member of firm, any individual previously in default or guilty of misrepresentation.

H. **Bid Results.** Bidders may secure information pertaining to results of bids by visiting Public Works' website, bids-pwht.countyofdane.com/.

## 5. CONTRACT PROVISIONS

A. **Acceptance Constitutes Contract.** Written acceptance by Public Works Project Manager of proposal for services shall constitute Contract, which shall bind bidder to perform the Work as detailed in Construction Documents, for bid amount and in accordance with all conditions of said accepted bid. Formal Contract containing all provisions of Contract signed by both parties shall be used when required by Public Works Project Manager.

B. **Local Restrictions and Permits.** All work shall be done according to applicable laws, ordinances and codes. Contractor shall procure and pay for all required permits for permanent or temporary work.

C. **Payment of Invoices.** Payment may be made only after inspection and acceptance by using agency and approval by Dane County Public Works Project Manager, and, where required by ordinances, approval by Dane County Board of Supervisors. If materials or equipment were delivered, constructed, erected, installed or tested on site, payment shall be made based on ninety-five percent (95%) of value of all the Work performed up to fifty percent (50%) of scheduled values less total of previous payments. Authorized extra work will be included in progress payments. Payment of balances will be made only after approval and final acceptance by County in consideration and elimination of possibilities of imperfect work, faulty materials or equipment, liens that have been filed, or if evidence indicates possible filing of claims.

D. **Contract Alterations.** No alterations or variables in terms of contract shall be valid or binding upon County unless made in writing and signed by Purchasing Agent or authorized agent.

E. **Assignments.** No contract may be assigned, sublet or transferred without written consent of Public Works Project Manager.

F. **Cancellations.** Contract may be canceled or voided by Public Works Project Manager upon non-performance or violation of contract provisions, and award made to next low bidder or articles specified may be purchased on open market. In either event, defaulting contractor (or their surety) shall be liable to Dane County for costs to County in excess of defaulting contractor's contract prices.

G. **Right of Department to Terminate Contract.**

1. In event that Contractor or any subcontractors violate any provisions of this Contract, 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) business 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) business days, cease and terminate.

2. 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. However, if Surety does not commence performance thereof within ten (10) business 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 for account and 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 equipment, materials and / or supplies as may be on site of the Work and therefore necessary.

H. **Non-Liability.** Contractor shall not be liable in damages for delay in shipment or failure to deliver when such delay or failure is result of fire, flood, strike, transporting carrier, act of God, act of government, act of alien enemy or by any other circumstances which, in Public Works Project Manager's opinion, is beyond control of Contractor. Under such circumstances, however, Public Works Project Manager may in discretion, cancel Contract.

I. **Quality Assurance.** Inspection of equipment, materials and / or supplies shall be made by or at direction of County or Agency to which goods are delivered, and any articles supplied that are defective, or fails in any way to meet Specifications or other requirements of Contract, will be rejected. Public Works Project Manager shall direct all required laboratory tests. Decision of Public Works Project Manager on acceptance shall be final.

J. **Time for Completion.** Contractor agrees that the Work shall be prosecuted regularly and diligently and complete entire project as stated in Construction Documents.

K. **Changes in the Work.**
1. Except in cases of emergency, no changes in the Work covered by approved Construction Documents shall be made without having prior written approval of Department. Charges or credits for work covered by approved change shall be determined by one of these methods:
   a) Unit bid prices previously approved.
   b) Agreed lump sum based on actual cost of:
      1) Labor, including foremen, and all fringe benefits that are associated with their wages;
      2) Materials entering permanently into the Work;
      3) Ownership or rental cost of construction plant and equipment during time of use on extra work;
      4) Power and consumable supplies for operation of construction or power equipment;
      5) Workmen's Compensation Insurance, Contractor's Public Liability and Property Damage Insurance, and Comprehensive Automobile Liability Insurance;
      6) Social Security, pension and unemployment contributions;
      7) To cost under K.1.b), there shall be added fixed fee to be agreed upon, but not to exceed fifteen percent (15%) of actual cost of the Work performed with their own labor force; fee shall be compensation to cover cost of supervision, overhead, bond, profit and any other general expense;
      8) On that portion of work under K.1.b) done under subcontract, Contractor may include not over seven and one-half percent (7½%) for supervision, overhead, bond, profit and any other general expense; and
      9) 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.
   c) Cost-Plus Work, with not-to-exceed dollar limit, based on actual cost of:
      1) Labor, including foremen, and all fringe benefits that are associated with their wages;
      2) Materials entering permanently into the Work;
      3) Ownership or rental cost of construction plant and equipment during time of use on extra work. (Rental cost cannot exceed fifty percent (50%) replacement value of rented equipment);

4) Power and consumable supplies for operation of construction or power equipment;
5) Workmen's Compensation, Contractor's Public Liability and Property Damage Insurance, and Comprehensive Automobile Liability Insurance;
6) Social Security, pension and unemployment contributions;
7) To cost under K.1.c) there shall be added fixed fee to be agreed upon, but not to exceed fifteen percent (15%) of actual cost of the Work performed with their own labor force; fee shall be compensation to cover cost of supervision, overhead, bond, profit, and any other general expense;
8) On that portion of work under K.1.c) done under subcontract, Contractor may include not over seven and one-half percent (7½%) for supervision, overhead, bond, profit, and any other general expense; and
9) 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.

2. If Contractor claims that by any instructions given by 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 thereof within two 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.

3. No claim for extra work or cost shall be allowed unless same was done in pursuance of written order of Engineer and approved by Department, as previously mentioned, and claim presented with payment request submitted after changed or extra work is completed.

4. Negotiation of cost for change in the Work shall not be cause for Contractor to delay prosecution of the Work if Contractor has been authorized in writing by Public Works Project Manager to proceed.

L. **Payments to Contractor.**

1. 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 approved Application and Certificate of Payment from Engineer and approval of Department.

2. Contractor shall submit to Engineer Application and Certificate of Payment. Engineer will review and approve this before sending it to Public Works Project Manager. Evidence may be required, and supplied on demand, that supports request and Contractor's right to payment claimed.

3. Request 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. Requests involving 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 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) business days from receipt of payment.

4. Payments by County will be due within forty-five (45) business days after receipt by Department of certified request.

5. Five percent (5%) of each request for certification will be retained 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, remaining payments will be made in full if Engineer and Public Works Project Manager find that progress of the Work corresponds with construction progress schedule. If Engineer and Public Works Project Manager find that progress of the Work does not correspond with construction progress schedule, up to ten percent (10%) of each request for payment may be retained for the Work completed.

6. All material and work covered by partial payments made shall become sole property of County. 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.

7. Final payment will be made within sixty (60) calendar days after final completion of the Work, and will constitute acceptance thereof.

8. On completion and acceptance of each separate division of Contract, on which stated price is separated in Contract, payment may be made in full, including retained percentages thereon, less authorized deductions.

9. 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.

M. **Withholding of Payments.**

1. 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. Then 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.

2. 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.

3. 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.

4. At Department's request, Contractor shall furnish satisfactory evidence that all obligations of nature designated above have been paid, discharged or waived.

N. **Acceptance of Final Payment as Release.**

1. Making of final payment shall constitute waiver of all claims by County except those arising from:

a) Unsettled lien;
b) Faulty or defective work appearing after substantial completion;
c) Failure of the Work to comply with requirements of Construction Documents; or
d) Terms of any special guarantees required by Construction Documents.

2. Acceptance of final payment shall constitute waiver of all claims by Contractor.

O. **Lien Waivers.** Contractor warrants that title to all work covered by application for Payment will pass to County no later than time of payment. Contractor further warrants that upon submittal of Application for Payment all work for which Certificates for Payment have been previously issued and payments received from County shall, to best of Contractor's knowledge, information and belief, be free and clear of liens, claims, security interests or encumbrances in favor of Contractor, subcontractor, material suppliers, or other persons or entities making claim by reason of having provide labor, materials and equipment related to the Work.

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

Q. **Correction of Work.**
1. 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 Engineer and Public Works Project Manager who shall be judge of quality and suitability of work, materials, and processes of manufacture for purposes for which they are used. Should they fail to meet Engineer's and Public Works Project Manager's approval they shall be reconstructed, made good, replaced or corrected, as case may be, by Contractor at Contractor's expense. Rejected material shall immediately be removed from site.

2. 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) business 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 payments then or thereafter due Contractor cost of correcting such deficiencies, including cost of Engineer's additional services made necessary by such default, neglect or failure.

## 6. 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 therefrom, which appear within period of one 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 Engineer and Public Works Project Manager.

D. Where guarantees or warrantees are required in sections of Construction Documents for periods in excess of one year, such longer terms shall apply; however, Contractor's Performance / Payment Bond shall not apply to any guarantee or warranty period in excess of one year.

## 7. IDENTICAL BIDDING

A. **Antitrust Laws.** All identical bids submitted to County because of advertised procurement for materials, supplies, equipment or services exceeding $1,000,000.00 in total amount shall be reported to Attorney Generals of the United States and State of Wisconsin for possible violation and enforcement of antitrust laws.

## 8. BINDING CONTRACTS

A. **Contract Commitment.** Any contracts resulting from this bid shall be binding on successful bidder(s) to its conclusion and on its assigns, heirs, executors, administrators or successors.

## 9. AFFIRMATIVE ACTION PROVISION AND MINORITY / WOMEN / DISADVANTAGED BUSINESS ENTERPRISES

A. **Affirmative Action Provisions.** During term of its 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, available 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.

B. Contractor is subject to this paragraph only if Contractor has twenty (20) or more employees and receives $20,000.00 or more in annual aggregate contracts with County. Contractor shall file Affirmative Action Plan with Dane County Contract Compliance Specialist in accord with Chapter 19 of Dane County Code of Ordinances. Contractor must file such plan within fifteen (15) business days of effective date of this Contract and failure to do so by that date shall constitute grounds for immediate termination of Contract. During term of this Contract, Contractor shall also provide copies of all announcements of employment opportunities to County's Office of Equity & Inclusion, and shall report annually number of persons, by race,

sex and handicap status, which apply for employment, and, similarly classified, number hired and number rejected.

C. Contact Dane County Contract Compliance Specialist at Dane County Office of Equity & Inclusion, 210 Martin Luther King, Jr. Blvd., Room 356, Madison, WI 53703, 608/266-4192.

D. In all solicitations for employment placed on Contractor's behalf during term of this Contract, Contractor shall include statement to effect that Contractor is "Equal Opportunity Employer."

E. Contractor agrees to furnish all information and reports required by County's Contract Compliance Specialist as same relate to affirmative action and nondiscrimination, which may include any books, records, or accounts deemed appropriate to determine compliance whit Chapter 19, Dane County Code of Ordinances, and provision of this Contract.

F. **Minority / Women / Disadvantaged / Emerging Small Business Enterprises.** Chapter 19.508 of Dane County Code of Ordinances is official policy of Dane County to utilize Minority Business Enterprises (MBEs), Women Business Enterprises (WBEs), Disadvantage Business Enterprises (DBEs) and Emerging Small Business Enterprises (ESBEs) fully.

## 10. COMPLIANCE WITH FAIR LABOR STANDARDS

A. During term of this Contract, Contractor shall report to County Contract Compliance Specialist, within ten (10) business 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 Specialist 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 Specialist 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."

## 11. DOMESTIC PARTNERSHIP BENEFITS

A. Not Used.

## 12. INSURANCE REQUIREMENTS

A. 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 there from, 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 a part indemnified hereunder.

B. 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.

C. Obligations of Contractor under this Contract shall not extend to liability of Engineer, its agents or employees arising out of (1) preparation or approval of maps, drawings, opinion, reports, surveys, change orders, designs or specifications; or (2) giving of or failure to give directions or instruction by Engineer, its agents or employees provided such giving or failure to give is primary cause of injury or damage.

D. 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.

E. **Contractor Carried Insurance.** In order to protect itself and County, Contractor shall not commence work under this Contract until obtaining all required insurance and County has approved such insurance. Contractor shall not allow any subcontractor to commence work on subcontract until insurance required of subcontractor has been so obtained and approved.

1. Worker's Compensation Insurance
   Contractor shall procure and shall maintain during life of this Contract, Worker's Compensation Insurance as required by statute for all of its employees engaged in work at site of project under this Contract and, in case of 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.

2. Contractor's Public Liability and Property Damage Insurance
   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 then $1,000,000.00 per occurrence for bodily injury and death, and Contractor's Property Damage Insurance in amount not less than $1,000,000.00 and shall be primary with Dane County as "Additional Insured".

3. Auto Liability Insurance
   Contractor shall procure and maintain during life of this Contract, Comprehensive Automobile Liability Insurance covering owned, non-owned and hired automobiles for limits of not less than $1,000,000.00 and shall be primary with Dane County as "Additional Insured".

F. Contractor either (1) shall require each subcontractors 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 that activities of subcontractors in their own policy.

G. Contractor shall furnish County with certificates showing type, amount, class of operations covered, effective dates and dates of expiration of policies. Such certificates shall also contain substantially this statement: "Insurance covered by this certificate will not be canceled or materially altered, except after ten (10) business days written notice has been received by County."

H. **Builder's Risk.** County shall provide Builder's Risk insurance coverage for its insurable interests in construction or renovation projects with completed value of $1,000,000 or less. Therefore, if project completed value is more than $1,000,000, Contractor shall obtain and maintain in force, at its own expense, Builder's Risk Insurance on all risks for amount equal to full completed value of covered structure or replacement value of alterations or additions. Any deductible shall not exceed $25,000 for each loss. Policy shall include occupancy clause and list Dane County as loss payee.

END OF SECTION

Department of Public Works, Highway & Transportation
**Public Works Engineering Division**
**608/266-4018**

Gerald J. Mandli, P.E.
**Commissioner / Director**

Joseph T. Parisi
**County Executive**

**Deputy Director**
Todd Draper

1919 Alliant Energy Center Way
Madison, Wisconsin 53713
Fax: 608/267-1533
www.countyofdane.com/pwht/public_works.aspx

# BEST VALUE CONTRACTING APPLICATION

## CONTRACTORS / LICENSURE APPLICANTS

The Dane County Department of Public Works requires all contractors & subcontractors to be a best value contractor before being hired. Application documents are due to the County prior to Bid Due Date. Approval or rejection shall be within five (5) days of Bid Due Date. This document shall be completed, properly executed, along with the necessary attachments and additional information that the County requires for the protection and welfare of the public in the performance of a County contract.

Contractors or subcontractors of any tier who attain qualification status will retain that status for a period of two (2) years from the date of qualification. Contractors shall notify the Dane County Department of Public Works, Highway & Transportation within fifteen (15) days of any changes to its business or operations that are relevant to the application. Failure to do so could result in suspension, revocation of the contractor's qualification, debarment from County contracts for up to three (3) years and / or other sanctions available under the law.

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

## EXEMPTIONS

- Contractors who employ less than five (5) apprenticeable trade workers are not required to qualify.
- Contractors performing work that does not apply to an apprenticeable trade, as outlined in Appendix A.
- The contractor / subcontractor provides sufficient documentation to demonstrate one or more of the following:
  - apprentices are not available in a specific geographic area;
  - the applicable apprenticeship program is unsuitable or unavailable; or
  - there is a documented depression of the local construction market which prevents compliance.

| SEC. | PROOF OF RESPONSIBILITY | CHECK IF APPLICABLE |
|---|---|---|
| 1 | Does your firm possesses all technical qualifications and resources, including equipment, personnel and financial resources, necessary to perform the work required for any project or obtain the same through the use of responsible, qualified subcontractors? | Yes: ☐ No: ☐ |
| 2 | Will your firm possess all valid, effective licenses, registrations or certificates required by federal, state, county, or local law, which are necessary for the type of work to be performed including, but not limited to, those for any type of trade work or specialty work? | Yes: ☐ No: ☐ |
| 3 | Will your firm meet all bonding requirements as required by applicable law or contract specifications? | Yes: ☐ No: ☐ |
| 4 | Will your firm meet all insurance requirements as required by applicable law or specifications, including general liability insurance, workers compensation insurance and unemployment insurance requirements? | Yes: ☐ No: ☐ |
| 5 | Will your firm maintain a substance abuse policy for employees hired for public works contracts that comply with Wis. Stats. Sec. 103.503? | Yes: ☐ No: ☐ |
| 6 | Will your firm fully abide by the equal opportunity and affirmative action requirements of all applicable laws, including County ordinances? | Yes: ☐ No: ☐ |
| 7 | 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: ☐ No: ☐ If Yes, attach details. |
| 8 | 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: ☐ No: ☐ If Yes, attach details. |
| 9 | In the past three (3) years, has your firm been debarred by any federal, state or local government agency? | Yes: ☐ No: ☐ If Yes, attach details. |
| 10 | In the past three (3) years, has your firm defaulted or failed to complete any contract? | Yes: ☐ No: ☐ If Yes, attach details. |
| 11 | 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: ☐ No: ☐ If Yes, attach details. |
| 12 | 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: ☐ No: ☐ If Yes, attach details. |
| 13 | Is your firm an active Wisconsin Trade Trainer as determined by the Wisconsin Bureau of Apprenticeship Standards? | Yes: ☐ No: ☐ |
| 14 | Is your firm exempt from being qualified with Dane County? | Yes: ☐ No: ☐ If Yes, attach reason for exemption. |
| 15 | 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 qualified with the County or become so within five (5) days after the Bid Due Date? | Yes: ☐ No: ☐ |
| 16 | Contractor has been in business less than one year? | Yes: ☐ No: ☐ |
| 17 | Is your firm a first time Contractor requesting a one time exemption, but, intend to comply on all future contracts and are taking steps typical of a “good faith” effort? | Yes: ☐ No: ☐ |

# 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: _____

(Application is invalid without signature)

Print Name: _____ Date: _____

Title: _____

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

# REMEMBER!

**RETURN ALL TO FORMS AND ATTACHMENTS, OR QUESTIONS TO:**

**TODD DRAPER**
**EMAIL: DRAPER@COUNTYOFDANE.COM**
**OFFICE: (608) 267-0119, FAX: (608) 267-1533**

**DANE COUNTY DEPARTMENT OF PUBLIC WORKS, HGHWAY & 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

END OF SECTION

SECTION 00 73 11

FAIR LABOR PRACTICES CERTIFICATION

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

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

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

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

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

_____ _____

Officer or Authorized Agent Signature | Date

_____

Printed or Typed Name and Title

_____

Printed or Typed Business Name

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

For reference, Dane County Ordinance 25.09 is as follows:

(1) 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 Controller shall investigate any such finding and make a recommendation to the committee, which shall determine whether the conduct resulting in the finding affects the bidder's responsibility to perform the contract.

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

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

END OF SECTION

SECTION 01 00 00

GENERAL REQUIREMENTS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Summary
2. Summary of the Work
3. Contractor Use of Premises
4. Applications for Payment
5. Change Procedures
6. Alternates
7. Lump Sum Allowances for Work
8. Coordination
9. Cutting and Patching
10. Conferences
11. Progress Meetings
12. Job Site Administration
13. Submittal Procedures
14. Proposed Products List
15. Shop Drawings
16. Product Data
17. Samples
18. Manufacturers' Instructions
19. Manufacturers' Certificates
20. Quality Assurance / Quality Control of Installation
21. References
22. Interior Enclosures
23. Protection of Installed Work
24. Parking
25. Staging Areas
26. Occupancy During Construction and Conduct of Work
27. Protection
28. Progress Cleaning
29. Products
30. Transportation, Handling, Storage and Protection
31. Product Options
32. Substitutions
33. Starting Systems
34. Demonstration and Instructions
35. Contract Closeout Procedures
36. Final Cleaning
37. Adjusting
38. Operation and Maintenance Data
39. Spare Parts and Maintenance Materials

40. As-Built and Record Drawings and Specifications

1.2 SUMMARY OF THE WORK

A. Project Description: Perform the Work as specified and detailed in Construction Documents package. Contractor to provide installation of new backup cooling units for the data room of the Public Safety Communications Center at the City-County Building.

B. Work by Owner: Not applicable.

C. Permits: Not applicable.

1.3 CONTRACTOR USE OF PREMISES

A. Limit use of premises to allow work by others and work by Owner.

B. Coordinate utility outages and shutdowns with Owner.

1.4 APPLICATIONS FOR PAYMENT

A. Submit one (1) original copies with “wet” signatures 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.

D. Submit Applications for Payment to Public Works Project Manager for approval & processing for payment.

1.5 CHANGE PROCEDURES

A. Contractor's costs for Products, delivery, installation, labor, insurance, payroll, taxes, bonding, equipment rental, overhead and profit will be included in Change Orders authorizing expenditure of funds from contingency allowance.

1.6 ALTERNATES

A. Alternates quoted on Bid Form shall be reviewed and accepted or rejected at Owner's option.

B. Coordinate related work and modify surrounding work as required.

C. Schedule of Alternates: there are no alternates proposed for this project.

1.7 LUMP SUM ALLOWANCES FOR WORK

A. Include in Base Bid lump sum allowance for installation of backup cooling units in the Public Safety Communications Center data room. Allowance shall include all necessary labor, equipment, materials, plus cost for delivery, installation, insurance, overhead, profit and applicable taxes. Coordinate this with Public Works Project Manager & Engineer

1.8 COORDINATION

A. Coordinate scheduling, submittals, and work of various sections of Specifications to assure efficient and orderly sequence of installation of interdependent construction elements.

B. Verify utility requirement characteristics of operating equipment are compatible with building utilities.

C. Coordinate space requirements and installation of mechanical and electrical work that are indicated diagrammatically on Drawings.

D. Contractor shall provide Public Works Project Manager with work plan that ensures the Work will be completed within required time of completion.

E. Public Works Project Manager may choose to photograph or videotape site or workers as the Work progresses.

1.9 CUTTING AND PATCHING

A. Employ 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.

1.10 CONFERENCES

A. Project shall have pre-bid conference; see Instructions to Bidders.

B. Owner will schedule preconstruction conference after Award of Contract for all affected parties.

C. Contractor shall submit Construction Schedule at pre-construction meeting.

1.11 PROGRESS MEETINGS

A. Schedule and administer meetings throughout progress of the Work at minimum of one (1) per week, with Public Works Project Manager.

B. Preside at meetings, record minutes, and distribute copies within two (2) business days to those affected by decisions made.

C. Attendance at progress meetings by General Contractor, subcontractors, or their authorized representative, is mandatory.

D. Contractors shall give verbal reports of progress on the Work, discuss schedule for upcoming period and present all conflicts, discrepancies or other difficulties for resolution.

E. Day & time of progress meetings to be determined at pre-construction meeting.

1.12 JOB SITE ADMINISTRATION

A. Not Used

1.13 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.

1.14 PROPOSED PRODUCTS LIST

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

1.15 SHOP DRAWINGS

A. Submit number of copies that Contractor requires, plus three (3) copies that shall be retained by Public Works Project Manager.

1.16 PRODUCT DATA

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

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.

1.17 SAMPLES

A. Submit samples to illustrate functional and aesthetic characteristics of Product.

B. Submit samples of finishes from full range of manufacturers' standard colors, textures, and patterns for Public Works Project Manager's selection.

1.18 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.

1.19 MANUFACTURERS' CERTIFICATES

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

1.20 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.

1.21 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 Manager before proceeding.

1.22 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.

1.23 PROTECTION OF INSTALLED WORK

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

1.24 PARKING

A. Arrange for temporary parking areas to accommodate construction personnel. Parking shall not be available at the Work site.

B. All contractors and their employees shall cooperate with General Contractor and others in parking of vehicles to avoid interference with normal operations and construction activities.

C. Do not obstruct existing service drives and parking lots with equipment, materials and / or vehicles. Keep accessible for Owner’s use at all times.

1.25 STAGING AREAS

A. Coordinate staging areas with Public Works Project Manager 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 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.

1.26 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. Work performed on Saturday shall be by permission of Owner. 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., and 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..

1.27 PROTECTION

A. Contractor shall protect from damage / injury all trees, shrubs, hedges, plantings, grass, mechanical, electrical & plumbing equipment, walks and driveways and pay for any damage to same resulting from insufficient or improper protection.

B. Contractor shall provide and maintain barricades & signage to prohibit public access to construction site.

C. 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.

1.28 PROGRESS CLEANING

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

1.29 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.

1.30 TRANSPORTATION, HANDLING, STORAGE AND PROTECTION

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

1.31 PRODUCT OPTIONS

A. Where definite material is specified, it is not intentional to discriminate against "equal" product made by another manufacturer. Intention is to set definite standard of material quality. Should bidder choose to bid materials other than those specified, bidder shall submit said materials specifications to Public Works Project Manager for approval at least seven (7) business days prior to Bid Due Date.

B. Products and materials that are not specified, but have been approved for use by Public Works Project Manager shall be identified in addenda to all bidding contractors.

C. Requests for material or product substitutions submitted after Bid Due Date may be considered. Owner reserves right to approve or reject substitutions based on Specification requirements and intended use.

1.32 SUBSTITUTIONS

A. Public Works Project Manager shall consider requests for Substitutions only within fifteen (15) calendar days after date of Public Works Construction Contract.

B. Document each request with complete data substantiating compliance of proposed Substitution with Construction Documents.

C. Submit three (3) copies of requests for Substitution for consideration. Limit each request to one (1) proposed Substitution.

D. Substitutions shall not change contract price established at Bid Due Date.

1.33 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.

1.34 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 photograph or videotape demonstration session; demonstration and demonstrator shall be to level of satisfaction of Owner.

1.35 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 Manager's inspection.

B. Submit final Application for Payment identifying total adjusted Contract Sum / Price, previous payments, and amount remaining due.

1.36 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.

1.37 ADJUSTING

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

1.38 OPERATION AND MAINTENANCE MANUAL

A. Provide two (2) bound, hard-copy operation and maintenance manuals that include all systems, materials, products, equipment, mechanical and electrical equipment and systems supplied and installed in the Work. Provide electronic version of operation and maintenance manual also.

1.39 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.

1.40 AS-BUILT AND RECORD DRAWINGS AND SPECIFICATIONS

A. Contractor-produced Drawings and Specifications shall remain property of Contractor whether Project for which they are made is executed or not. Contractor shall furnish Engineer with original marked up redlines of Construction Documents' drawings and specifications that shall include all Addendums, Change Orders, Construction Bulletins,

on-site changes, field corrections, etc. These are project As-Built Drawings & Specifications.

B. Engineer shall update original Construction Documents to include all Addendums & any other changes including those provided by Contractor in As-Built Drawings & Specifications. These updates are project Record Drawings & Specifications.

C. Engineer shall furnish Public Works Project Manager with Record Drawings as detailed in Professional Services Agreement.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

SECTION 01 74 19

CONSTRUCTION WASTE MANAGEMENT, DISPOSAL & RECYCLING

## PART 1 GENERAL

### 1.1 SUMMARY

A. Section Includes:
1. Summary
2. Waste Management Goals
3. Construction and / or Demolition Waste Management
4. Waste Management Plan
5. Reuse
6. Recycling
7. Materials Sorting and Storage On Site
8. Lists of Recycling Facilities Processors and Haulers
9. Waste Management Plan Form

B. Related Sections:
1. Section 01 00 00 - General 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 Dane County Green Building Policy, Resolution 299, 1999-2000.

### 1.3 CONSTRUCTION AND / OR DEMOLITION WASTE MANAGEMENT

A. All construction and demolition waste suitable for recycling must go to Dane County Construction & Demolition Recycling Facility located at 7102 US Hwy 12, Madison, located across from Yahara Hills Golf Course. This facility can receive mixed loads of construction and demolition waste. For complete list of acceptable materials see www.countyofdane.com/pwht/recycle/CD_Recycle.aspx.

B. Dane County Landfill, also at 7102 US Hwy 12, Madison, must receive all other waste from this project. www.countyofdane.com/pwht/recycle/landfill.aspx.

### 1.4 WASTE MANAGEMENT PLAN

A. Contractor shall develop Waste Management Plan (WMP) for this project. Dane County's Special Projects & Materials Manager may be contacted with questions. 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.

B. Contractor shall complete WMP and include cost of recycling / reuse in Bid. WMP will be submitted to Public Works Project Manager within fifteen (15)

business days of Bid Due 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.

1.5 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.

1.6 RECYCLING

A. These materials must be recycled at Dane County Construction & Demolition Recycling Facility:
    1. Wood.
    2. Wood Pallets.
    3. PVC Plastic (pipe, siding, etc.).
    4. Asphalt & Concrete.
    5. Bricks & Masonry.
    6. Vinyl Siding.
    7. Cardboard.
    8. Metal.
    9. Unpainted Gypsum Drywall.
    10. Shingles.

B. These materials can be recycled elsewhere in Dane County area:
    1. Fluorescent Lamps.
    2. Foam Insulation & Packaging (extruded and expanded).
    3. Carpet Padding.
    4. Barrels & Drums.

C. All materials must be recycled at WDNR permitted waste processing facilities that adhere to all State Statutes.

1.7 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.

C. Mixed loads of recycled materials are allowed only per instructions at www.countyofdane.com/pwht/recycle/CD_Recycle.aspx.

1.8 LISTS OF RECYCLING FACILITIES PROCESSORS AND HAULERS

A. Refer to www.countyofdane.com/pwht/recycle/CD_Recycle.aspx for information on Dane County Construction & Demolition Recycling Facility.

B. Web site www.countyofdane.com/pwht/recycle/categories.aspx lists current information for Dane County Recycling Markets. Contractors can also contact Allison Rathsack at 608/266-4990, or local city, village, town recycling staff listed at site www.countyofdane.com/pwht/recycle/contacts.aspx. Statewide listings of recycling / reuse markets are available from UW Extension at https://www.uwgb.edu/shwec/.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

## WASTE MANAGEMENT PLAN FORM

Contractor 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.<br>_____ tons | _____ Recycled _____ Reused<br>_____ Landfilled _____ Other | Name:_____ |
| Wood | _____ cu. yds.<br>_____ tons | _____ Recycled _____ Reused<br>_____ Landfilled _____ Other | Name:_____ |
| Wood Pallets | _____ units | _____ Recycled _____ Reused<br>_____ Landfilled _____ Other | Name:_____ |
| PVC Plastic | _____ cu. ft.<br>_____ lbs. | _____ Recycled _____ Reused<br>_____ Landfilled _____ Other | Name:_____ |
| Asphalt & Concrete | _____ cu. ft.<br>_____ lbs. | _____ Recycled _____ Reused<br>_____ Landfilled _____ Other | Name:_____ |
| Bricks & Masonry | _____ cu. ft.<br>_____ lbs. | _____ Recycled _____ Reused<br>_____ Landfilled _____ Other | Name:_____ |
| Vinyl Siding | _____ cu. ft.<br>_____ lbs. | _____ Recycled _____ Reused<br>_____ Landfilled _____ Other | Name:_____ |
| Cardboard | _____ cu. ft.<br>_____ lbs. | _____ Recycled _____ Reused<br>_____ Landfilled _____ Other | Name:_____ |
| Metals | _____ cu. yds.<br>_____ tons | _____ Recycled _____ Reused<br>_____ Landfilled _____ Other | Name:_____ |
| Unpainted Gypsum / Drywall | _____ cu. yds.<br>_____ tons | _____ Recycled _____ Reused<br>_____ Landfilled _____ Other | Name:_____ |
| Shingles | _____ cu. yds.<br>_____ tons | _____ Recycled _____ Reused<br>_____ Landfilled _____ Other | Name:_____ |
| Fluorescent Lamps | _____ cu. ft.<br>_____ lbs. | _____ Recycled _____ Reused<br>_____ Landfilled _____ Other | Name:_____ |
| Foam Insulation | _____ cu. ft.<br>_____ lbs. | _____ Recycled _____ Reused<br>_____ Landfilled _____ Other | Name:_____ |
| Carpet Padding | _____ cu. ft.<br>_____ lbs. | _____ Recycled _____ Reused<br>_____ Landfilled _____ Other | Name:_____ |
| Barrels & Drums | _____ units | _____ Recycled _____ Reused<br>_____ Landfilled _____ Other | Name:_____ |
| Glass | _____ cu. yds.<br>_____ tons | _____ Recycled _____ Reused<br>_____ Landfilled _____ Other | Name:_____ |

## WASTE MANAGEMENT PLAN FORM

| | | | |
|---|---|---|---|
| Other | _____ | _____ Recycled _____ Reused<br>_____ Landfilled _____ Other | Name:_____ |
| Other | _____ | _____ Recycled _____ Reused<br>_____ Landfilled _____ Other | Name:_____ |
| Other | _____ | _____ Recycled _____ Reused<br>_____ Landfilled _____ Other | Name:_____ |
| Other | _____ | _____ Recycled _____ Reused<br>_____ Landfilled _____ Other | Name:_____ |
| Other | _____ | _____ Recycled _____ Reused<br>_____ Landfilled _____ Other | Name:_____ |

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

## P A R T 1 - G E N E R A L

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

PART 1 - GENERAL
- Scope
- Related Work
- Reference
- Reference Standards
- Quality Assurance
- Continuity of Existing Services
- Protection of Finished Surfaces
- Sleeves and Openings
- Sealing and Fire Stopping
- Submittals
- Off Site Storage
- Certificates and Inspections
- Operating and Maintenance Data
- Training of Owner Personnel
- Record Drawings

PART 2 - PRODUCTS
- Access Panels and Doors
- Identification
- Sealing and Fire Stopping

PART 3 - EXECUTION
- Demolition
- Concrete Work
- Cutting and Patching
- Building Access
- Equipment Access
- Coordination
- Identification
- Lubrication
- Sleeves and Openings
- Sealing and Fire Stopping

**RELATED WORK**
Section 23 05 13 - Common Motor Requirements for HVAC.

**REFERENCE**
Applicable provisions of Division 1 govern work under this section.

**REFERENCE STANDARDS**
Abbreviations of standards organizations referenced in other sections are as follows:

| | |
|---|---|
| AABC | Associated Air Balance Council |
| ABMA | American Boiler Manufacturers Association |
| ADC | Air Diffusion Council |
| AGA | American Gas Association |
| AMCA | Air Movement and Control Association |
| ANSI | American National Standards Institute |
| ARI | Air-Conditioning and Refrigeration Institute |
| ASHRAE | American Society of Heating, Refrigerating and Air Conditioning Engineers |
| ASME | American Society of Mechanical Engineers |
| ASTM | American Society for Testing and Materials |
| AWWA | American Water Works Association |
| AWS | American Welding Society |
| CGA | Compressed Gas Association |

| | |
|---|---|
| CTI | Cooling Tower Institute |
| EPA | Environmental Protection Agency |
| GAMA | Gas Appliance Manufacturers Association |
| IEEE | Institute of Electrical and Electronics Engineers |
| ISA | Instrument Society of America |
| MCA | Mechanical Contractors Association |
| MICA | Midwest Insulation Contractors Association |
| MSS | Manufacturer's Standardization Society of the Valve & Fitting Industry, Inc. |
| NBS | National Bureau of Standards |
| NEBB | National Environmental Balancing Bureau |
| NEC | National Electric Code |
| NEMA | National Electrical Manufacturers Association |
| NFPA | National Fire Protection Association |
| SMACNA | Sheet Metal and Air Conditioning Contractors' National Association. Inc. |
| UL | Underwriters Laboratories Inc. |
| ASTM E814 | Standard Test Method for Fire Tests of Through-Penetration Fire Stops |
| ASTM E84 | Standard Test Method for Surface Burning Characteristics of Building Materials |
| UL1479 | Fire Tests of Through-Penetration Firestops |
| UL723 | Surface Burning Characteristics of Building Materials |

**QUALITY ASSURANCE**
Refer to Division 1, General Conditions, Equals and Substitutions.

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

**CONTINUITY OF EXISTING SERVICES**
Do not interrupt or change existing services without prior written approval from the owner Project Representative. When interruption is required, coordinate the down-time with the user agency to minimize disruption to their activities. Unless specifically stated, all work involved in interrupting or changing existing services is to be done during normal working hours.

**PROTECTION OF FINISHED SURFACES**
Refer to Division 1, General Requirements, Protection of Finished Surfaces.

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

**SLEEVES AND OPENINGS**
Refer to Division 1, General Requirements, Sleeves and Openings.

**SEALING AND FIRE STOPPING**
Sealing and fire stopping of sleeves/openings between ductwork, piping, etc. and the sleeve, structural or partition opening shall be the responsibility of the contractor whose work penetrates the opening. Provide all fire stopping of fire rated penetrations and sealing of smoke rated penetrations in compliance with section 07 84 00 Fire Stopping.

**SUBMITTALS**
Refer to Division 1, General Conditions, Submittals.

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

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

motor starter schedules are in agreement or indicate any discrepancies. See related comments in Section 23 05 13 in Part 1 under Electrical Coordination.

Include wiring diagrams of electrically powered equipment.

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

- Operating and Maintenance Manuals 2 copies
- Testing, Adjusting and Balancing Contractor 1 copy
- Division of Facilities Development 1 copy
- A/E 1 copy

**OFF SITE STORAGE**
Prior approval by the owner and the A/E will be needed. The contractor shall submit Storage Agreement Form AD-BDC-74 to the owner for consideration of off site materials storage.

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

**CERTIFICATES AND INSPECTIONS**
Refer also to Division 1, General Conditions, Permits, Regulations, Utilities and Taxes.

Obtain and pay for all required State installation inspections except those provided by the Architect/Engineer in accordance with code. Deliver originals of these certificates to the Division Project Representative. Include copies of the certificates in the Operating and Maintenance Instructions.

**OPERATION AND MAINTENANCE DATA**
All operations and maintenance data shall comply with the submission and content requirements specified under section GENERAL REQUIREMENTS.

In addition to the general content specified under GENERAL REQUIREMENTS supply the following additional documentation:

1. Records of tests performed a to certify compliance with system requirements
2. Certificates of inspection by regulatory agencies
3. Valve schedules
4. Lubrication instructions, including list/frequency of lubrication
5. Copies of all approved shop drawings.
6. Manufacturer's wiring diagrams for electrically powered equipment
7. Temperature control record drawings and control sequences
8. Parts lists for manufactured equipment
9. Warranties
10. Additional information as indicated in the technical specification sections

**TRAINING OF OWNER PERSONNEL**
Instruct user agency personnel in the proper operation and maintenance of systems and equipment provided as part of this project; video tape all training sessions. Include not less than __2__ hours of instruction, using the Operating and Maintenance manuals during this instruction. Demonstrate startup and shutdown procedures for all equipment. All training to be during normal working hours.

**RECORD DRAWINGS**
Refer to Division 1, General Requirements, Record Drawings.

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

## P A R T 2 - P R O D U C T S

**ACCESS PANELS AND DOORS**

LAY-IN CEILINGS:
Removable lay-in ceiling tiles in 2 X 2 foot or 2 X 4 foot configuration provided under Section 09500 are sufficient; no additional access provisions are required unless specifically indicated.

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

**IDENTIFICATION**
STENCILS:
Not less than 1 inch high letters/numbers for marking pipe and equipment.

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

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

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

**SEALING AND FIRE STOPPING**
FIRE AND/OR SMOKE RATED PENETRATIONS:
Provide all fire stopping of fire rated penetrations and sealing of smoke rated penetrations in compliance with section 07 84 00 “Fire Stopping”.

NON-RATED PENETRATIONS:

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

## P A R T 3 - E X E C U T I O N

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

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

**CUTTING AND PATCHING**
This contractor shall be responsible for all cutting and patching. Refer to Division 1, General Requirements, Cutting and Patching.

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

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

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

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

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

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

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

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

Identify piping not less than once every 30 feet, not less than once in each room, adjacent to each access door or panel, and on both side of the partition where exposed piping passes through walls, floors or roofs. Place flow directional arrows at each pipe identification location. Use one coat of black enamel against a light background or white enamel against a dark background for stenciling or provide snap-on pipe markers as specified in Part 2 – Products.

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

Use engraved name plates to identify control equipment.

**LUBRICATION**

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

**SLEEVES AND OPENINGS**
Pipe penetrations in existing concrete floors: Core drill openings.

Where penetrating pipe or conduit weight is supported by floor, provide manufactured product or structural bearing collar designed to carry load.

**SEALING AND FIRE STOPPING**
FIRE AND/OR SMOKE RATED PENETRATIONS
Provide all fire stopping of fire rated penetrations and sealing of smoke rated penetrations in compliance with section 07 84 00 Fire Stopping.

NON-RATED PENETRATIONS:
In exterior wall openings below grade, assemble rubber links of mechanical seal to the proper size for the pipe and tighten in place, in accordance with manufacturer's instructions. Install so that the bolts used to tighten the seal are accessible from the interior of the building or vault.

At all interior walls and exterior walls, pipe penetrations are required to be sealed. Apply sealant to both sides of the penetration in such a manner that the annular space between the pipe sleeve or cored opening and the pipe or insulation is completely blocked.

END OF SECTION

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

## P A R T 1 - G E N E R A L

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

PART 1 - GENERAL
- Scope
- Related Work
- Reference
- Reference Standards
- Quality Assurance
- Shop Drawings
- Operating and Maintenance Data
- Electrical Coordination
- Product Criteria

PART 2 - PRODUCTS
- Three Phase, Single Speed Motors
- Single Phase, Single Speed Motors

PART 3 - EXECUTION
- Installation

**RELATED WORK**
Division 26 00 00 - Electrical

**REFERENCE**
Applicable provisions of Division 1 govern work under this section.

**REFERENCE STANDARDS**

| | |
|---|---|
| ANSI/IEEE 112 | Test Procedure for Polyphase Induction Motors and Generators |
| ANSI/NEMA MG-1 | Motors and Generators |
| ANSI/NFPA 70 | National Electrical Code |

**QUALITY ASSURANCE**
Refer to division 1, General Conditions, Equals and Substitutions.

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

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

**OPERATION AND MAINTENANCE DATA**
All operations and maintenance data shall comply with the submission and content requirements specified under section GENERAL REQUIREMENTS.

In addition to the general content specified under GENERAL REQUIREMENTS supply the following additional documentation:
1. Lubrication instructions, including list/frequency of lubrication
2. Table noting full load power factor, service factor, NEMA design designation, insulation class and frame type for each motor provided

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

Electrical drawings and/or specifications show number and horsepower rating of all motors furnished by this Contractor, together with their actuating devices if these devices are furnished by the Electrical Contractor.

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

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

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

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

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

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

## P A R T 2 - P R O D U C T S

**THREE PHASE, SINGLE SPEED MOTORS**
Use NEMA rated [460] volt, three phase, 60 hertz motors for all motors 1/2 HP and larger unless specifically indicated.

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

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

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

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

FULL LOAD NOMINAL MOTOR EFFICIENCY BY MOTOR SIZE AND SPEED

| MOTOR HP | -----Open Drip-Proof Motors------ -------Nominal Motor Speed------- 1200 rpm | 1800 rpm | 3600 rpm |
|---|---|---|---|
| 1 | 82.5 | 85.5 | 77.0 |
| 1-1/2 | 86.5 | 86.5 | 84.0 |
| 2 | 87.5 | 86.5 | 85.5 |
| 3 | 88.5 | 89.5 | 85.5 |
| 5 | 89.5 | 89.5 | 86.5 |
| 7-1/2 | 90.2 | 91.0 | 88.5 |

| MOTOR | ----Totally Enclosed Fan-Cooled---- -------Nominal Motor Speed------ |
|---|---|

| HP | 1200 rpm | 1800 rpm | 3600 rpm |
|---|---|---|---|
| 1 | 82.5 | 85.5 | 77.0 |
| 1-1/2 | 87.5 | 86.5 | 84.0 |
| 2 | 88.5 | 86.5 | 85.5 |
| 3 | 89.5 | 89.5 | 86.5 |
| 5 | 89.5 | 89.5 | 88.5 |

**P A R T 3 - E X E C U T I O N**

**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 connected to the driven device by means of a belt drive, mount sheaves on the appropriate shafts in accordance with the manufacturer's instructions. Use a straight edge to check alignment of the sheaves; reposition sheaves as necessary so that the straight edge contacts both sheave faces squarely. After sheaves are aligned, loosen the adjustable motor base so that the belt(s) can be added and tighten the base so that the belt tension is in accordance with the drive manufacturer's recommendations. Frequently recheck belt tension and adjust if necessary during the first day of operation and again after 80 hours of operation.

Verify the proper rotation of each three-phase motor as it is being wired or before the motor is energized for any reason.

Lubricate all motors requiring lubrication. Record lubrication material used and the frequency of use. Include this information in the maintenance manuals.

END OF SECTION

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

## P A R T 1 - G E N E R A L

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

PART 1 - GENERAL
- Scope
- Related Work
- Reference
- Reference Standards
- Quality Assurance
- Description
- Shop Drawings
- Design Criteria

PART 2 - PRODUCTS
- Pipe Hanger and Support Manufacturers
- Structural Supports
- Pipe Hangers and Supports
- Beam Clamps
- Wood Structure Supports
- Concrete Inserts
- Anchors
- Roof Mounted Supports
- Equipment Curbs
- Pipe Penetrations through Roof

PART 3 - EXECUTION
- Installation
- Hanger and Support Spacing
- Vertical Riser Clamps
- Anchors
- Roof Mounted Supports
- Equipment Curbs
- Pipe Penetration through Roof

**RELATED WORK**
Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment
Section 23 07 00 - HVAC Insulation

**REFERENCE**
Applicable provisions of Division 1 shall govern work under this section.

**REFERENCE STANDARDS**
MSS SP-58 Materials, Design, Manufacture, Selection, Application, and Installation

**QUALITY ASSURANCE**
Refer to Division 1, General Conditions, Equals and Substitutions.

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

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

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

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

**SHOP DRAWINGS**

Refer to division 1, General Conditions, Submittals.

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

All submittals are to comply with submission and content requirements specified in specification Section 01 91 01 or 01 91 02.

**DESIGN CRITERIA**
Materials and application of pipe hangers and supports shall be in accordance with MSS Standard Practice SP-58 unless noted otherwise.

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

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

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

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

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

## P A R T 2 - P R O D U C T S

**PIPE HANGER AND SUPPORT MANUFACTURERS**
Anvil, B-Line, Fee and Mason, Kindorf, Michigan Hanger, Unistrut, or approved equal. Anvil figure numbers are listed below; equivalent material by other manufacturers is acceptable.

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

**PIPE HANGERS AND SUPPORTS**
HANGERS FOR STEEL PIPE SIZES 1/2" THROUGH 2":
Carbon steel, adjustable, clevis, black finish. Anvil figure 65 or 260.

HANGERS FOR STEEL PIPE SIZES 2-1/2" AND OVER:
Carbon steel, adjustable, clevis, black finish. Anvil figure 260.

Adjustable steel yoke, cast iron roll, double hanger. Anvil figure 181.

MULTIPLE OR TRAPEZE HANGERS:
Steel channels with welded spacers and hanger rods if calculations are submitted.

WALL SUPPORT:
Welded steel bracket with hanger. B-Line 3068 Series, Anvil 194 Series.

Perforated epoxy painted finish, 16-12 gauge min., steel channels securely anchored to wall structure with interlocking, split type, bolt secured, galvanized pipe/tubing clamps. B-Line type S channel with B-2000 series clamps, Anvil type AS200 H with AS 1200 clamps. When copper piping is being supported,

provide flexible elastomeric/thermoplastic isolation cushion material to completely encircle the piping and avoid contact with the channel or clamp, equal to B-Line B1999 Vibra Cushion or provide manufacturers clamp and cushion assemblies, B-Line BVT series, Anvil cushion clamp assembly.

VERTICAL RISER SUPPORT:
Carbon steel riser clamp, copper plated when used with copper pipe. Anvil figure 261 for steel pipe, figure CT121 for copper pipe.

FLOOR SUPPORT FOR PIPE SIZES THROUGH 4":
Cast iron adjustable pipe saddle, locknut nipple, floor flange, and concrete pier or steel support.

COPPER PIPE SUPPORT:
Carbon steel ring, adjustable, copper plated or polyvinylchloride coated.

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

STEEL HANGER RODS:
Threaded both ends, threaded one end, or continuous threaded, black finish.

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

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

| Maximum Load (Lbs.) (650°F Maximum Temp.) | Rod Diameter (inches) |
|---|---|
| 610 | 3/8 |
| 1130 | 1/2 |
| 1810 | 5/8 |
| 2710 | 3/4 |
| 3770 | 7/8 |
| 4960 | 1 |
| 8000 | 1-1/4 |

Provide rods complete with adjusting and lock nuts.

**BEAM CLAMPS**
MSS SP-58 Type 23 malleable black iron clamp for attachment to beam flange to 0.62 inches thick for single threaded rods of 3/8, 1/2, and 5/8 inch diameter, for use with pipe sizes 4 inch and less. Furnish with a hardened steel cup point set screw. Anvil figure 86.

MSS SP-58 Type 28 or Type 29 forged steel jaw type clamp with a tie rod to lock clamp in place, suitable for rod sizes to 1-1/2 inch diameter but limited in application to pipe sizes 8 inch and less without prior approval. Anvil figure 228.

**CONCRETE INSERTS**
Carbon steel expansion anchors, vibration resistant, with ASTM B633 zinc plating. Use drill bit of same manufacturer as anchor. Hilti, Rawl, Redhead.

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

**ROOF MOUNTED SUPPORTS**

HEIGHT OF SUPPORTS:
Based on the length of the longest main support member, the height of the support member above the roof deck to be as follows:

| Length of Longest Support Member (inches) | Min. Height of Support Above Finished Roof |
|---|---|

| | |
|---|---|
| Up to 36” | 18 inches |
| 37” and Over | 36 inches |

Wood Build Sleeper Curb:

Constructed of wood blocking anchored to the deck. The curb must be structurally capable of supporting the intended load with no penetrations through the curb flashing. Galvanized steel counter flashing with metal receiver cap. Attach a steel channel track for securing pipe or duct roller support. Do not use built-in metal base flashings or cants.

Use galvanized structural steel members supported by pipe supports and use pipe or duct rollers fastened to the structural member. Pipe supports to be secured to the roof structure and sealed per pipe penetrations through roof specifications as specified in this section.

**PIPE PENETRATIONS THROUGH ROOF**

Multiple Pipe Penetrations:

Refer to acceptable Equipment Curb types listed above for curb specifications. An 8” high (minimum) curb height is required. The coping cap shall be constructed from laminated acrylic clad thermoplastic (ABS) with graduated step boots to accommodate various size pipes, stainless steel fastening screws for cover, stainless steel band clamps for securing boots around the pipe, and stainless steel band clamp or mechanical locking seal for securing boots around the ABS coping cap flanges.

## P A R T 3 - E X E C U T I O N

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

Piping shall be supported independently from ductwork and all other trades.

Where piping can be conveniently grouped to allow the use of trapeze type supports, use standard structural shapes for the supporting steel.

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

**HANGER AND SUPPORT SPACING**
Place a hanger within 12 inches of each horizontal elbow, valve, strainer, or similar piping specialty item.

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

Support riser piping independently of connected horizontal piping.

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

Space hangers for pipe as follows:

| Pipe Material | Pipe Size | Max. Spacing |
|---|---|---|
| Steel | 1/2" through 1-1/4" | 6'-6" |
| Steel | 1-1/2" through 6" | 10'-0" |
| Steel | 8" through 12" | 14'-0" |

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

**VERTICAL RISER CLAMPS**
Support vertical piping with clamps secured to the piping and resting on the building structure or secured to the building structure below at each floor.

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

**ROOF MOUNTED SUPPORTS**
Use for all pipe and ductwork on roof. Secure bottom of support flat on roof deck. Apply two coats of zinc rich paint to cut edges of all galvanized steel elements. Flashing and counter flashing by the Division 07 Contractor.

**PIPE PENETRATION THROUGH ROOF**
Install at points where pipes penetrate roof. Install as shown on the drawings, as detailed and according to the manufacturer's installation instructions. Flashing and counterflashing by the Division 07 Contractor.

END OF SECTION

**SECTION 23 05 48**
**VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT**

## P A R T 1 - G E N E R A L

**SCOPE**
This section includes specifications for vibration isolation material for equipment, piping systems, and duct systems. Included are the following topics:



**RELATED WORK**
Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment

**REFERENCE**
Applicable provisions of Division 1 govern work under this section.

**QUALITY ASSURANCE**
Refer to division 1, General Conditions, Equals and Substitutions.

**DESIGN CRITERIA**
Isolate all motor driven mechanical equipment from the building structure and from the systems which they serve to prevent equipment vibrations from being transmitted to the structure. Consider equipment weight distribution to provide uniform isolator deflections.

For equipment with variable speed capability, select vibration isolation devices based on the lowest speed.

Provide flexible piping connections for all piping to rotating or reciprocating equipment mounted on vibration isolators except do not use flexible piping connectors on any type of gas piping or with inline pumps. Piping connected to a coil which is in an assembly mounted on vibration isolators is to have flexible piping connections and piping vibration hangers as specified below. Piping connected to a coil which is in an assembly where the fan is separately isolated by means of vibration isolators and duct flexible connections does not require flexible piping connectors or piping vibration hangers.

Credit will be given for the inherent flexibility and vibration absorption characteristics of mechanical grooved pipe connections providing that supporting calculations are submitted for approval.

Coordinate the selection of devices with the isolator and equipment manufacturers.

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

Include isolator type, materials of construction, isolator free and operating heights, and isolation efficiency based on the lowest operating speed of the equipment supported.

## P A R T 2 - P R O D U C T S

**MATERIALS**
Use materials that will retain their isolation characteristics for the life of the equipment served. Use industrial grade neoprene for elastomeric materials.

Treat all isolators to resist corrosion. For isolation devices exposed to the weather or used in high humidity areas, hot dip galvanize steel parts, apply a neoprene coating on all steel parts, or use stainless steel parts; include limit stops to resist wind.

Provide pairs of neoprene side snubbers or restraining springs where side torque or thrust may develop.

Use isolators with a ratio of lateral to vertical stiffness not less than 1.0 or greater than 2.0.

**VIBRATION ISOLATOR MANUFACTURERS**
Mason Industries, Amber/Booth Co., Vibration Mounting & Controls, Peabody Noise Control, or approved equal.

**TYPE 1: NEOPRENE PAD**
Neoprene waffle pad, 40 durometer with 16 gauge shims between layers.

**TYPE 2: NEOPRENE PAD**
Double deflection neoprene mount having a minimum static deflection of 0.35 inches. Cover all metal surfaces with neoprene to resist corrosion. Include friction pads on both top and bottom surfaces so mounts need not be bolted to the floor but include bolt holes for those areas where bolting is required. For equipment such as small vent sets and close coupled pumps, include steel rails for use between the isolator and the equipment to accommodate equipment overhang.

**TYPE 5: SPRING HANGER WITH NEOPRENE**
Vibration hanger with a steel spring and 0.3" deflection neoprene element in series. Use neoprene element molded with a rod isolation bushing that passes through the hanger box. Select spring diameters and size hanger box lower holes large enough to permit the hanger rod to swing through a 30 degree arc before contacting the hole and short circuiting the spring. Select springs so they have a minimum additional travel to solid equal to 50% of the rated deflection.

**TYPE 7: SPRING HANGER WITH NEOPRENE**
Steel spring hanger located in a neoprene cup manufactured with a grommet to prevent short circuiting of the hanger rod. Neoprene cup to contain a steel washer designed to properly distribute the load on the neoprene and prevent its extrusion. Design spring diameter and size hanger box lower hole sufficiently large to permit the hanger rod to swing through a 30° arc before contacting the hole perimeter and short circuiting the spring. Select spring so it has a minimum additional travel to solid equal to 50% of the rated deflection. Provide hanger with an eye bolt on the spring end and provision to attach the housing to the flat iron duct straps.

**FLEXIBLE PIPING CONNECTIONS**
Suitable for pressure, temperature, and fluid involved; minimum pressure rating for any system is 125 psig at the design temperature of the fluid. Use 12 inch minimum line length of flexible hose or length required to absorb 3/4" lateral movement, whichever is greater.

MANUFACTURERS:
Flexonics, Mason, Kinetics, Mercer Rubber, Metraflex, or approved equal.

WATER AND/OR PUMPED CONDENSATE:
Multiple plies of nylon tire cord fabric reinforced with an EPDM cover and liner. Do not use steel wire or rings as pressure reinforcement. Use threaded or soldered connections for sizes 2" and smaller; design the steel flange end so the steel flange is recessed to lock a steel wire bead ring in the raised face of the EPDM flange. Construct straight-through connections with twin spheres. Use control rods when recommended by the manufacturer.

REFRIGERANT:
Seamless bronze corrugated flexible hose with bronze wire braided cover and solder type copper tube ends with the entire assembly fabricated specifically for refrigerant duty.

**PERFORMANCE**
Select vibration isolation devices as indicated below or to provide not less than 95% isolation efficiency, whichever is greater.

| | ---------- Floor Span or Column Spacing---------- | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | --On Grade-- | | ---20 Feet--- | | ---30 Feet--- | | ---40 Feet--- | |
| TYPE OF EQUIPMENT | Iso. Type | Min. Static Defl. In. | Iso. Type | Min. Static Defl. In. | Iso. Type | Min. Static Defl. In. | Iso. Type | Min. Static Defl. In. |
| AIR-COOLED CONDENSING UNITS: | Bolt to pad | | 3 | 0.75 | 4 | 1.50 | 4 | 2.50 |

## P A R T 3 - E X E C U T I O N

**INSTALLATION**
Install vibration isolation devices for motor driven equipment in accordance with the manufacturer's installation instructions.

Set steel bases for one inch clearance between the concrete floor or housekeeping pad and the base.

Do not allow installation practices to short circuit any isolation device.

END OF SECTION

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

## P A R T 1 - G E N E R A L

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

PART 1 - GENERAL
- Scope
- Related Work
- Reference
- Reference Standards
- Description
- Pre-Installation Meeting and Scheduling
- Pre-Balance Conference
- Submittals

PART 2 - PRODUCTS
- Instrumentation

PART 3 - EXECUTION
- Preliminary Procedures
- Existing Equipment
- Performing Testing, Adjusting and Balancing
- Deficiencies

### RELATED WORK
Section 23 05 00 Common Work Results for HVAC
Section 23 07 00 HVAC Insulation

### REFERENCE
Applicable provisions of the General Conditions, Supplementary General Conditions and General Requirements in Division 1 govern work under this section.

### REFERENCE STANDARDS

| | |
|---|---|
| AABC | National Standards for Total System Balance, Sixth Edition, 2002. |
| ASHRAE | ASHRAE Handbook, 2007 HVAC Applications, Chapter 37, Testing Adjusting and Balancing. |
| NEBB | Procedural Standards for Testing Adjusting Balancing of Environmental Systems, Seventh Edition, 2005. |
| TABB | Tab Procedural Guide, First Edition, 2003. |

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

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

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

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

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

**QUALITY ASSURANCE**

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

A certified member of AABC or certified by NEBB or TABB in the specific area of work performed. Maintain certification for the entire duration of the project. If certification of firm or any staff performing work is terminated or expires during the duration of the project, contact owner immediately.

Technicians on this project must have satisfactorily completed work on a minimum of (3) three projects of at least 50% in size, and of similar complexity. Size is defined as the quantity of each specific individual item requiring testing and balancing such as, but not limited to, equipment, devices, terminal devices, and grilles and diffusers.

Submit Qualifications of firm and project staff to owner upon requested.

**SUBMITTALS**
See also Related Work in this section.

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

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

- General Information
- Summary
- Air Systems

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

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

Summary: Provide summary sheet describing mechanical system deficiencies. Describe objectionable noise or drafts found during testing, adjusting and balancing. Provide recommendations for correcting unsatisfactory performances and indicate whether modifications required are within the scope of the contract, are design related or installation related. List instrumentation used during testing, adjusting and balancing procedures.

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

## P A R T 2 - P R O D U C T S

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

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

## P A R T 3 - E X E C U T I O N

### DAILY REPORTS

Submit to owner’s Project Representative daily work activity reports for each day on which testing and balancing work is performed. Reports shall include description of day's activities and description of any system deficiencies.

### PRELIMINARY PROCEDURES

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

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

Notify owner’s Project Representative on a daily basis during balancing. Identify deficiencies preventing completion of testing, adjusting and balancing procedures. Do not proceed until systems are fully operational with all components necessary for complete testing, adjusting and balancing. Installing Contractors are required to provide personnel to check and verify system completion, readiness for balancing and assist Balancing Agency in providing specified system performance.

### PERFORMING TESTING, ADJUSTING AND BALANCING

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

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

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

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

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

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

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

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

and will require an itemized cost breakdown submitted to owner's project representative. Prior authorization is needed before this work is started.

Final air system measurements to be within the following range of specified cfm:

| | |
|---|---|
| Fans | 0% to +10% |

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

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

**DEFICIENCIES**

Division 23 00 00 contractor to correct any installation deficiencies found by the test and balance agency that were specified and/or shown on the Contract Documents to be performed as part of that division of work. Test and balance agency will notify the owners Project Representative of these items and instructions will be issued to the Division 23 00 00 contractor for correction of the deficient work. All corrective work to be done at no cost to the State of Wisconsin. Retest mechanical systems, equipment, and devices once corrective work is complete as specified.

END OF SECTION

**SECTION 23 07 00**
**HVAC INSULATION**

## P A R T 1 - G E N E R A L

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

PART 1 - GENERAL
- Scope
- Related Work
- Reference
- Reference Standards
- Quality Assurance
- Description
- Definitions
- Shop Drawings
- Operation and Maintenance Data
- Environmental Requirements

PART 2 - PRODUCTS
- Materials
- Insulation Types
- Adhesives, Mastics, Sealants, and Reinforcing Materials
- Jackets
- Insulation Inserts and Pipe Shields
- Accessories

PART 3 - EXECUTION
- Examination
- Installation
- Protective Jacket Installation
- Piping, Valve and Fitting Insulation
- Piping Protective Jackets
- Pipe Insulation Schedule
- Construction Verification Items

**RELATED WORK**
Section 23 05 00 - Common Work Results for HVAC
Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment

**REFERENCE**
Applicable provisions of Division 1 govern work under this section.

**QUALITY ASSURANCE**
Refer to division 1, General Conditions, Equals and Substitutions

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

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

Fluid-applied ductwork insulation is a roofing product that shall be applied only by qualified contractors. Contractor shall be recognized by the manufacturer of the Polyurea 2-part liquid membrane system as an “approved” or “authorized” applicator. Only manufacturer recognized, qualified and authorized Contractor’s who’s labor and material are fully covered, without exception, by the manufacturer’s warranty, as required by this section, will be allowed to perform the work. Manufacturer must submit letterhead document verifying the Contractor as an authorized applicator of their product and able to receive the specified warranty.

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

- Pipe Insulation

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

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

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

Submit a schedule of all insulating materials to be used on the project, including adhesives, fastening methods, fitting materials along with material safety data sheets and intended use of each material. Include manufacturer's technical data sheets indicating density, thermal characteristics, jacket type, and manufacturer's installation instructions. Include copies of the MICA plates that are applicable to this project.

**OPERATION AND MAINTENANCE DATA**
All operations and maintenance data shall comply with the submission and content requirements specified under section GENERAL REQUIREMENTS.

In addition to the general content specified under GENERAL REQUIREMENTS supply the following additional documentation:

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

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

## P A R T 2 - P R O D U C T S

**MATERIALS**
Manufacturers: Armacell, CertainTeed, Manson, Childers, Dow, Extol, Fibrex, Halstead, Foster, Imcoa, ITW, Johns Manville, Knauf Insulation, Owens-Corning, Pittsburgh Corning, VentureTape or approved equal.

Materials or accessories containing asbestos will not be accepted.

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

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

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

RIGID FIBERGLASS INSULATION:
Minimum nominal density of 3 lbs. per cu. ft., and thermal conductivity of not more than 0.23 at 75 degrees F mean temperature, 0.25 at 125 degrees F, 0.27 at 150 degrees F, 0.29 at 200 degrees F, 0.32 at 250 degrees F, minimum compressive strength of 25 PSF at 10% deformation, rated for maximum service temperature of 450 degrees F.

CALCIUM SILICATE INSULATION:
Rigid hydrous calcium silicate, ASTM C533, Type I, minimum dry density of 12.5 lbs. per cu. ft., thermal conductivity of not more than 0.44 at 300 degrees F mean temperature, maximum water absorption of 90% by volume, minimum compressive strength 140 psi at 5% deformation, rated for service temperature range of 0 degrees F to 1,200 degrees F,. Material to be visually coded or marked to indicate it is asbestos free.

ELASTOMERIC INSULATION:
Flexible closed cell, minimum nominal density of 5.5 lbs. per cu. ft., thermal conductivity of not more than 0.28 at 75 degrees F mean temperature, minimum compressive strength of 4.5 psi at 25% deformation, maximum water vapor permeability of 0.08 perm inch, maximum water absorption of 6% by weight, rated for service temperature range of -20 degrees F to 220 degrees F on piping and 180 degrees F where adhered to equipment.

POLYOLEFIN INSULATION:
Flexible closed cell, minimum nominal density of 1.5 lbs. per cu. ft., thermal conductivity of not more than 0.25 at 75 degrees F mean temperature, minimum compressive strength of 5 psi at 25% deformation, maximum water vapor permeability of 0.0 perm inch, maximum water absorption of 0% by weight and volume, rated for service temperature range of -165 degrees F to 210 degrees F.

EXTRUDED POLYSTYRENE INSULATION:
Rigid closed cell, minimum nominal density of 1.6 lbs. per cu. ft., thermal conductivity of not more than 0.26 at 75 degrees F mean temperature, minimum compressive strength of 20 psi, maximum water vapor permeability of 1.5 perm inch, maximum water absorption of 0.5 % by volume (ASTM C272), rated for service temperature range of -290 degrees F to 165 degrees F.

POLYISOCYANURATE INSULATION:
Rigid closed cell polyisocyanurate, minimum nominal density of 2.0 lbs. per cu. ft., thermal conductivity of not more than 0.19 at 75 degrees F mean temperature aged 180 days, minimum compressive strength of 24 psi parallel and 13 psi perpendicular, maximum water vapor permeability of 4 perm inch, maximum water absorption of 2% by volume, rated for service temperature range of -290 degrees F to 300 degrees F.

FIREPROOFING INSULATION:
Mineral wool with nominal density of 8 lbs. per cu. ft., flame spread index of 25, fuel contribution index of 0, and smoke developed index of 0, thermal conductivity of not more than 0.23 at 75 degrees F mean temperature, rated for service temperature range of -120 degrees F to 1200 degrees F. Use rigid or semi-rigid board for duct insulations.

Foil-scrim-polyethylene vapor retarding jacket, factory applied to insulation, maximum permeance of .02 perms.

FIRE RATED INSULATION:
Noncombustible, non-asbestos, non-ceramic fiber, high temperature blanket or board fireproofing insulation, constructed of calcium silicate or calcium/magnesium/silica amorphous wool with 2-hour ASTM E814 “F” and “T” fire ratings, UL or equivalent third party listed, labeled and specifically evaluated for such purpose in accordance with ASTM E2336. Foil-scrim-polyethylene fiberglass reinforced factory applied jacket.

**ADHESIVES, MASTIC, SEALANTS, AND REINFORCING MATERIALS**
Products shall be compatible with surfaces and materials on which they are applied, and shall be suitable for use at operating temperatures of systems to which they are applied.

FIBERGLASS INSULATION ADHESIVE:
Must comply with ASTM C916, Type II: Foster 85-60, Childers CP-127, Duro Dyne SSG.

VAPOR RETARDING MASTIC:
For below ambient equipment/piping use a water based mastic with a water vapor permeance of less than 0.04 perms at 40 mils dry film thickness per ASTM E 96: Childers CP-34, Foster 30-65 Vapor-Fas, , Knauf Insulation, KI-900 or KI-905, Vimasco 749.

For below ambient equipment/piping use water based, anti-fungal mastic that meets ASTM D 5590 with a 0 growth rating (AF) and a water vapor permeance that is less than 0.013 perms at 43 mils dry film thickness per ASTM E 96 Procedure B: Foster 30-80AF Vapor Safe Mastic or equal.

Anti-fungal mastic to be used in the following locations;
- Exterior locations

WEATHER BARRIER BREATHER MASTIC:
For above ambient equipment/piping use water based mastic with a permeance greater than 1.0 perms at 1/16" dry film thickness per ASTM E96. Foster 46-50 Weatherite, Childers Vi-Cryl CP-10/CP-11, Vimasco WC-5, Knauf Insulation KI-700 or KI-705.

METAL JACKETING SEALANT FOR ALL ALUMINUM JACKETING:
Metal jacketing sealants to be non-shrinking and permanently flexible.
Use Foster 95-44 Elastolar, Childers CP-76 Chil-Byl, Pittsburgh Corning 727.
For Polystyrene use Foster 30-45N, or Childers CP-70.

INSULATION JOINT SEALANT:
Joint sealants to be non-shrinking and permanently flexible.
Used on all below ambient piping to prevent moisture ingress.
For Cellular Glass, Polyisocyanurate, Phenolic use Foster 95-44 Elastolar, Childers CP-76 Chil-Byl, Pittsburgh Corning CW Sealant.
For Polystyrene use Foster 30-45N, Childers CP-70.
For Elastomeric use Armaflex 520 or equal.

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

PROTECTIVE METAL JACKETS (PMJ):
0.016 inch thick aluminum or 0.010 inch thick stainless steel with safety edge for indoor installations and 0.024 inch thick aluminum or 0.016 inch thick stainless steel with safety edge for outdoor installations.

SELF-ADHERING JACKETS (SAJ):
5-ply, self-adhering multiple laminated waterproofing material with reflective aluminum foil, high density polymer films and cold weather acrylic adhesive providing zero (0.0) permeance. Minimum 6 mils material thickness, 25lb puncture resistance when tested in accordance with ASTM D1000 and flame spread/smoke developed rating of 10/20 when tested in accordance with UL 723.

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

FABRIC REINFORCED MASTIC JACKETS (FMJ):
Glass fiber reinforcing fabric imbedded in weather barrier mastic as per manufacturer's recommended procedure for 2 coat application.

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

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

**INSULATION INSERTS AND PIPE SHIELDS**
Manufacturers: B-Line, Pipe Shields, Value Engineered Products.

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

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

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

Wood blocks will not be accepted.

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

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

Insulation bands to be 3/4 inch wide, constructed of aluminum or stainless steel. Minimum thickness to be 0.015 inch for aluminum and 0.010 inch for stainless steel.

Tack fasteners to be stainless steel ring grooved shank tacks.

Staples to be clinch style.

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

Finishing cement to be ASTM C449.

Fibrous glass or canvas fabric reinforcing used with lagging adhesive shall have a minimum untreated weight of 6 oz./sq. yd.

## P A R T 3 - E X E C U T I O N

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

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

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

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

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

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

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

All pipe and duct insulation shall be continuous through walls, ceiling or floor openings and through sleeves except where firestop or fire safing materials are required. Vapor retarding jacket shall be maintained continuous through all penetrations.

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

Provide a complete vapor retarding jacket for insulation on the following systems:

- Refrigerant

**PROTECTIVE JACKET INSTALLATION**

PVC FITTING COVERS AND JACKETS (PFJ):

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

PROTECTIVE METAL JACKET (PMJ):

Lap seams a minimum of 2 inches. Secure with metal bands for end to end joints, and rivets or sheet metal screws for longitudinal joints. Rivets, screws, and bands to be constructed of the same material as the jacket. For piping with VRJ jacket provide metal bands at 12" centers, rivets and screws cannot be used. Locate longitudinal seams on the side (3:00 O'clock) for exterior applications. Seal laps with 1/8" bead of metal jacketing sealant to prevent water entry.

SELF-ADHERING JACKETS (SAJ):

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

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

FABRIC REINFORCED MASTIC JACKETS (FMJ):

Glass fiber fabric shall be fitted without wrinkles. Glass fiber fabric shall be sized immediately upon application with lagging adhesive and shall be capable of drying within 6 hrs. Apply adhesive and coating in accordance with manufacturer's recommendations. All seams shall overlap not less than 2".

VAPOR RETARDING JACKETS (VRJ):

Piping with vapor retarding jackets (VRJ) shall have elbows, fittings, valves and butt joints wrapped with 2 layers of vapor retarding tape. For piping without a (PFJ) jacket, wrap jacket with 1" wide vapor retarding tape at 12" centers with a 25% overlap. Piping with a PVC jacket (PFJ) installed over the vapor retarding jackets (VRJ) may be provided with a single, lapped layer of vapor retarding tape for elbows, fittings and valves under the PVC jacket. Vapor retarding tape shall be compatible with the jacket material used.

**PIPING, VALVE, AND FITTING INSULATION**

GENERAL:

Install insulation with butt joints and longitudinal seams closed tightly. Provide minimum 2" lap on jacket seams and 3" tape on butt joints, firmly cemented with lap adhesive unless otherwise noted. Additionally secure with clinch style staples along seams and butt joints.

On systems requiring a vapor retarding jacket, seal off all raw ends of insulation and butt joints with vapor retarding mastic at intervals of not more than 20 feet on piping to create a vapor dam. Also provide a vapor dam on each side of valves, unions, and tees. Coat staples, longitudinal and transverse seams with vapor retarding mastic and on systems requiring vapor retarding jacket, coat insulated elbows, fittings, and valves with vapor retarding mastic.

Install insulation continuous through pipe hangers and supports with hangers and supports on the exterior of insulation. Where a vapor retarding jacket is not required or where roller hangers are not being used, hangers and supports may be attached directly to piping with insulation completely covering hanger or support and jacket sealed at support rod penetration. Where riser clamps are required to be attached directly to piping requiring vapor retarding jacket, extend insulation and vapor retarding jacketing/coating around riser clamp.

Where insulated piping is installed on hangers and supports, the insulation shall be installed continuous through the hangers and supports. High density inserts shall be provided as required to prevent the weight of the piping from crushing the insulation. Pipe shields are required at all support locations. The insulation shall not be notched or cut to accommodate the supporting channels.

INSULATION INSERTS AND PIPE SHIELDS:
Provide pipe shields at all hanger and support locations. Rigid insulation inserts shall be installed between the pipe and the insulation shields. Quantity and placement of inserts shall be according to the manufacturer's installation instructions, however the inserts shall be no less than 12" in length. Inserts shall be of equal thickness to the adjacent insulation and shall be vapor sealed as required for system.

Provide insulation inserts and pipe shields at all hanger and support locations. Inserts may be omitted on 3/4" and smaller copper piping provided 12" long 22 gauge pipe shields are used.

ELASTOMERIC AND POLYOLEFIN:
Where practical, slip insulation on piping during pipe installation when pipe ends are open. Miter cut fittings allowing sufficient length to prevent stretching. Completely seal seams and joints for vapor tight installation. For elastomeric insulation, apply full bed of adhesive to both surfaces. For polyolefin, seal factory preglued seams with roller and field seams and joints with full bed of hot melt polyolefin glue to both surfaces. Cover elastomeric insulation on systems operating below 40 degrees F with vapor retarding mastic.

EXTRUDED POLYSTYRENE AND POLYISOCYANURATE:
Fittings, valves, unions, flanges, couplings and specialties shall be insulated with factory molded insulation of the same thickness as adjoining insulation. Secure insulation sections with two wraps of nylon filament tape 9"-12" on center. On single insulation layer systems and on the outer layer of double insulation layer systems, apply a 1/16" thick bead of joint sealant rated for system operating temperatures to the outer edge of all longitudinal and butt insulation joints. For piping service below 20°F, use two layers of insulation with inner and outer butt and longitudinal joints staggered and offset 90 degrees. Where two layers of insulation are used, do not use sealant on the inner layer or adhere the inner layer to the outer layer. Apply vapor stop bead of joint sealant between pipe and insulation on both sides of valves, expansion/contraction joints, flanges, thermometers/gauges, attached vent and drain lines. Insulate attached non-circulated lines, control lines, vents, etc. for a minimum distance of 6" from pipe. Cover insulation with a protective jacket as specified below. Do not penetrate protective covering or insulation with mechanical fasteners.

**PIPING PROTECTIVE JACKETS**
Provide a protective PVC jacket (PFJ) for the following insulated piping:
- Piping exposed in finished locations
- Exterior refrigeration piping.

Provide a protective PVC (PFJ) or Fabric Reinforced Mastic (FMJ) jacket for the following insulated piping:
- All piping within mechanical rooms.

Provide a protective metal (PMJ) or self-adhering (SAJ) jacket for the following insulated piping:
- Exterior installed refrigeration piping.

**PIPE INSULATION SCHEDULE:**
Provide insulation on new and existing remodeled piping system as indicated in the following schedule:

| SERVICE | INSULATION | JACKET | INSULATION THICKNESS BY PIPE SIZE | | | | |
|---|---|---|---|---|---|---|---|
| | | | < 1" | 1" to < 1-1/2" | 1-1/2" to < 4" | 4" to < 8" | 8" and Larger |
| Refrigeration Suction | | | | | | | |
| > 40°F | Elastomeric | None | 1.5" | 1.5" | 1.5" | 1.5" | 1.5" |
| 40°F to 20°F | Elastomeric | None | 1.5" | 1.5" | 1.5" | 1.5" | 1.5" |
| 20°F to -20°F | Polystyrene / Polyisocyanurate | VRJ or SAJ | 1.5" | 2" | 2" | 2" | 2.5" |
| -20°F to -60°F | Polystyrene / Polyisocyanurate | VRJ or SAJ | 2" | 2" | 2.5" | 2.5" | 3" |
| Cooling Coil Condensate Drain | Rigid Fiberglass | ASJ | 0.5" | 0.5" | 1" | 1" | 1" |

ELASTOMERIC/POLYOLEFIN:
Apply full cover coat of adhesive to surface to be insulated, insulation and edge butt joints. Place insulation with edge joints firmly butted pressing to surface for full adhesion. Seal seams and joints vapor tight.

**CONSTRUCTION VERIFICATION ITEMS**
Contractor is responsible for utilizing the construction verification checklists supplied under specification Section 23 08 00 in accordance with the procedures defined for construction verification in Section 01 91 01 or 01 91 02.

END OF SECTION

# SECTION 23 21 13
# HYDRONIC PIPING

## P A R T 1 - G E N E R A L

### SCOPE
This section contains specifications for all HVAC hydronic pipe and pipe fittings for this project. Included are the following topics:

PART 1 - GENERAL
- Scope
- Related Work
- Reference
- Reference Standards
- Shop Drawings
- Quality Assurance
- Delivery, Storage, and Handling
- Design Criteria

PART 2 - PRODUCTS
- Cooling Coil Condensate

PART 3 - EXECUTION
- Erection
- Copper Pipe Joints
- Cooling Coil Condensate
- Construction Verification Items

### RELATED WORK
Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment
Section 23 07 00 - HVAC Insulation

### REFERENCE
Applicable provisions of Division 1 govern work under this section.

### REFERENCE STANDARDS
| | |
|---|---|
| ANSI B16.22 | Wrought Copper and Wrought Copper Alloy Solder Joint Pressure Fittings |
| ASTM B75 | Seamless Copper Tube |
| ASTM B88 | Seamless Copper Water Tube |

### SHOP DRAWINGS
Refer to division 1, General Conditions, Submittals.

Contractor shall submit schedule indicating the ASTM specification number of the pipe being proposed along with its type and grade and sufficient information to indicate the type and rating of fittings for each service.

COPPER TUBE:
Statement from manufacturer on his letterhead that the pipe furnished meets the ASTM specification contained in this section.

### QUALITY ASSURANCE
Order all Type E and Type S steel pipe with heat numbers rolled, stamped, or stenciled to each length or each bundle, depending on the size of the pipe, and in accordance with the appropriate ASTM specification.

Any installed material not meeting the specification requirements must be replaced with material that meets these specifications without additional cost to the Owner.

### DELIVERY, STORAGE, AND HANDLING
Promptly inspect shipments to insure that the material is undamaged and complies with specifications.

Cover pipe to eliminate rust and corrosion while allowing sufficient ventilation to avoid condensation. Do not store materials directly on grade. Protect pipe, tube, and fitting ends so they are not damaged. Where end caps are provided or specified, take precautions so the caps remain in place. Protect fittings, flanges, and unions by storage inside or by durable, waterproof, above ground packaging.

Offsite storage agreements will not relieve the contractor from using proper storage techniques.

Storage and protection methods must allow inspection to verify products.

**DESIGN CRITERIA**

Use only new material, free of defects, rust and scale, and meeting the latest revision of ASTM specifications as listed in this specification.

Construct all piping for the highest pressures and temperatures in the respective system in accordance with ANSI B31, but not less than 125 psig unless specifically indicated otherwise.

Where ASTM A53 type F pipe is specified, ASTM A53 grade A type E or S, or ASTM A53 grade B type E or S may be substituted at Contractor's option. Where ASTM A53 grade A pipe is specified, ASTM A53 grade B pipe may be substituted at Contractor's option. Where the grade or type is not specified, Contractor may choose from those commercially available.

Where ASTM B88, type L hard temper copper tubing is specified, ASTM B88, type K hard temper copper tubing may be substituted at Contractor's option.

## P A R T 2 - P R O D U C T S

**COOLING COIL CONDENSATE**

ASTM B88, type L hard temper copper tubing with ASTM B145/ANSI B16.23 cast red bronze or ASTM B75/ANSI B16.29 wrought solder-type drainage fittings.

## P A R T 3 - E X E C U T I O N

**ERECTION**

Carefully inspect all pipe, fittings, valves, equipment and accessories before installation. Any items that are unsuitable, cracked or otherwise defective shall be rejected and removed from the job site immediately. Excluding minor surface rust, piping that exhibits significant oxidation or corrosion will be rejected.

Exercise care at every stage of storage, handling, laying and erecting to prevent entry of foreign matter into piping, fittings, valves, equipment and accessories. Do not erect or install any item that is not clean.

Remove all lose dirt, scale, oil, chips, burrs and other foreign material from the internal and external surfaces of all pipe and piping components prior to assembly, including debris associated with cutting, threading and welding.

During fabrication and assembly, remove slag and weld spatter from internal pipe surfaces at all joints by peening, chipping and wire brushing.

During construction, until system is fully operational, keep all openings in piping and equipment closed except when actual work is being performed on that item of the system. Use plugs, caps, blind flanges or other items designed for this purpose.

Furnish and install all flanges, caps, bypasses, drains, valves, etc. required to facilitate flushing and draining all heating and cooling system piping.

Provide anchors, expansion joints, swing joints and/or expansion loops so that piping may expand and contract without damage to itself, equipment, or building.

Mitered ells, notched tees, and orange peel reducers are not acceptable. On threaded piping, bushings are not acceptable.

"Weldolets" and "Threadolets" may be used for branch takeoffs up to one-half (1/2) the diameter of the main.

Install drains throughout the systems to permit complete drainage.

Install all valves, control valves, and piping specialties, including items furnished by others, as specified and/or detailed. Make connections to all equipment installed by others where that equipment requires the piping services indicated in this section.

**COPPER PIPE JOINTS**

Remove all slivers and burrs remaining from the cutting operation by reaming and filing both pipe surfaces. Clean fitting and tube with emery cloth or sandpaper. Remove residue from the cleaning operation, apply flux, and assemble joint. Use 95-5 solder or brazing to secure joint as specified for the specific piping service.

Where mechanically formed tee fittings are allowed, form mechanically extracted collars in a continuous operation, consisting of drilling a pilot hole and drawing out the tube surface to form a collar having a height of not less than three times the thickness of the tube wall. Use an adjustable collaring device. Notch and dimple the branch tube. Remove all debris created by the forming process from the inside of the pipe. Braze the joint, applying heat properly so that pipe and tee do not distort; remove distorted connections.

**COOLING COIL CONDENSATE**

Trap each cooling coil drain pan connection with a trap seal of sufficient depth to prevent conditioned air from moving through the piping. Extend drain piping to nearest code approved drain location. Construct trap with plugged tee for cleanout purposes.

**CONSTRUCTION VERIFICATION ITEMS**

Contractor is responsible for utilizing the construction verification checklists supplied under specification Section 23 08 00 in accordance with the procedures defined for construction verification in Section 01 91 01 or 01 91 02.

END OF SECTION

# SECTION 23 23 00
# REFRIGERANT PIPING

## P A R T 1 - G E N E R A L

**SCOPE**

This section contains specifications for all Refrigerant piping for this project. Included are the following topics:

PART 1 - GENERAL
- Scope
- Related Work
- Reference
- Reference Standards
- Shop Drawings
- Quality Assurance
- Delivery, Storage, and Handling
- Design Criteria

PART 2 - PRODUCTS
- Refrigerant Piping
- Refrigerant Piping Accessories

PART 3 - EXECUTION
- Preparation
- Erection
- Refrigerant Piping
- Refrigerant Piping Accessories
- Construction Verification Items

**RELATED WORK**

Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment
Section 23 07 00 - HVAC Insulation

**REFERENCE**

Applicable provisions of Division 1 govern work under this section.

**REFERENCE STANDARDS**

| | |
|---|---|
| ANSI B16.22 | Wrought Copper and Wrought Copper Alloy Solder Joint Pressure Fittings |
| ASTM B88 | Seamless Copper Water Tube |
| ASTM B280 | Seamless Copper Tube for Air Conditioning and Refrigeration Field Service |
| ASHRAE 15 | Safety Code for mechanical Refrigeration |

**SHOP DRAWINGS**

Refer to division 1, General Conditions, Submittals.

Contractor shall submit schedule indicating the ASTM specification number of the pipe being proposed along with its type and grade and sufficient information to indicate the type and rating of fittings for each service.

COPPER TUBE:
Statement from manufacturer on his letterhead that the pipe furnished meets the ASTM specification contained in this section.

**QUALITY ASSURANCE**

Order all copper refrigeration tube with each shipping unit marked with the purchase order number, metal or alloy designation, temper, size, and name of supplier; with soft straight lengths or coils identified with a tag indicating that the product was manufactured in accordance with ASTM B280; and with each hard temper straight length identified throughout its length by a blue colored marking not less than 3/16 inch in height and a legend at intervals of not greater than three feet that includes the designation "ACR" and pipe outside diameter.

Any installed material not meeting the specification requirements must be replaced with material that meets these specifications without additional cost to the Owner.

**DELIVERY, STORAGE, AND HANDLING**

Promptly inspect shipments to insure that the material is undamaged and complies with specifications.

Cover pipe to eliminate rust and corrosion while allowing sufficient ventilation to avoid condensation. Do not store materials directly on grade. Protect pipe, tube, and fitting ends so they are not damaged. Where end caps are provided or specified, take precautions so the caps remain in place. If end caps are not present on tube bearing the "ACR" designation, clean and re-cap in accordance with ASTM B280. Protect fittings, flanges, and unions by storage inside or by durable, waterproof, above ground packaging.

Offsite storage agreements will not relieve the contractor from using proper storage techniques.

Storage and protection methods must allow inspection to verify products.

**DESIGN CRITERIA**

Use only new material, free of defects and scale, and meeting the latest revision of ASTM specifications as listed in this specification.

Where ASTM B88, type L hard temper copper tubing is specified, ASTM B88, type K hard temper copper tubing may be substituted at Contractor's option.

## P A R T 2 - P R O D U C T S

**REFRIGERANT PIPING**

ASTM B88 type L hard drawn copper tube, cleaned and capped in accordance with ASTM B280, and marked "ACR", with ANSI B16.22 wrought copper or forged brass solder-type fittings.

Precharged tubing line sets may be used on systems 3-1/2 tons and less in size.

**REFRIGERANT PIPING ACCESSORIES**

Provide all refrigerant piping specialties with a maximum working pressure of full vacuum to 450 psig and a maximum working temperature of 225 deg F. For systems using R-410A, provide all refrigerant piping specialties with a maximum working pressure of full vacuum to 850 psig and a maximum working temperature of 225 deg F.

Flexible pipe connectors: Double braided bronze hose flexible pipe connectors with solder end connections.

Filter Dryers: For circuits 15 tons and over provide angle pattern filter dryers with replaceable core. For circuits below 15 tons provide straight pattern filter dryers without replaceable core.

Sight glasses: Two piece brass construction with solder end connections. Include color indicator for sensing moisture.

Solenoid Valves: Two way normally closed with two piece brass body, full port, stainless steel plug, stainless steel spring, teflon diaphragm and solder end connections. Provide replaceable coil assembly.

Hot Gas Bypass Valves: Provide with integral solenoid valve, external equalizer connection and adjustable pilot assembly.

Thermostatic Expansion Valves: Brass body, bronze disc, neoprene seat, bronze bonnet, stainless steel spring and solder end connections.

Charging Valves: Provide ¼” SAE brass male flare access ports with finger tight, quick seal caps. Provide 2-inch long copper extension sections.

Check valves: Spring loaded type with bronze body, bronze disc, neoprene seat, bronze bonnet, stainless steel spring and solder end connections.

## P A R T 3 - E X E C U T I O N

**PREPARATION**

Remove all foreign material from interior and exterior of pipe and fittings.

**ERECTION**

Install all piping parallel to building walls and ceilings and at heights which do not obstruct any portion of a window, doorway, stairway, or passageway. Where interferences develop in the field, offset or reroute piping as required to clear such interferences. In all cases, consult drawings for exact location of pipe spaces, ceiling heights, door and window openings, or other architectural details before installing piping.

Do not route piping through transformer vaults or above transformers, panelboards, or switchboards, including the required service space for this equipment, unless the piping is serving this equipment

This requirement is based on NFPA 70, 2014 450-47.

Do not install piping running through any elevator shaft, public stairway, stair landing, or means of egress.

Install all valves and piping specialties, including items furnished by others, as specified and/or detailed. Make connections to all equipment installed by others where that equipment requires the piping services indicated in this section.

**REFRIGERANT PIPING**

Refrigeration piping to be installed by firms who are experienced in installation of such piping and in accordance with the requirements of the International Mechanical Code, Chapter 11 and the Wisconsin Administrative Code Chapter SPS 345.

All brazing filler metals shall have a melting temperature above 1400 degrees F and contain a mimimum of 6% silver.

Tubing to be new and delivered to the job site with the original mill end caps in place. Clean and polish all joints before brazing. Avoid prolonged heating and burning during brazing. Purge all lines with nitrogen during brazing. Provide manual shut-off and check valves as required.

No refrigerant is to be vented directly to the atmosphere except that which may escape through leaks in the system during leak testing. During evacuation procedures, use equipment designed to recover and allow recycling of the refrigerant.

Leak test the system by charging the system to a pressure of 10 psig with an HFC refrigerant, with the compressor suction and discharge valves closed and with all other system valves open. Increase pressure to 300 psig with dry nitrogen. Rap all joints with a mallet and check for leaks with an electric leak detector having a certified sensitivity of at least one ounce per year. Seal any leaks that may be found and retest.

After completion of the leak test, evacuate the system with a vacuum pump to an absolute pressure not exceeding 1500 microns while the system ambient temperature is above 60°F. Break the vacuum to 2 psig with the refrigerant to be used in the system. Repeat the evacuation process, again breaking the vacuum with refrigerant. Install a drier of the required size in the liquid line, open the compressor suction and discharge valves, and evacuate to an absolute pressure not exceeding 500 microns. Leave the vacuum pump running for not less than two hours without interruption. Raise the system pressure to 2 psig with refrigerant and remove the vacuum pump.

Charge refrigerant directly from original drums through a combination filter-drier. Each drier may be used for a maximum of three cylinders of refrigerant and then must be replaced with a fresh drier. Charge the system by means of a charging fitting in the liquid line. Weigh the refrigerant drum before charging so that an accurate record can be kept of the weight of refrigerant put in the system. If refrigerant is added to the system through the suction side of the compressor, charge in vapor form only.

**REFRIGERANT PIPING ACCESSORIES**

Install accessories in accordance with the manufacturer’s written instructions and recommendations.

**CONSTRUCTION VERIFICATION ITEMS**

Contractor is responsible for utilizing the construction verification checklists supplied under specification Section 23 08 00 in accordance with the procedures defined for construction verification in Section 01 91 01 or 01 91 02.

END OF SECTION

**SECTION 23 81 26**
**SPLIT SYSTEM COMPUTER ROOM UNIT SPECIFICATION**

## PART 1 - GENERAL

### SCOPE

This section includes specifications for split-system ductless heat pump and cooling only type systems. Included are the following topics:

**RELATED WORK**

Section 23 05 00 - Common Work Results for HVAC
Section 23 05 13 – Common Motor Requirements
Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment
Section 23 05 93 – Testing, Adjusting, and Balancing of HVAC Systems
Section 23 21 13 – Hydronic Piping
Section 23 23 00 – Refrigerant Piping

**REFERENCE**

Applicable provisions of Division 1 shall govern work under this section.

**REFERENCE STANDARDS**

| | |
|---|---|
| ARI 210/240 | Unitary Air Conditioning and Heat Pump Equipment |
| ARI 365 | Commercial and Industrial Unitary Air Conditioning Condensing Units |
| ASHRAE 15 | Safety Standard for Refrigeration Systems |
| ASHRAE 90.1 | (2004 edition) Energy Standard for Buildings Except Low Rise Residential Buildings |
| NEC | National Electrical Code |
| ASTM B117 | Standard Practice for Operating Salt Spray (fog) Apparatus |
| UL | Underwriters Laboratory |

**QUALITY ASSURANCE**

Refer to division 1, General Conditions, Equals and Substitutions.

Unit rated performance in accordance with the latest edition of ARI Standard 365 or ARI Standard 210/240, whichever is applicable for the equipment.

Construct units in accordance with ASHRAE 15, UL standards and the NEC. Units shall carry the UL label.

Factory run and test units to see that each control device operates properly. Pressure test, evacuate, charge with holding charge of refrigerant and full oil charge prior to shipping from the factory.

**DESIGN REQUIREMENTS**

Standard 60Hz units shall be CSA-certified to the harmonized U.S. and Canadian product safety standard, "CSA C22.2 No 236/UL 1995 for Heating and Cooling Equipment" and are marked with the CSA c-us logo. It shall be specifically designed for service from the front and right side of the unit. The system shall be designed for draw-through air arrangement to insure even air distribution to the entire face area of the coil.

The system shall be AHRI Certified™, the trusted mark of performance assurance for heating, ventilation, air conditioning and commercial refrigeration equipment, using AHRI Standard 1360.

**SUBMITTALS**

Refer to division 1, General Conditions, Submittals

Submit air cooled condensing unit and evaporative unit shop drawings including the following information: specific manufacturer and model numbers, dimensional and weight data, required clearances, materials of construction, capacities and ratings, efficiencies, stages of unloading capacity achievable without hot gas bypass, refrigerant type and charge, component information, size and location of piping connections, electrical connections, wiring diagrams and information for all specialties and accessories.

Submit manufacturer's installation and start-up instructions, maintenance data, troubleshooting guide, parts lists, controls and accessories.

At substantial completion, submit warranty certificate and copy of start-up report.

**OPERATION AND MAINTENANCE DATA**

All operations and maintenance data shall comply with the submission and content requirements specified under section GENERAL REQUIREMENTS.

**DELIVERY, STORAGE AND HANDLING**

Comply with manufacturer's instructions for storing, rigging, unloading, and transporting units. Protect units from physical damage. Leave factory-shipping covers in place until installation.

Ship units to jobsite fully assembled.

**WARRANTY**

Provide a one year parts and labor warranty on the entire unit beginning upon substantial completion of project.

Provide a five year parts warranty on the compressor(s) beginning upon substantial completion of project.

## PART 2 - PRODUCTS

### COMPUTER ROOM UNITS

Manufacturers: Liebert, DataAire, Stulz, or approved equal.

### GENERAL

Provide a heating and cooling Heat Pump unit or Cooling Only unit with an indoor ceiling or wall mounted fan coil with matched outdoor condensing unit as scheduled.

Indoor fan coil units shall be complete with coil, fan, fan motor, piping connectors, electrical controls, microprocessor control system, R-410A or R32 refrigerant and integral Temperature sensing. Unit shall be furnished with integral wall mounting bracket and mounting hardware.

Outdoor condensing unit shall be factory assembled suitable for ground, rooftop, or wall hung mounting. Units shall consist of a compressor, an air cooled coil, propeller type outdoor fan, metering device(s), and control box. Units shall discharge air horizontally or vertically as shown on the drawings.

### COOLING SYSTEM

#### AIR-COOLED REFRIGERATION SYSTEM

##### SYSTEM DESCRIPTION

Single refrigeration circuit shall include a liquid line filter drier, a refrigerant sight glass with moisture indicator, an expansion valve, pressure safety switches, and a liquid line solenoid valve. The indoor evaporator refrigerant piping shall be filled with a nitrogen holding charge and spun shut. Field relief of the Schrader valve shall indicate a leak-free system.

##### HYDROPHILIC-COATED EVAPORATOR COIL

The direct-expansion, tilted-slab cooling coil shall be constructed of copper tubes and hydrophilic-coated aluminum fins. The hydrophilic coating shall significantly improve the speed of condensate drainage from the fins and shall provide superior water carryover resistance. One stainless steel condensate drain pan shall be provided.

##### R-410A REFRIGERANT

The system shall be designed for use with R-410A refrigerant, which meets the U.S. Clean Air Act for phase out of HCFC refrigerants.

##### COMPRESSOR

##### DIGITAL SCROLL COMPRESSOR

The compressor shall be an R-410A scroll-type with variable capacity operation from 20-100%, commonly known as a digital scroll. The compressor solenoid valve shall unload the digital scroll compressor to provide variable capacity operation. The compressor shall have a suction gas cooled motor, EPDM Rubber vibration isolators, internal thermal overloads, automatic reset high pressure switch with lockout after three failure occurrences, rota-lock service valves, low pressure transducer, and crankcase heater. The compressor shall be removable and serviceable from the front of the unit. The crankcase heater and a discharge check valve shall be provided for additional system protection from refrigerant migration during Off cycles.

## EXPANSION VALVE

### THERMOSTATIC EXPANSION VALVE (TXV)

A manually-adjustable, externally-equalized, thermostatic expansion valve (TXV) shall control the flow of liquid refrigerant entering the direct expansion coil. The TXV shall maintain consistent superheat of the refrigerant vapor at the outlet of the evaporator coil over the unit's operating range. The TXV shall prevent liquid refrigerant from returning to the compressor.

## FAN AND MOTOR

The unit shall be equipped with one plug fan: integral direct driven fan with backward-curved blades and electronically commutated DC motor; commonly referred to as EC fan. The fan speed shall be variable and automatically regulated by the controller through all modes of operation. The fan shall have a dedicated motor, fault monitoring circuitry, and speed controller, which shall provide a level of redundancy. The impeller shall be made of aluminum and dynamically balanced. The EC fan shall be located within the unit. The EC fan shall also provide greater energy savings than forward curved centrifugal fan and variable speed drives.

## AIR FLOW CONFIGURATION

### UPFLOW SUPPLY

### UPFLOW SUPPLY WITH FRONT AIR RETURN

The supply air shall exit from the top of the cabinet. The return air shall be through the front factory installed grilles. The EC fan shall be factory mounted in the upper portion of the unit. The fan shall be located to pull air through the filters and cooling coil to ensure even air distribution and maximum coil performance.

## CABINET CONSTRUCTION AND ACCESSIBILITY

### CABINET CONSTRUCTION

The exterior panels shall be 20 gauge steel and powder-coated with RAL 7021 black color paint to protect against corrosion. The exterior panels shall be insulated with 1/2” to 1" (12.7 to 25.4mm), 1-1/2 lb. (0.68 kg) insulation. Front and side panels shall have captive, quarter-turn fasteners. The cabinet shall be designed so that all components are serviceable and removable using the front and right sides of the unit.

## FLOOR STAND

## SUPPLY AIR FLOOR STAND

### DOWNFLOW RAISED FLOOR (UPFLOW, NOT REAR RETURN)

The floor stand shall be constructed of galvanized steel. The floor stand shall have adjustable legs with vibration isolation pads. The floor stand shall be: 6in. [15cm] high.

## PLENUM

## PLENUM CONSTRUCTION

The exterior panels shall be 20 gauge steel and powder-coated with black color paint to protect against corrosion. The exterior panels are insulated with 1/2” to 1" (12.7 to 25.4mm), 1-1/2 lb. (0.68 kg) insulation. Front and side panels shall have captive, quarter-turn fasteners.

## AIR FLOW CONFIGURATION

### TWO-WAY GRILLE

The unit shall be supplied with a two-way air discharge plenum. The plenum shall be 18 in. (457mm) high and shall discharge front and right of unit.

**LOCKING DISCONNECT SWITCH**

A locking-type fused disconnect switch shall be mounted in the electrical panel and shall be capable of disrupting the flow of power to the unit. The locking type shall consist of a main unit switch operational from outside the unit. The electric panel compartment shall be accessible only with the switch in the Off position. The locking disconnect shall be lockable in support of lockout/tagout safety programs.

**SHORT-CIRCUIT CURRENT RATING (SCCR)**

The electrical panel shall provide at least 65,000A SCCR.

Short-circuit current rating (SCCR) is the maximum short-circuit current a component or assembly can safely withstand when protected by a specific overcurrent protective device(s) or for a specified time.

**FILTRATION**

**MERV 8 FILTERS**

The filter shall be an integral part of the system and located within the cabinet. The filter shall be deep-pleated, 2 in. (51mm) thick with a MERV 8 rating efficiency based on ASHRAE 52.2-2007. A filter clog switch shall be included. Mesh type, cleanable filters shall be unacceptable.

**INTEGRAL CONDENSATE PUMP**

The dual-float condensate pump shall be complete with integral primary and secondary float switches, pump, motor assembly and reservoir. The secondary float shall send a signal to the local alarm and shut down the unit upon high water condition. The condensate pump shall be factory-installed on upflow units and field-installed on downflow units.

**SMOKE SENSORS**

The included smoke sensor samples the return air, shuts down the unit upon activation, and sends visual and audible alarms. Dry contacts are available for a remote customer alarm. This sensor includes a “supervision” contact closure. This smoke sensor is not intended to function as or replace any room smoke detection system that may be required by local or national codes.

An additional factory-provided smoke sensor shall be installed so it samples the supply air, shuts down the unit upon activation, and sends visual and audible alarms.

**POINT LEAK DETECTION SENSOR FOR REMOTE MOUNTING**

A total of 2 solid-state water sensor(s) with no moving parts and hermetically sealed to keep out dust and dirt shall be provided. The sensor shall provide a single-point detection of leaks. The point detection sensor shall have two gold-plated sensing probes to prevent corrosion resistance and to provide accurate readings. The unit shall constantly monitor points for leaks, internal faults, and power failures and warn of any abnormal conditions. Mounting brackets shall allow for sensor height adjustment and leveling. The unit shall provide two independent outputs to signal both a local alarm panel and a remote building management system or external equipment. The unit shall be rated for 24VAC, 50/60Hz and 0.10 amps.

**LOW-VOLTAGE TERMINAL PACKAGE**

Factory-installed and factory-wired terminals shall be provided for customer connection:

- Remote Shutdown Terminals - Two additional pairs of terminals provide the customer with additional locations to remotely shut down the unit by field-installed devices or controls.
- Extra Common Alarm Contacts - Two additional pairs of terminals provide the customer with normally open contacts for remote indication of unit alarms.

- Main Fan Auxiliary Switch - One set of normally open contacts wired to the EC fan motor contactor will close when EC fan operation is required. This set of dry contacts could also be used to initiate air economizer operation. Air economizer and associated devices by others.
- Liquid Sensor Shutdown - One pair of dry contacts for the liquid sensor signal will provide unit shut down. (Liquid sensor is not included)

**COMPRESSOR OVERLOAD**

A factory-installed sensor designed to detect high compressor currents and provide controller input to shut down the compressor as a compressor protection feature.

**INFRASTRUCTURE MONITORING SYSTEM REQUIREMENTS**

All material and equipment used shall be standard components, regularly manufactured and available and not custom-designed especially for this project. All systems and components shall have previously been thoroughly tested and proven in actual use before installation on this project.

The manufacturer will furnish or supply a site-specific Critical Infrastructure Management software system based on customer requirements. The system must be a software-only solution; no substitutions shall be accepted.

The system architecture shall consist of network interface cards that shall be installed in all critical infrastructures that, at a minimum, support HTTP and SNMP simultaneously.

The system shall receive SNMP traps from managed equipment and display the alarm notification in a graphical user interface.

The system shall be based on SNMP open protocols and shall integrate seamlessly with Vertiv, Aperture™ software suite and Network Management Systems.

Open protocol support shall include:

- HTTP(s)
- TCP/IP/v4, TCP/IP/v6
- SNMPv1, SNMPv2

The system shall have the capability of being remotely monitored and managed 24 hours a day, 7 days a week by the manufacturer.

The system shall have the ability to be deployed worldwide.

The system shall operate as a client-to-server application.

The Web interface of each managed device shall integrate directly into the system.

The system shall support enterprise-level databases including Microsoft® SQL™.

The system shall support exporting of all recorded parametric trend data.

The system shall operate on a server determined by the customer. Specific server brand or function is not permissible.

The system shall support virtual server environments by default.

The system shall include, at no additional cost, one (1) year of Software Assurance.

**CRITICAL INFRASTRUCTURE SYSTEM VENDOR RESPONSIBILITIES**

Provide hardware and software as listed.

- Critical Infrastructure software and licenses for server and workstation installations.

- Software Assurance for the first year at no additional cost.
- 7 x 24 system application and service support through a toll-free telephone number.
- Warranty (parts and labor) per the manufacturer's warranty statement.
- Vendor shall be ISO 9001 listed for design and manufacture of environmental control systems for Critical Monitoring and Control applications.

## PART 3 - CONTROLS

### MICROPROCESSOR CONTROL WITH 9 INCH COLOR TOUCHSCREEN

The controller shall be microprocessor-based with a 9-inch, high definition, capacitive, color touchscreen display and shall be mounted in an ergonomic, aesthetically pleasing housing. The display and housing shall be viewable while the front panel is open or closed. The controls shall be menu-driven. The system shall display user menus for active alarms, event log, graphic data, unit view/status overview (including the monitoring of room conditions, operational status in percentage of each function, date and time), total run hours, various sensors, display setup and service contacts. A password shall be required to make system changes. Service menus shall include setpoints, standby settings (lead/lag), timers/sleep mode, alarm setup, sensor calibration, maintenance/wellness settings, options setup, system/network setup, auxiliary boards and diagnostics/service mode. The controller shall provide Ethernet/RS-485 ports dedicated for BMS connectivity (i.e. Base-Comms).

- **PASSWORD PROTECTION** - The controller shall contain two unique passwords to protect against unauthorized changes. An auto hide/show feature shall allow the user to see applicable information based on the login used.
- **UNIT BACKUP AND RESTORE** - The user shall be able to create safe copies of important control parameters. The controller shall have the capacity for the user to automatically backup unit configuration settings to internal memory or USB storage drive. Configuration settings may be transferred to another unit for a more streamlined unit startup.
- **PARAMETER DOWNLOAD** - The controller shall enable the user to download a report that lists parameter names, factory default settings and user programmed settings in.csv format for remote reference.
- **PARAMETER SEARCH** - The controller shall have search fields for efficient navigation and parameter lookup.
- **CONTEXT-SENSITIVE HELP** - The controller shall have an on-board help database. The database shall provide context-sensitive help to assist with setup and navigation of the menus.
- **DISPLAY SETUP** - The user shall be able to configure the display information based on the specific user's preference. Language, units of measure, screen contrast, home screen layout, back-light timer, and the hide/show of certain readouts shall be configurable through the display.
- **ADDITIONAL READOUTS** - The display shall enable the user to configure custom widgets on the main screen. Widget options will include items such as fan speed, call for cooling, call for free-cooling, maintenance status, call for hot water reheat, call for electric reheat, call for dehumidification, call for humidification, airflow, static pressure, fluid flow rate and cooling capacity.
- **STATUS LEDS** - The controller shall show the unit's operating status using an integral LED. The LED shall indicate if the unit has an active alarm; if the unit has an active alarm that has been acknowledged; or if the unit is On, Off or in standby status.
- **EVENT LOG** - The controller shall automatically store the last 400 unit-only events (messages, warnings, and alarms).

- **SERVICE CONTACT INFORMATION** - The controller shall be able to store the local service or sales contact information.
- **UPGRADEABLE** - Controller upgrades shall be performed through a USB connection.
- **TIMERS/SLEEP MODE** - The menus shall allow various customer settings for turning the unit On or Off.
- **MENU LAYOUT** - The menus shall be divided into two main menus: User and Service. The User screen shall contain the menus to access parameters required for basic unit control and setup. The Service screen shall be de-signed for service personnel and shall provide access to advanced control setup features and diagnostic information.
- **SENSOR CALIBRATION** - The menus shall allow unit sensors to be calibrated with external sensors.
- **MAINTENANCE/WELLNESS SETTINGS** - The menus shall allow reporting of potential component problems before they occur.
- **OPTIONS SETUP** - The menus shall provide operation settings for the installed components.
- **AUXILIARY BOARDS** - The menus shall allow setup of optional expansion boards.
- **VARIOUS SENSORS -** The menus shall allow setup and display of optional custom sensors. The control shall include four customer accessible analog inputs for field-supplied sensors. The analog inputs shall accept a 4 to 20mA signal. The user shall be able to change the input to 0 to 5VDC or 0 to 10VDC. The gains for each analog input shall be programmable from the front display. The analog inputs shall be able to be monitored from the front display.
- **DIAGNOSTICS/SERVICE MODE** - The controller shall be provided with self-diagnostics to aid in troubleshooting. The microcontroller board shall be diagnosed and reported as pass/not pass. Control inputs shall be indicated as On or Off at the front display. Control outputs shall be able to be turned On or Off from the front display without using jumpers or a service terminal. Each control output shall be indicated by an LED on a circuit board.

**BASE-COMMS FOR BMS CONNECTIVITY** – The controller shall provide one Ethernet Port and RS-485 Port dedicated for BMS Connectivity. Provides ground fault isolated RS-485 Modbus, BACnet IP & Modbus IP network connectivity to Building Management Systems for unit monitoring and management. Also, provides ground fault isolated 10/100 baseT Ethernet connectivity for unit monitoring and management. The supported management interfaces include: SNMP for Network Management Systems, HTTP for web page viewing, SMTP for email, and SMS for mobile messaging. The controller shall support dual IP on one network and one 485 protocol simultaneously.

**ALARMS**

All unit alarms shall be annunciated through both audio and visual cues, clearly displayed on the screen, automatically recorded in the event log and communicated to the customers Building Management System/Building Automation System. The controller shall activate an audible and visual alarm in event of any of the following conditions:

- High Temperature
- Low Temperature
- High Humidity
- Low Humidity
- EC Fan Fault
- Change Filters
- Loss of Air Flow
- Loss of Power
- Compressor Overload (Optional)
- High Head Pressure
- Low Suction Pressure
- Custom Alarms

Custom alarm inputs shall be provided to indicate facility-specific events. Custom alarms can be identified with programmable labels. Frequently used alarm inputs include:

- Leak Under Floor
- Smoke Detected
- Standby Unit On

Each alarm (unit and custom) shall be separately enabled or disabled, selected to activate the common alarm and programmed for a time delay of 0 to 255 seconds.

## CONTROL METHODS AND OPTIONS

The controller shall be factory-set to allow precise monitoring and control of the condition of the air entering and leaving the unit. This control shall include predictive methods to control air flow and cooling capacity based control sensors installed. Proportional and Tunable PID shall also be user selectable options.

### CONTROLLING SENSOR OPTIONS

The controller shall be flexible in the sense that it shall allow for controlling the capacity and fan from multiple different sensor selections. The sensor selections shall be:

#### COOLING CAPACITY

- Supply
- Remote
- Return

#### FAN SPEED

- Supply
- Remote

- Return
- Manual (for diagnostic or to receive a signal from the BMS through the remote monitoring devices or analog input)
- Static Pressure

**TEMPERATURE COMPENSATION**

The controller shall be able to adjust the capacity output based on supply and return temperature conditions to meet SLA guidelines while operating at highest efficiency.

**WIRED SUPPLY SENSOR**

Each controller shall have one factory-supplied and connected supply air sensor that may be used as a controlling sensor or reference. When multiple sensors are applied for control purposes, the user shall be able to control based on a maximum or average temperature reading.

**VIRTUAL MASTER**

Unit shall allow for a virtual master that coordinates operation. The Virtual Master function shall provide smooth control operation if the group's communication is compromised. When the lead unit, which is in charge of component staging in teamwork, unit staging and standby rotation, becomes disconnected from the network, the controller shall automatically assign a virtual master. The virtual master shall assume the same responsibilities as the master until communication is restored.

**VIRTUAL BACK-DRAFT DAMPER**

The controller shall allow the use of a virtual back-draft damper, eliminating the need for a mechanical damper. This shall allow the fans to spin slower (15% or less) to act as a damper.

**COMPRESSOR SHORT CYCLE CONTROL**

To help maximize the life of the compressor, there shall be start-to-next start delay for each compressor. The control shall monitor the number of compressor starts in an hour. If the compressor starts more than 10 times in 60 minutes, the local display and remote monitoring shall notify the user through a Compressor Short Cycle event.

**CONDENSER UNIT COMMUNICATION**

The controller shall communicate directly with the condenser via field-supplied CANbus communication wires and via field-supplied, low-voltage interlock wires. This shall provide enhanced monitoring, alarming, diagnostics, low-noise mode, and condenser-fan reversal for cleaning mode.

**SYSTEM AUTO RESTART**

The auto restart feature shall automatically restart the system after a power failure. Time delay shall be programmable. An optional capacitive buffer may be provided for continuous control operation through a power failure.

**SEQUENTIAL LOAD ACTIVATION**

On initial startup or restart after power failure, each operational load shall be sequenced with a minimum delay of one second to minimize total inrush current.

**LOW-PRESSURE MONITORING**

Units shall ship standard with low-pressure transducers for monitoring compressor suction pressure. If the pressure falls due to loss of charge or other mechanical cause, the corresponding circuit shall shut down to prevent equipment damage. The user shall be notified of the low-pressure condition through the local display and remote monitoring.

**WINTER START TIME DELAY—AIR-COOLED MODELS**

An adjustable software timer shall be provided to assist with compressor starting during cold weather. When the compressor starts, the low-pressure input shall be ignored for the period set in the user-adjustable timer. Once the time period has elapsed after the compressor start, the low-pressure input should remain in the normal state. If the low-pressure input does not remain in the normal state when the time delay has elapsed, the circuit shall lock out on low pressure. The low-pressure alarm shall be announced on the local display and communicated to remote monitoring systems.

**ADVANCED HIGH-PRESSURE PROTECTION—MODELS WITH DIGITAL SCROLL COMPRESSORS**

When the compressor is initially activated, the system shall be monitored for high pressure. When high pressure is detected, the control shall alter the compressor operation and the condenser fan speed to reduce the system discharge pressure, preventing circuit shut down. If the unit is unsuccessful in correcting the problem through this interaction, an alarm shall occur and the affected compressor shall be immediately locked off. The control shall re-enable the compressor when the pressure returns to a safe level. This feature is standard on units equipped with liquid line transducers and digital scroll.

**REFRIGERANT PRESSURE TRANSDUCER FAILURE**

The control shall monitor the high-side and low-side refrigerant pressure transducers. If the control senses the transducer has failed, has been disconnected, has shorted or the reading has gone out of range, the user shall be notified through an event on the local display and remote monitoring. The corresponding circuit that the failure has occurred on shall be disabled to prevent unit damage.

**OIL RETURN PROTECTION**

The control shall monitor compressor operation and staging to ensure that liquid and hot gas velocity are maintained for proper oil return to the compressor.

**DIGITAL SCROLL HIGH-TEMPERATURE PROTECTION**

The control shall monitor digital scroll temperature during unit operation. A compressor temperature limit shall be imposed to help prevent damage to the compressor. If the temperature reaches the maximum temperature limit, the compressor shall be locked out for 30 minutes and an alarm shall be annunciated on the local display and through monitoring. After the initial lockout, the control shall continue to monitor compressor temperature during the off-cycle and re-enable the circuit once a safe operating temperature is reached and the 30 minutes has elapsed. The control shall store the number of high-temperature trips. The number of trips shall be accessible through the local display.

**DIGITAL SCROLL SENSOR FAILURE**

The control shall monitor the status of the digital scroll sensor(s). If the control senses that the thermistor is disconnected, shorted or the reading goes out of range, the user shall be notified through an event on the local display and remote monitoring.

**COMPRESSOR HIGH- AND LOW-TEMPERATURE LIMIT PROTECTION**

The control shall monitor the return air to ensure that the compressor is operated within the manufacturer's defined window of operation. If the return air temperature deviates from the manufacturer's window of operation, the controller shall automatically adjust to prevent damage to the cooling unit or reduction in its reliability.

**COMPRESSOR RUN TIME MONITORING**

The control shall log these compressor statistics:

- Number of compressor starts

- Run hours
- Average run time
- Starts per day
- Starts per day worst
- Number of high-pressure alarms
- Operating phase in which the high-pressure alarm occurred
- Number of low-pressure alarms
- Operating phase in which the low-pressure alarm occurred
- Number of compressor overloads
- Number of high-temperature alarms (scroll compressors)

The user shall have the ability to monitor compressor operating temperature and pressure from the local display to be used as a diagnostic tool.

### FLOODED START PROTECTION

The control shall isolate each compressor through a dedicated circuit liquid line solenoid valve and/or electronic expansion valve. These devices, combined with a spring-closed discharge check valve and compressor crank-case heater (air-cooled models), shall help ensure refrigerant does not migrate/carry oil out of the compressor case during the off cycle.

## PART 4 – HEAT REJECTION – ROOFTOP CONDENSING UNIT

### ROOFTOP CONDENSER SUMMARY

The condenser shall be designed to reject waste heat to outdoor air and to control refrigerant head pressure as indoor equipment loading and outdoor ambient conditions change.

The manufacturer shall design and furnish all equipment in the quantities and configurations shown on the project drawings.

Standard 60Hz units shall be CSA-certified to the harmonized U.S. and Canadian product safety standard “CSA C22.2 No 236/UL 1995 for Heating and Cooling Equipment” and shall be marked with the CSA c-us logo.

### CONDENSER DESIGN REQUIREMENTS

The air-cooled condenser shall be a factory-assembled unit, complete with integral electrical panel, designed for outdoor installation. The condenser shall be a draw-through design.

### CONDENSER STANDARD FEATURES

Condenser shall consist of microchannel condenser coil(s), propeller fan(s) direct-driven by individual fan motor(s), electrical controls, housing, and mounting legs. The air-cooled condenser shall provide positive refrigerant head pressure control to the indoor cooling unit by adjusting heat rejection capacity. Microchannel coils shall provide superior heat transfer, reduce air-side pressure drop, increase energy efficiency, and significantly reduce the system refrigerant volume required. EC fans and fan operating techniques shall reduced sound levels. Various methods shall be available to match indoor unit type, maximum outdoor design ambient and maximum sound requirements.

## CONDENSER COIL

Microchannel coils shall be constructed of aluminum microchannel tubes, fins, and manifolds. Tubes shall be flat and contain multiple, parallel flow microchannels and span between aluminum headers. Full-depth louvered aluminum fins shall fill spaces between the tubes. Tubes, fins, and aluminum headers shall be oven-brazed to form a complete refrigerant-to-air heat exchanger coil. Copper stub pipes shall be electric resistance welded to aluminum coils and joints protected with polyolefin to seal joints from corrosive environmental elements. Coil assemblies shall be factory leak tested at a minimum of 300 psig (2068kPag). Hot gas and liquid lines shall be copper and shall be brazed using nitrogen gas flow to the stub pipes with spun-closed ends for customer piping connections. Complete coil/piping assembly shall be then filled and sealed with an inert gas holding charge for shipment.

## CONDENSER FAN MOTOR/BLADE ASSEMBLY

The fan motor/blade assembly shall have an external rotor motor, fan blades and fan/finger guard. Fan blades shall be constructed of cast aluminum or glass-reinforced polymeric material. Fan guards shall be heavy gauge, close-mesh steel wire, coated with a black corrosion resistant finish. Fan terminal blocks shall be in an IP54 enclosure on the top of the fan motor. Fan assemblies shall be factory-balanced, tested before shipment and mounted securely to the condenser structure.

### CONDENSER EC FAN MOTOR

The EC fan motors shall be electronically commutated for variable speed operation and shall have ball bearings. The EC fans shall provide internal overload protection through built-in electronics. Each EC fan motor shall have a built-in controller and communication module, linked via RS485 communication wire to each fan and the Premium Control Board, allowing each fan to receive and respond to precise fan speed inputs from the Premium Control Board.

## CONDENSER ELECTRICAL CONTROLS

Electrical controls and service connection terminals shall be provided and factory-wired inside the attached control panel section. Only high-voltage supply wiring and low voltage indoor unit communication/interlock wiring are required at condenser installation.

### EC FAN SPEED AND PREMIUM CONTROL

The EC fan/Premium Control System shall include an electronic control board, EC fan motor(s) with internal overload protection, refrigerant and ambient temperature thermistors, and refrigerant pressure transducers. The Premium Control Board shall communicate directly with the indoor unit's control via field-supplied CANbus communication wires and via field-supplied low voltage interlock wires. The control board shall use sensor and communication inputs to maintain refrigerant pressure by controlling each EC fan on the same refrigerant circuit to the same speed. The Premium control board shall be rated to a temperature of -30°F to 125°F. The premium control shall be factory set for fan speed with receiver control.

### LOCKING DISCONNECT SWITCH

A Locking-Type disconnect switch shall be factory-mounted and wired to the electrical panel and be capable of disrupting the flow of power to the unit and controlled via an externally mounted locking and lockable door handle. The locking disconnect shall be lockable in support of lockout/tagout safety programs.

### SHORT CIRCUIT CURRENT RATING

The electrical panel shall provide at least 65,000A SCCR.

### CABINET

The condenser cabinet shall be constructed of bright aluminum sheet and divided into individual fan sections by full width baffles. Internal structural support members, including coil support frame, shall be galvanized steel for strength and corrosion resistance. Panel doors shall be provided on two sides of each

coil/fan section to permit coil cleaning. An electrical panel shall be contained inside a factory-mounted NEMA 3R weatherproof electrical enclosure.

### CONDENSER MOUNTING LEGS STANDARD ALUMINUM LEGS

Aluminum legs shall be provided to mount unit for vertical air discharge with rigging holes for hoisting the unit into position. Standard height is 18 in. (457mm).

### CONDENSER ACCESSORIES

#### LOW AMBIENT RECEIVER SYSTEM

Receiver kit shall contain an insulated, heated receiver tank with sight glasses, mounting plate, mounting hardware, pressure relief valve, rota-lock valve for refrigerant charge isolation and piping assembly with head pressure operated three-way valve and check valve. Components shall be field-assembled to the condenser. The three-way valve shall sense refrigerant head pressure and adjust the flooding charge in the condenser coil to adjust the condenser heat rejection capacity. The heater shall be 150W, shall include an integral thermostat to maintain refrigerant temperature at a minimum of 85°F (29°C) and shall require a separate power supply of (120V-1ph-60Hz).

The receiver kit shall function with manufacturer’s variable speed fan motors and electronic controls that lower fan speed in lower outdoor ambient temperatures for maximum energy efficiency. This system shall allow system startup and positive head pressure control with ambient temperatures as low as -30°F (-34.4°C).

#### FUSIBLE PLUG KIT

A fusible plug kit shall be field-installed on the liquid line for compliance with building codes requiring refrigerant relief during high temperature and building fire conditions.

### IBC/OSHPD SEISMIC CERTIFICATION AND IBC WIND/SNOW LOAD COMPLIANT

IBC/OSHPD Seismic Certification and IBC Wind/Snow Load Compliant condensers shall be provided with any applicable bracing and field-installation instructions. Condensers shall bear a label certifying compliance with IBC/OSHPD requirements.

## PART 5 – EXECUTION

### INSTALLATION OF PRECISION COOLING UNITS

#### GENERAL

Install precision cooling units in accordance with manufacturer's installation instructions. Install units plumb and level, firmly anchored in locations indicated, and maintain manufacturer's recommended clearances.

#### ELECTRICAL WIRING

Install and connect electrical devices furnished by manufacturer but not specified to be factory mounted. Furnish copy of manufacturer's electrical connection diagram submittal to electrical contractor.

#### PIPING CONNECTIONS

Install and connect devices furnished by manufacturer but not specified to be factory-mounted. Furnish copy of manufacturer's piping connection diagram submittal to piping contractor.

## REFRIGERANT PIPING SIZING

The unit manufacturer shall verify the final refrigeration pipe sizing process to ensure conformance to specific unit requirements such as maximum lengths, refrigerant velocities, unloading considerations and proper oil return. This contractor shall provide refrigeration piping drawings from the field which details the way the piping will actually be installed.

## REFRIGERANT PIPING

Refrigeration piping to be installed by firms who are experienced in installation of such piping and in accordance with the requirements of the International Mechanical Code, Chapter 11 and the Wisconsin Administrative Code Chapter SPS 345.

All brazing filler metals shall have a melting temperature above 1400 degrees F and contain a minimum of 6% silver.

Tubing to be new and delivered to the job site with the original mill end caps in place. Clean and polish all joints before brazing. Avoid prolonged heating and burning during brazing. Purge all lines with nitrogen during brazing. Provide manual shut-off and check valves as required.

No refrigerant is to be vented directly to the atmosphere except that which may escape through leaks in the system during leak testing. During evacuation procedures, use equipment designed to recover and allow recycling of the refrigerant.

Leak test the system by charging the system to a pressure of 10 psig with refrigerant, with the compressor suction and discharge valves closed and with all other system valves open. Increase pressure to 300 psig with dry nitrogen. Rap all joints with a mallet and check for leaks with an electric leak detector having a certified sensitivity of at least one ounce per year. Seal any leaks that may be found and retest.

After completion of the leak test, evacuate the system with a vacuum pump to an absolute pressure not exceeding 1500 microns while the system ambient temperature is above 60°F. Break the vacuum to 2 psig with the refrigerant to be used in the system. Repeat the evacuation process, again breaking the vacuum with refrigerant. Install a drier of the required size in the liquid line, open the compressor suction and discharge valves, and evacuate to an absolute pressure not exceeding 500 microns. Leave the vacuum pump running for not less than two hours without interruption. Raise the system pressure to 2 psig with refrigerant and remove the vacuum pump.

Charge refrigerant directly from original drums through a combination filter-drier. Each drier may be used for a maximum of three cylinders of refrigerant and then must be replaced with a fresh drier. Charge the system by means of a charging fitting in the liquid line. Weigh the refrigerant drum before charging so that an accurate record can be kept of the weight of refrigerant put in the system. If refrigerant is added to the system through the suction side of the compressor, charge in vapor form only.

## FIELD QUALITY CONTROL

Start the system in accordance with manufacturer's startup instructions. Test controls and demonstrate compliance with requirements. These specifications describe requirements for a computer room environmental control system. The system shall be designed to maintain temperature and humidity conditions in the rooms containing electronic equipment.

The manufacturer shall design and furnish all equipment to be fully compatible with heat dissipation requirements.

## SUPPLY AND DRAIN WATER PIPING

Connect water supply and drains to air conditioning unit. Provide pitch and trap as manufacturer's instructions and local codes require.

**WARRANTY START-UP AND CONTROL PROGRAMMING**

Engage manufacturer's field service technician to provide warranty start-up supervision and assist in programming of unit(s) controls and ancillary panels supplied by them.

END OF SECTION

**SECTION 26 05 00**
**COMMON WORK RESULTS FOR ELECTRICAL**

## PART 1 - GENERAL

The electrical work included in all other divisions is the responsibility of the contractor performing the division 26 work unless noted otherwise.

### PROJECT OVERVIEW

### SCOPE

The work under this section includes basic electrical requirements, which are applicable to all Division 26 sections. This section includes information common to two or more technical specification sections or items that are of a general nature, not conveniently fitting into other technical sections. Included are the following topics:

PART 1 - GENERAL
- Project Overview
- Scope
- Related Work
- Reference Standards
- Regulatory Requirements
- Quality Assurance
- Continuity of Existing Services and Systems
- Protection of Finished Surfaces
- Approved Electrical Testing Laboratories
- Sleeves and Openings
- Sealing and Fire Stopping
- State and/or User Agency Furnished Equipment
- Work by State and/or User Agency
- Provisions for Future Work
- Intent
- Omissions
- Submittals
- Project/Site Conditions
- Work Sequence and Scheduling
- Work by Other Trades
- Offsite Storage
- Salvage Materials
- Certificates and Inspections
- Operating and Maintenance Data
- Record Drawings

PART 2 - PRODUCTS
- Access Panels and Doors
- Identification
- Sealing and Fire Stopping

PART 3 - EXECUTION
- Excavation and Backfill
- Concrete Work
- Cutting and Patching
- Building Access
- Equipment Access
- Coordination
- Sleeves and Openings
- Sealing and Fire Stopping
- Housekeeping and Clean Up
- Agency Training

### RELATED WORK

Applicable provisions of Division 1 govern work under this Section.

Section 01 91 01 or 01 91 02 – Commissioning Process
Section 07 84 00 – Fire Stopping

**REFERENCE STANDARDS**
Abbreviations of standards organizations referenced in this and other sections are as follows.

| | |
|---|---|
| ANSI | American National Standards Institute |
| ASTM | American Society for Testing and Materials |
| EPA | Environmental Protection Agency |
| ETL | Electrical Testing Laboratories, Inc. |
| IEEE | Institute of Electrical and Electronics Engineers |
| IES | Illuminating Engineering Society |
| ISA | Instrument Society of America |
| NBS | National Bureau of Standards |
| NEC | National Electric Code |
| NEMA | National Electrical Manufacturers Association |
| NESC | National Electrical Safety Code |
| NFPA | National Fire Protection Association |
| UL | Underwriters Laboratories Inc. |
| DSPS | Wisconsin Department of Safety and Professional Services |

**REGULATORY REQUIREMENTS**
All work and materials are to conform in every detail to applicable rules and requirements of the Wisconsin State Electrical Code (SPS 316), the National Electrical Code (NFPA 70), other applicable National Fire Protection Association codes, the National Electrical Safety Code, and present manufacturing standards (including NEMA).

All Division 26 work shall be done under the direction of a currently licensed State of Wisconsin Master Electrician.

**QUALITY ASSURANCE**
Where equipment or accessories are used which differ in arrangement, configuration, dimensions, ratings, or engineering parameters from those indicated on the contract documents, the contractor is responsible for all costs involved in integrating the equipment or accessories into the system and the assigned space, and for obtaining the performance from the system into which these items are placed.

Manufacturer references used herein are intended to establish a level of quality and performance requirements unless more explicit restrictions are stated to apply.

All materials, except medium voltage equipment and components, shall be listed by and shall bear the label of an approved electrical testing laboratory. If none of the approved electrical testing laboratories has published standards for a particular item, then other national independent testing standards, if available, applicable, and approved by owner, shall apply and such items shall bear those labels. Where one of the approved electrical testing laboratories has an applicable system listing and label, the entire system, except for medium voltage equipment and components, shall be so labeled.

**CONTINUITY OF EXISTING SERVICES AND SYSTEMS**
No outages shall be permitted on existing systems except at the time and during the interval specified by the user agency and by the owner. The institution may require written approval. Any outage must be scheduled when the interruption causes the least interference with normal institutional schedules and business routines. No extra costs will be paid to the Contractor for such outages which must occur outside of regular weekly working hours.

This Contractor shall restore any circuit interrupted as a result of this work to proper operation as soon as possible. Note that institutional operations are on a seven-day week schedule.

**PROTECTION OF FINISHED SURFACES**
Furnish one can of touch-up paint for each different color factory finish furnished by the Contractor. Deliver touch-up paint with other "loose and detachable parts" as covered in the General Requirements.

**APPROVED ELECTRICAL TESTING LABORATORIES**
The following laboratories are approved for providing electrical product safety testing and listing services as required in these specifications:

Underwriters Laboratories Inc.
Electrical Testing Laboratories, Inc.

**SLEEVES AND OPENINGS**
Refer to Division 1, General Requirements, Sleeves and Openings.

**SEALING AND FIRE STOPPING**
Sealing and fire stopping of sleeves/openings between conduits, cable trays, wireways, troughs, cablebus, busduct, etc. and the sleeve, structural or partition opening shall be the responsibility of the contractor whose work penetrates the opening. Provide all fire stopping of fire rated penetrations and sealing of smoke rated penetrations in compliance with section 07 84 00 Fire Stopping.

**STATE AND/OR USER AGENCY FURNISHED EQUIPMENT**

**WORK BY STATE AND/OR USER AGENCY**

PCB equipment (other than light fixture ballasts) removal and disposal, if required, will be by the owner under separate contract.

Electrical testing not described in these contract documents will be by the owner under separate contract.

**PROVISIONS FOR FUTURE WORK**

**INTENT**
The Contractor shall furnish and install all the necessary materials, apparatus, and devices to complete the electrical equipment and systems installation herein specified, except such parts as are specifically exempted herein.

If an item is either called for in the specifications or shown on the plans, it shall be considered sufficient for the inclusion of said item in this contract. If a conflict exists within the Specifications or exists within the Drawings, the Contractor shall furnish the item, system, or workmanship, which is the highest quality, largest, or most closely fits the owner intent (as determined by the owner's Project Manager). Refer to the General Conditions of the Contract for further clarification.

It must be understood that the details and drawings are diagrammatic. The Contractor shall verify all dimensions at the site and be responsible for their accuracy.

All sizes as given are minimum except as noted.

Materials and labor shall be new (unless noted or stated otherwise), first class, and workmanlike, and shall be subject at all times to the owners and/or A/E's inspections, tests and approval from the commencement until the acceptance of the completed work.

Whenever a particular manufacturer's product is named, it is intended to establish a level of quality and performance requirements unless more explicit restrictions are stated to apply.

**OMISSIONS**
No later than ten (10) days before bid opening, the Contractor shall call the attention of the owner to any materials or apparatus the Contractor believes to be inadequate and to any necessary items of work omitted.

**SUBMITTALS**
Submit for all equipment and systems as indicated in the respective specification sections, marking each submittal with that specification section number. Mark general catalog sheets and drawings to indicate specific items being submitted and proper identification of equipment by name and/or number, as indicated in the contract documents. Failure to do this may result in the submittal(s) being returned to the Contractor for correction and resubmission. Failing to follow these instructions does not relieve the Contractor from the requirement of meeting the project schedule.

On request from the owner, the successful bidder shall furnish additional drawings, illustrations, catalog data, performance characteristics, etc.

Submittals shall be grouped to include complete submittals of related systems, products, and accessories in a single submittal. Mark dimensions and values in units to match those specified. Include wiring diagrams of electrically powered equipment.

The submittals must be approved before fabrication is authorized.

Submit sufficient quantities of submittals to allow the following distribution:

| | |
|---|---|
| Operating and Maintenance Manuals | 2 copies |
| User agency | 1 copy |
| A/E | 1 copy |
| Owner Field Office | 1 copy |

**PROJECT/SITE CONDITIONS**

Install Work in locations shown on drawings, unless prevented by project conditions.

Prepare drawings showing proposed rearrangement of work to meet project conditions, including changes to work specified in other sections. Obtain permission of owner before proceeding.

Tools, materials and equipment shall be confined to areas designated by the owner and user agency.

**WORK SEQUENCE AND SCHEDULING**
Install work in phases to accommodate user agency's occupancy requirements. During the construction period coordinate electrical schedule and operations with owner Construction Representative.

**WORK BY OTHER TRADES**
Every attempt has been made to indicate in this trade's specifications and drawings all work required of this Contractor. However, there may be additional specific paragraphs in other trade specifications and addenda, and additional notes on drawings for other trades which pertain to this trade's work, and thus those additional requirements are hereby made a part of these specifications and drawings.

Electrical details on drawings for equipment to be provided by others are based on preliminary design data only. This Contractor shall lay out the electrical work and shall be responsible for its correctness to match equipment actually provided by others.

**OFFSITE STORAGE**
Prior approval by owner and the A/E will be needed. The contractor shall submit Storage Agreement Form DOA-4528 to owner for consideration of off-site materials storage. In general, building wire, conduit, fittings and similar rough-in material will not be accepted for off-site storage. No material will be accepted for off-site storage unless shop drawings for the material have been approved.

**SALVAGE MATERIALS**
No materials removed from this project shall be reused unless specifically noted otherwise. All materials removed shall become the property of and shall be disposed of by the Contractor.

[The following material shall be removed from service and turned over to the owner or user agency, at a site selected by the owner, in the same condition as when it was removed.]

**CERTIFICATES AND INSPECTIONS**

Obtain and pay for all required installation inspections, except those provided by the owner, in accordance with the Wisconsin Administrative Code. Deliver originals of these certificates to the owners Project Representative.

The Electrical Contractor is responsible for coordination of owner electrical inspections. Prior to the start of significant on-site electrical work, the contractor shall schedule a pre-installation meeting with the owner Electrical Inspector to discuss the inspection requirements and review the contract requirements (also see Article 15 of the General Conditions). The Electrical Contractor shall be present when the owner Electrical Inspector conducts the electrical inspections.

**OPERATION AND MAINTENANCE DATA**
All operations and maintenance data shall comply with the submission and content requirements specified under section GENERAL REQUIREMENTS.

In addition to the general content specified under GENERAL REQUIREMENTS supply the following additional documentation:

1. Manufacturer's wiring diagrams for electrically powered equipment.
2. *[A/E and commissioning provider to define detailed operation and maintenance data requirements for this section per agency direction.]*

**RECORD DRAWINGS**
The Contractor shall maintain at least one copy each of the specifications and drawings on the job site at all times.

The owner will provide the Contractor with a suitable set of contract drawings on which daily records of changes and deviations from contract shall be recorded. Dimensions and elevations on the record drawings shall locate all buried or concealed piping, conduit, or similar items.

The daily record of changes shall be the responsibility of Contractor's field superintendent. No arbitrary mark-ups will be permitted.

At completion of the project, the Contractor shall submit the marked-up record drawings to the Architect/Engineer prior to final payment.

## PART 2 - PRODUCTS

**ACCESS PANELS AND DOORS**

Lay-in Ceilings:
Removable lay-in ceiling tiles in 2 x 2 foot or 2 x 4 foot configuration provided under other divisions are sufficient; no additional access provisions are required unless specifically indicated.

Concealed Spline Ceilings:
Removable sections of ceiling tile held in position with metal slats or tabs compatible with the ceiling system used will be provided under other divisions.

Metal Pan Ceilings:
Removable sections of ceiling tile held in position by pressure fit will be provided under other divisions.

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

**IDENTIFICATION**
See Electrical section 26 05 53 – Identification for Electrical Systems.

**SEALING AND FIRE STOPPING**
FIRE AND/OR SMOKE RATED PENETRATIONS:
Provide all fire stopping of fire rated penetrations and sealing of smoke rated penetrations in compliance with section 07 84 00 "Fire Stopping".

NON-RATED PENETRATIONS:

Conduit Penetrations Through Below Grade Walls:
In exterior wall openings below grade, use a modular mechanical type seal consisting of interlocking synthetic rubber links shaped to continuously fill the annular space between the uninsulated conduit and the cored opening or water-stop type wall sleeve.

Conduit and Cable Tray Penetrations:

At conduit and cable tray penetrations of non-rated interior partitions, floors and exterior walls above grade, use urethane caulk in annular space between conduit and sleeve, or the core drilled opening.

## PART 3 - EXECUTION

### EXCAVATION AND BACKFILL

Perform all excavation and backfill work to accomplish indicated electrical systems installation unless noted otherwise.

### CONCRETE WORK

The Division 3 Contractor will perform all cast-in-place concrete unless noted otherwise elsewhere. Provide all layout drawings, anchor bolts, metal shapes, and/or templates required to be cast into concrete or used to form concrete for the support of electrical equipment.

### CUTTING AND PATCHING

Refer to Division 1, General Requirements, Cutting and Patching.

### BUILDING ACCESS

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

### EQUIPMENT ACCESS

Install all piping, conduit, ductwork, and accessories to permit access to equipment for maintenance. Coordinate the exact location of wall and ceiling access panels and doors with the General Contractor, making sure that access is available for all equipment and specialties. Where access is required in plaster or drywall walls or ceilings, furnish the access doors to the General Contractor and reimburse the General Contractor for installation of those access doors.

### COORDINATION

The Contractor shall cooperate with other trades and owner in locating work in a proper manner. Should it be necessary to raise or lower or move longitudinally any part of the electrical work to better fit the general installation, such work shall be done at no extra cost to the owner, provided such decision is reached prior to actual installation. The Contractor shall check location of electrical outlets with respect to other installations before installing.

The Contractor shall verify that all devices are compatible for the surfaces on which they will be used. This includes, but is not limited to light fixtures, panelboards, devices, etc. and recessed or semi-recessed heating units installed in/on architectural surfaces.

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

### SLEEVES AND OPENINGS

Conduit penetrations in new poured concrete horizontal construction requiring F and T rating: Form opening using hole form or core drill opening. Alternatively provide cast in place fire stopping devices/sleeves.

Conduit penetrations in new poured concrete horizontal construction requiring F rating but no T rating: Same as conduit penetrations in new poured concrete construction requiring F and T ratings except that schedule 40 steel pipe sleeves may also be used.

Conduit penetrations in new poured concrete horizontal construction that do not require F or T ratings: Provide schedule 40 steel pipe sleeve, form opening using hole form or core drill opening.

Conduit penetrations in existing concrete floors: Core drill openings.

Conduit penetrations through existing floors located in food service areas that do not require a T rating: Core drill sleeve opening large enough to insert schedule 40 sleeve, extend sleeve 2 inches above the floor and grout area around sleeve with hydraulic setting, non-shrink grout.

Where penetrating conduit weight is supported by floor, provide manufactured product or structural bearing collar designed to carry load.

**SEALING AND FIRE STOPPING**
FIRE AND/OR SMOKE RATED PENETRATIONS:
Provide all fire stopping of fire rated penetrations and sealing of smoke rated penetrations in compliance with section 07 84 00 Fire Stopping.

NON-RATED PENETRATIONS:
In exterior wall openings below grade, assemble rubber links of mechanical seal to the proper size for the conduit and tighten in place, in accordance with the manufacturer's instructions. Install so that the bolts used to tighten the seal are accessible from the interior of the building or vault.

At all interior walls and exterior walls, conduit penetrations are required to be sealed. Apply sealant to both sides of the penetration in such a manner that the annular space between the sleeve or cored opening and the conduit is completely blocked.

PENETRATIONS SUBJECT TO WATER INTRUSION:
For penetrations (both rated and non-rated) in floors subject to water intrusion or in rooms housing electrical equipment (but not within walls) provide one of the following:

- Conduit penetration where steel pipe sleeve is used extend steel sleeve 2" above the floor.
- Conduit penetration where cast in place fire stopping device/sleeve is used, extend device/sleeve 2" above the floor (provided it meets the device's UL listing).
- Conduit penetration where there is no steel sleeve or cast in place fire stopping device/sleeve, provide 2"x 2" x 1/8" galvanized steel angles fastened to floor surrounding the penetration or group of penetrations to prevent water from getting to penetration. Provide urethane caulk between angles and floor and fasten angles to floor minimum 8"on center. Seal corners water tight with urethane caulk.

Floors subject to water intrusion or rooms housing electrical equipment include the following locations:

- Food Service/Kitchen Areas
- Walk In Coolers/Freezers
- Laundries
- Restrooms
- Locker/Shower Rooms
- Janitor Rooms w/ Sinks
- Wet Laboratories
- Mechanical/Plumbing Equipment Rooms
- Swimming Pool Rooms/Pool Equipment Rooms
- Chemical/Hazardous Waste Storage
- Maintenance/Industrial Shops
- Vehicle Storage and Parking Ramps
- Greenhouses
- Data/Telecommunications Rooms
- Electrical Equipment Rooms

Provide waterproof caulk sealant top coating on fire stopping system (or other approved means to protect the fire stopping system from water) in areas subject to wash down such as Food Service and Dish Washing Areas.

**HOUSEKEEPING AND CLEAN UP**
The Contractor shall clean up and remove from the premises, on a daily basis, all debris and rubbish resulting from its work and shall repair all damage to new and existing equipment resulting from its work. When job is complete, this Contractor shall remove all tools, excess material and equipment, etc., from the site.

**AGENCY TRAINING**
All training provided for agency shall comply with the format, general content requirements and submission guidelines specified under Section 01 91 01 or 01 91 02.

Contractor to provide factory authorized representative and/or field personnel knowledgeable with the operations, maintenance and troubleshooting of the system and/or components defined within this section for a minimum period of [XX] hours.

END OF SECTION

**SECTION 26 05 23**
**CONTROL-VOLTAGE ELECTRICAL POWER CABLES**

## PART 1 – GENERAL

### 1.01 SCOPE OF WORK
A. Base Bid: The work under this section includes furnishing and installing required remote control and signal cabling.

### 1.02 SECTION INCLUDES
A. General
B. Manufacturers
C. Remote Control and Signal Cable
D. Wiring Connectors

### 1.03 SUBMITTALS
A. Submit product data: Provide for each cable assembly type.
B. Submit manufacturer's installation instructions. Indicate application conditions and limitations of use stipulated by product testing agency specified under Regulatory Requirements.

### 1.04 REFERENCE STANDARDS
A. NFPA 70 - National Electrical Code

### 1.05 FUNCTIONAL PERFORMANCE TEST
A. Refer to Section 26 05 00 – Common Work for Electrical – Functional Performance Test.
B. A continuity check shall be performed on control and instrumentation wiring.

### 1.06 PROJECT CONDITIONS
A. Verify that field measurements are as shown on Drawings.
B. Conductor sizes are based on copper.
C. Wire and cable routing shown on Drawings is approximate unless dimensioned. Route wire and cable as required to meet Project Conditions.
D. Where wire and cable routing is not shown, and destination only is indicated, determine exact routing and lengths required.

## PART 2 – PRODUCTS

### 2.01 GENERAL
A. All wire shall be new, delivered to the site in unbroken cartons and shall be less than one year old out of manufacturer's stock.
B. All conductors shall be copper.
C. Insulation shall have a 600 volt rating.
D. All conductors must be suitable for the application intended. Conductors #12 and smaller may be solid or stranded with the following requirements or exceptions:
E. All conductors terminated with crimp type devices must be stranded.
F. Stranded conductors may only be terminated with UL OR ETL Listed type terminations or methods: e.g. stranded conductors may not be wrapped around a terminal screw but must be terminated with a crimp type device or must be terminated in an approved back wired method.

### 2.02 MANUFACTURERS
A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
   1. Alcan Products Corporation; Alcan Cable Division
   2. American Insulated Wire Corp.; a Leviton Company

3. General Cable Corporation
4. Senator Wire & Cable Company
5. Southwire Company
6. Houston Wire & Cable

## 2.03 REMOTE CONTROL AND SIGNAL CABLE

A. All systems cabling shall meet the requirements of NEC Article 725 and the following:
B. Control Cable for Class 1 Remote Control and Signal Circuits: 600 volt insulation, individual conductors twisted together, [shielded], and covered with an overall PVC jacket. Cable shall be Listed, temperature rated, and plenum or non-plenum rated for the application as required in the National Electrical Code.
C. Control Cable for Class 2 or Class 3 Remote Control and Signal Circuits shall be constructed, Listed, temperature rated, and plenum or non-plenum rated for the application as required in the NEC Article 725.
   1. )

## 2.04 WIRING CONNECTORS

A. Split Bolt Connectors: Not acceptable.
B. Spring Wire Connectors: Solderless spring type pressure connector with insulating covers for copper wire splices and taps. Use for conductor sizes 10 AWG and smaller.
C. All wire connectors used in underground or exterior pull boxes shall be gel filled twist connectors or a connector designed for damp and wet locations.

# PART 3 – EXECUTION

## 3.01 GENERAL WIRING METHODS

A. Low voltage control and signal cables shall be installed in conduit. However, they may be installed without conduit above accessible ceilings if the cable meets NEC requirements for the application, unless specified to be in conduit in other sections of the specifications. See requirements for free-air cabling installation below.
B. Control cables for controlling HVAC and lighting equipment connected to emergency power shall be routed in raceway.
C. Do not use wire smaller than 14 AWG for control wiring greater than 60 volts, or 18 AWG for voltages less than 60 volts, all sizes subject to NEC 725 requirements.
D. Splice only in junction boxes.
E. Identify wire per section 26 05 53.
F. Neatly train and lace wiring inside boxes, and equipment.

## 3.02 WIRING INSTALLATION IN RACEWAYS

A. Pull all conductors into a raceway at the same time. Use Listed wire pulling lubricant for pulling conditions when necessary.
B. Install wire in raceway after interior of building has been physically protected from the weather and all mechanical work likely to injure conductors has been completed.
C. Completely and thoroughly swab raceway system before installing conductors.

## 3.03 FREE-AIR CABLE INSTALLATION

A. When permitted in exposed ceiling areas, ‘Free-Air’ wiring runs shall avoid areas of high traffic (i.e. aisle way), shall be run as close as possible to outlining walls and shall be a minimum of ten (10) feet above finished floor.
B. Cabling shall be neatly run at right angles and be kept clear of other trades work.
C. Cabling shall be supported at a maximum of 4-foot intervals utilizing ‘bridal-type’ mounting rings anchored to ceiling concrete, piping supports or structural steel beams. If cable sag at mid-span exceeds 12-inches, another support shall be provided. Mounting rings shall be designed to maintain cables bend to larger than the minimum bed radius (typically 4 x cable diameter).

D. Cabling shall not be attached to or supported by existing cabling, plumbing or steam piping, ductwork, suspended ceiling supports or electrical conduit. Additionally, cabling shall not be laid directly on the ceiling grid.
E. To reduce or eliminate Electro-Magnetic Interference (EMI), the following minimum separation distances for 'Free-Air' cabling installations shall be adhered to:
    1. Twelve (12) inches from power lines of less than 5kV.
    2. Thirty-nine (39) inches from power lines of 5kV or greater.
    3. Eighteen (18) inches from lighting fixtures.
    4. Thirty-nine (39) inches from transformers and motors.
F. A coil of 2 feet in each cable shall be placed in the ceiling at each 'free-air' wired device. These coils shall be secured (wire tied) at the last cable support before the cable reaches the device and shall be coiled from 100% to 200% of the cable recommended minimum bend radius.
G. All cable shall be free of tension at both ends. Nylon strain relief connectors shall be provided at each device and junction box where cables enter. In cases where the cable must bear some stress, Kellum type grips may be used to spread the strain over a longer length of cable.
H. Cable manufacturers minimum bend radius shall be observed in all instances. Care should be taken in the use of cable ties to secure and anchor the station cabling. Ties should not be over tightened as to compress the cable jacket. No sharp burrs should remain where excess length of the cable tie has been cut.
I. All exposed vertical cable extensions to devices located below the finished ceiling shall be in conduit.
J. Provide protection for exposed cables where subject to damage.
K. Use suitable cable fittings and connectors.

## 3.04 WIRING CONNECTIONS AND TERMINATIONS

A. Splice only in accessible junction boxes.
B. All splices shall be so made that they have an electrical resistance not in excess of two feet (600 mm) of the conductor.
C. Use solderless spring type pressure connectors with insulating covers for wire splices and taps, 10 AWG and smaller.
D. Thoroughly clean wires before installing lugs and connectors.
E. At all splices and terminations, leave tails long enough to cut splice out and completely re-splice.

## 3.05 FIELD QUALITY CONTROL

A. Field inspection and testing will be performed under provisions of Section 26 05 04.

END OF SECTION

**SECTION 26 05 26**
**GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS**

## PART 1 - GENERAL

### SCOPE
The work under this section includes grounding electrodes and conductors, equipment grounding conductors, and bonding for Electrical and Communications systems. Included are the following topics:

PART 1 - GENERAL
- Scope
- Related Work
- References
- Performance Requirements
- Submittals
- Project Record Documents
- Regulatory Requirements

PART 2 - PRODUCTS
- Rod Electrode
- Concrete-Encased Grounding Electrode
- Mechanical Connectors
- Compression Connectors
- Exothermic Connections
- Conductors
- Bus/Busbar

PART 3 - EXECUTION
- Examination
- General
- Medium Voltage System Grounding
- Less Than 600 Volt System Grounding
- Communication System Grounding
- Field Quality Control
- Identification and Labeling
- Construction Verification Items
- Warranty

All hardware, cables and related termination and support hardware shall be furnished, installed, wired, tested, labeled, and documented by the Contractor, as detailed in this and related sections.

### RELATED WORK
Applicable provisions of Division 1 govern work under this Section.

Section 26 08 00 - Commissioning of Electrical.
Section 01 91 01 or 01 91 02 – Commissioning Process

### REFERENCES
ANSI/IEEE 142 (Latest edition) - Recommended Practice for Grounding of Industrial and Commercial Power Systems
UL 467 Electrical Grounding and Bonding Equipment
IEEE 837 - IEEE Standard for Qualifying Permanent Connections Used in Substation Grounding
TIA-607-C - Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications

### PERFORMANCE REQUIREMENTS
Grounding System Resistance:
- Equipment Rated 500 KVA and Less: 10 ohms maximum at building service entrance.
- Equipment Rated 500 to 1000 KVA: 5 ohms maximum at building service entrance.
- Equipment Rated more than 1000 KVA: 3 ohms building service entrance.
- Communications Busbars: 5 ohms maximum.

**Testing of grounding system resistance is to be witnessed by the DFD Electrical Inspector or Construction Representative.**

Provide test report of grounding system overall resistance and resistance of each electrode in final O&M manuals and noted on record documents.

**SUBMITTALS**
Product Data: Provide data for grounding electrodes and connections.

Provide samples of ground labels.

Test Reports: Indicate overall resistance to ground [and resistance of each electrode].

Manufacturer's Instructions: Include instructions for preparation, installation and examination of exothermic connectors.

**PROJECT RECORD DOCUMENTS**
Record locations of all electrical and telecommunications grounding electrodes, busbars and grounding conductors as installed including recorded ground resistance test results.

**REGULATORY REQUIREMENTS**
Conform to requirements of NFPA 70.

Furnish products listed and classified by Underwriters Laboratories, Inc. or testing firm acceptable to authority having jurisdiction as suitable for purpose specified and shown.

## PART 2 - PRODUCTS

**ROD ELECTRODE**
Material: Copper-clad steel.

Diameter: 3/4 inch (19 mm) minimum.

Length: 10 feet (3.5 m) minimum. Rod shall be driven at least 9' 6" deep.

**CONCRETE-ENCASED GROUNDING ELECTRODE FOR POLE BASES**
Fabricate per NFPA 70, Article 250.52 (A)(3) using 20 feet (6m) of bare copper wire not smaller than bare seven-strand #4 AWG. If concrete foundation is less than 20 feet (6m) long, coil excess conductor within the base of the foundation. Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts.

**MECHANICAL CONNECTORS**
The mechanical connector bodies shall be manufactured from high strength, high conductivity cast copper alloy material. Bolts, nuts, washers and lock washers shall be made of Silicon Bronze and supplied as a part of the connector body and shall be of the two bolt type.

Split bolt connector types are NOT allowed. Exception: the use of split bolts is acceptable for grounding of wire-basket type cable tray, and for cable shields/straps of medium voltage cable.

The connectors shall meet or exceed UL 467 and be clearly marked with the catalog number, conductor size and manufacturer.

**COMPRESSION CONNECTORS**
The compression connectors shall be manufactured from pure wrought copper. The conductivity of this material shall be no less than 99% by IACS standards.

Each connector shall be factory filled with an oxide-inhibiting compound.

The connectors shall meet or exceed the performance requirements of IEEE 837, latest revision.

The connectors shall be clearly marked with the manufacturer, catalog number, conductor size and the required compression tool settings.

The installation of the connectors shall be made with a compression tool and die system, as recommended by the manufacturer of the connectors, and shall be irreversible.

Pre-crimping of the ground rod is required for all irreversible compression connections to a ground rod.

Terminal lug for communication system grounding shall be compression type and conform to the following:

Material: Tin Plated Copper (aluminum not permitted).
Wire Size: to match conductor
Number of Stud Holes: 2
Stud Hole Size: 3/8”
Bolt Hole Spacing: per TIA-607-C
Tongue Angle: Straight

**EXOTHERMIC CONNECTIONS**
As manufactured by Erico Cadweld, Harger Ultraweld or similar.

**CONDUCTORS**
Material: Stranded copper (aluminum not permitted).

Grounding Electrode Conductor: Bare seven-strand conductors. Size as shown on drawings, specifications or as required by NFPA 70, whichever is larger.

Foundation Electrodes: As shown on drawings.

Primary Manhole, Main Switchgear room and Vault Bonding: No. 4/0 minimum.

Feeder and Branch Circuit Equipment Ground: Size as shown on drawings, specifications or as required by NFPA 70, whichever is larger. Differentiate between the normal ground and the isolated ground when both are used at the same facility.

Branch Circuit Equipment Ground shall be proportionately increased in size when routed with phase conductors increased in size.

Conductors for Telecommunications shall be as follows:

Telecommunications Bonding Conductor (TMGB to Service Ground): No. 3/0 minimum or as shown on drawings.
Telecommunications Bonding Backbone (TBB; TMGB to TGB): No. 3/0 minimum or as shown on drawings.
Telecommunications Grounding Equalizer (GE): No. 3/0 minimum or as shown on drawings.
Bonding Conductors shall be insulated with a Green Jacket or jacket marked with Green Tape or labeled per NEC Guidelines.

**BUS/BUSBAR**
Material: Copper (aluminum not permitted).

Size:

All Power systems: 1/4" X 2", length as needed (24” minimum).
Telecommunications Main Ground Busbar (TMGB): 1/4" x 4" x 20" long (minimum).
Telecommunications Grounding Busbar (TGB): 1/4" x 2" x 12" long (minimum).

Busbars:

Be pre-drilled to accommodate two-hole lugs.
3/8” stud hole size; hole spacing per TIA-607-C.
Incorporate insulators and stand-off brackets that electrically isolate busbar from mounting surface.

Provide main ground busbar located adjacent to main electrical service equipment to terminate all ground conductors. Refer to DFD grounding detail 26 05 26-1.

## PART 3 - EXECUTION

**EXAMINATION**
Verify that final backfill and compaction has been completed before driving rod electrodes.

**GENERAL**
Install Products in accordance with manufacturer's instructions.

Mechanical connections shall be accessible for inspection and checking. No insulation shall be installed over mechanical ground connections.

Ground connection surfaces shall be cleaned and all connections shall be made so that it is impossible to move them.

Attach grounds permanently before permanent building service is energized.

Terminate each grounding conductor on its own terminal lug. Sharing a single lug by multiple conductors is not allowed.

All grounding electrode conductors and individual grounding conductors shall be installed in PVC conduit, in exposed locations.

Each grounding electrode conductor shall be labeled at each terminated end as to system served and location of second termination.

**MEDIUM VOLTAGE SYSTEM GROUNDING**
Provide and install a ¼" x 2" ground bus 18" above finished floor with insulated standoffs 36" on center, completely around the perimeter of the room (vault) containing the medium voltage switchgear and unit substation. Route bus over door. All connections to bus shall be bolted with Belleville washers and tool applied compression spade lugs (2 hole) or exothermic.

[Provide a minimum of six (6) ground rods equally spaced around the perimeter of the high voltage switchgear room or as indicated by the drawings, whichever is greater.] [Provide three (3) ground rods arranged in a triangle configuration on the exterior of the building.] Connect ground rods to perimeter ground bus with 4/0 copper conductor. Connection from ground rod to conductor shall be irreversible compression or exothermic. Pre-crimping of the ground rod is required for all irreversible compression connections. Connection from ground bus to conductor shall be bolted with Belleville washers and tool applied compression spade lugs (2 hole) or exothermic.

Provide separate 4/0 copper conductor from perimeter ground bus to:
- XO terminal of each transformer.
- Each high voltage switch ground bus.
- Secondary service equipment ground bus.
- Transformer high voltage grounded terminal (if applicable).

Provide full size 600V copper THHN/THWN or XHHW-2 grounding conductor in each conduit, raceway or enclosure which contains high voltage conductors. Terminate at ground bus of equipment containing high voltage terminations. Connect to ground rod and grounding conductor in each manhole.

Bond each enclosure containing high voltage parts (switches, fuses, transformers, pull boxes, etc.) to room ground bus with 4/0 copper conductor.

Bond all conduits containing high voltage conductors or secondary service conductors to penetrated enclosures using grounding bushing and #4 copper conductor. Attach to penetrated enclosures using grounding bushing and #4 copper conductor. Attach to penetrated enclosure using compression lug on stud or bolt and Belleville washers.

Provide #10 stranded wire from each high voltage termination shield drain wire to ground bus within enclosure. Connect to nearest grounded conductor if ground bus is not within 24". Route shield drains away from energized parts. Make connections with "Sta-Kon" type terminals or tool applied tap connectors. Use of split bolts is acceptable when braided drain wires are used.

Bond all conduits carrying individual grounding or grounding electrode conductors with grounding bushing and separate #4 copper grounding conductor to ground bus.

Provide ground rod in each section of each secondary switchboard. Connect ground rod to ground bus with 4/0 copper conductor and irreversible compression connectors or exothermic.

**LESS THAN 600 VOLT ELECTRICAL SYSTEM GROUNDING**

Supplementary Grounding Electrode: [Use driven ground rod on exterior of building.] [Use effectively grounded metal frame of the building.]

Provide code sized copper grounding electrode conductor from electrical room ground bus to secondary switchboard ground bus, each separately derived system neutral, secondary service system neutral to street side of water meter, building steel, ground rod, and any concrete encased electrodes. Provide bonding jumper around water meter. Provide physical protection as required.

Equipment Grounding Conductor: Provide separate, insulated equipment grounding conductor within each raceway. Terminate each end on suitable lug, bus, enclosure or bushing. Provide a ground wire from each device to the respective enclosure.

Bond together system neutrals, service equipment enclosures, exposed non-current carrying metal parts of electrical equipment, metal raceway systems, grounding conductor in raceways and cables, receptacle ground connectors, and plumbing systems.

Install ground grid under access floors where indicated. Construct grid of #4 AWG bare copper wire installed on 72 inch centers both ways. Bond each access floor support pedestal to grid.

Bond together each metallic raceway, pipe, duct and other metal object entering space under access floors. Bond to under floor ground grid. Use #4 AWG bare copper conductor.

**COMMUNICATION SYSTEM GROUNDING**

Grounding and Bonding System for Communications shall be an isolated grounding system with a single ground point. That ground point is to be the common grounding electrode system at the building electrical service entrance (main ground bar located in electrical room).

The system shall be compliant with ANSI J-STD-607-B with the exception that the ground cable shall not be bonded to building steel except at the electrical service entrance.

Provide Grounding Busbar for Telecommunications at each Telecommunications Room, the Main Equipment Room and at the electrical service entrance per project drawings. Coordinate Busbar location(s) and conductor routing per drawings with Division 27 contractor.

Provide Telecommunications Bonding Conductor from Telecommunications Main Grounding Busbar (TMGB) at the Communications Entrance Facility to building common grounding electrode system. Attach grounding conductor to building steel as allowed only at the main electrical service entrance. Provide physical protection as required.

Provide Telecommunications Bonding Backbone (TBB) conductor from the TMGB to Telecommunications Grounding Busbar (TGB) at each Telecommunication Room, Telecommunications Equipment Room and Telecommunications Enclosure.

TBB shall be continuous and not connected through Telecommunications Grounding Busbars (TGBs).
Bond TGBs to TBB via tap off of TBB. Gauge of conductor to be same at TBB.
Leave 10 feet slack in conductor from TBB to TGB at TGB location(s).
Do not bond TBB or TGB to building steel at TGB location(s).

Provide Grounding Equalizer(s) (GE) per project drawings. Connect GE conductor directly to TGBs being interconnected.

**FIELD QUALITY CONTROL**
Inspect grounding and bonding system conductors and connections for tightness and proper installation.

Testing of grounding system resistance is to be witnessed by the DFD Electrical Inspector or Construction Representative. Provide test report of grounding system resistance in final O&M manuals and noted on record drawings.

Provide resistance test at each electrical and telecommunications Busbar to ground.

**IDENTIFICATION AND LABELING**
Label Grounds at point of termination.

Label for TBB connection at TMGB and TGB(s) shall be plastic and include the following:

| |
|---|
| IF THIS CONNECTOR OR CABLE IS LOOSE OR MUST BE REMOVED, PLEASE CALL THE BUILDING TELECOMMUNICATIONS MANAGER. |

**CONSTRUCTION VERIFICATION**
Contractor is responsible for utilizing the construction verification checklists supplied under specification Section 26 08 00 in accordance with the procedures defined for construction verification in Section 01 91 01 or 01 91 02.

Record locations of all electrical and telecommunications grounding electrodes, busbars and grounding conductors as installed including recorded ground resistance test results.

**WARRANTY**
See Division 1, General Conditions, and General Requirements.

END OF SECTION

**SECTION 26 05 29**
**HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS**

## PART 1 - GENERAL

**SCOPE**
The work under this sections includes conduit and equipment supports, straps, clamps, steel channel, etc., and fastening hardware for supporting electrical work. Included are the following topics:

PART 1 - GENERAL
Scope
Related Work
Submittals
Quality Assurance
PART 2 - PRODUCTS
Material
PART 3 - EXECUTION
Installation

**RELATED WORK**
Applicable provisions of Division 1 govern work under this Section.

Section 01 91 01 or 01 91 02 – Commissioning Process
Section 26 05 53 – Identification for Electrical Systems

**SUBMITTALS**
Product Data: Provide data for support channel.

**QUALITY ASSURANCE**
Support systems shall be adequate for weight of equipment and conduit, including wiring, which they carry.

## PART 2 - PRODUCTS

**MATERIAL**
Support Channel

- Epoxy Painted:
  - Strut shall be made from steel meeting the minimum mechanical properties of ASTM A1011 SS Grade 33, then painted with water born epoxy applied by a cathodic electro-deposition process.
  - All fittings and hardware shall be zinc plated in accordance with ASTM B633 (SC3 for fittings, SC1 for threaded hardware).
- Hot-dip Galvanized Steel:
  - Strut shall be made from steel meeting the minimum mechanical properties of ASTM A1011 SS, Grade 33 and shall be hot-dip galvanized after fabrication in accordance with ASTM A123.
  - Fittings shall be manufactured from steel meeting the minimum requirements of ASTM A907 SS, Grade 33, and hot-dip galvanized after fabrication in accordance with ASTM A123.
  - All hardware shall be stainless steel Type 304 or chromium zinc ASTM F1136 Gr. 3.
  - All hot-dip galvanized after fabrication products must be returned to point of manufacture after coating for inspection and removal of all sharp burrs.
- Stainless Steel:
  - All strut, fittings and hardware shall be made of AISI Type 304 or Type 316 stainless steel as indicated.

Conduit Supports

- Conduit clamps, straps, supports, etc., shall be steel or malleable iron.

- One-hole straps shall be heavy duty type. All straps shall have steel or malleable backing plates when rigid steel conduit is installed on the interior or exterior surface of any exterior building wall.

- Above suspended ceilings, bar joist conduit hangers: Spring Steel Clips with Snap-Close Clamps (Conduit Supports): Conduit clamps shall pivot a full 360 degrees and shall snap close around the conduit. Push-in type conduit clamps are not allowed. Spring clips shall require a hammer to install onto supporting surface.

- Stud wall applications: Spring Steel Clips with Push-in or Snap-Close Conduit Clamps (Conduit Supports): Conduit clamps shall pivot a full 360 degrees. Spring clips shall require a fastener to install onto stud.

- Box/conduit hanger with rod/wire clip (a.k.a. antlers): One assembly provides support for electrical box and conduit from drop wire or rod. Conduit clamps shall snap close around the conduit.

- Spring Steel Clip products shall be provided with corrosion resistance and be warranted against failure from corrosion for a period of ten (10) years from date of manufacture.

Nylon anchors

- Nylon anchors may only be used in limited applications with the pre-approval of the State of Wisconsin DFD Electrical Inspector. See Part 3 – Execution for examples of applications of where nylon anchors may be allowed.

- Nylon wall plugs shall be designed for 2-way expansion, providing rapid fixing with high pull-out values. Nylon wall plugs shall be molded with protruding side fins which restrict rotation and prevent fall out from overhead holes. Examples of these include Mungo types MN or MU, or Fischer type S nylon plugs.

- Nylon one-piece self-drilling anchors designed for use in hollow gypsum wallboard for light duty loads. Anchors shall be engineered nylon or Zamac alloy. Examples of these are the Zip-It ® or Zip-It Jr. ® self-drilling anchors.

- Manufacturer's names and catalog numbers are used for quality and performance only. Anchors manufactured by others shall be equally acceptable provided they meet or exceed in performance and quality as specified.

Threaded Rod: Minimum sized threaded rod for supports shall be 3/8” for trapezes and single conduits 1-1/4” and larger, and ¼” for single conduits 1” and smaller.

Hardware: Corrosion resistant, or as noted for each product above.

## PART 3 - EXECUTION

**INSTALLATION**

Fasten hanger rods, conduit clamps, and outlet-, junction-, and pull-boxes to building structure using pre-cast insert system, preset inserts, beam clamps, or expansion anchors.

Use toggle bolts or hollow wall fasteners in hollow masonry, plaster, or gypsum board partitions and walls; expansion anchors or preset inserts in solid masonry walls; self-drilling anchors or expansion anchors on concrete surfaces; sheet metal screws in sheet metal studs and wood screws in wood construction. If nail-in anchors are used, they must be removable type anchors.

Powder-actuated fasteners are not permitted.

Do not fasten supports to piping, ductwork, mechanical equipment, cable tray or conduit. Do not fasten to suspended ceiling grid system.

Do not drill structural steel members unless approved by DFD.

In wet locations, mechanical rooms, and electrical rooms, install free-standing electrical equipment on 3.5-inch (89 mm) concrete pads.

Install surface-mounted cabinets and panelboards with a minimum of four anchors. At all cabinet and panelboard locations on concrete or concrete block walls, and at ALL locations below grade, provide steel channel supports to stand cabinet one inch (25 mm) off wall (7/8" Uni-strut or 3/4" painted fire-retardant plywood is acceptable). In above-grade equipment rooms that have drywall walls, the cabinets and panelboards may be mounted to the drywall if backing is provided in the stud walls behind the equipment.

Bridge studs top and bottom with channels to support flush-mounted cabinets and panelboards in stud walls.

Furnish and install all supports as required to fasten all electrical components required for the project, including free standing supports required for those items remotely mounted from the building structure, catwalks, walkways etc.

Fabricate supports from galvanized structural steel or steel channel, rigidly welded or bolted to present a neat appearance. Use hexagon head bolts with spring lock washers under all nuts.

Support Channel

Use one of the following types of support channel as appropriate for the installed environment:

- Indoor: Epoxy Painted Steel, Hot-dipped Galvanized Steel, or as noted on the drawings.
- Exterior and wet locations: Hot-dipped Galvanized Steel or Stainless Steel, as appropriate for the environment or as noted on the drawings. Type 316 stainless steel shall be used for Food Service type environments. Epoxy painted support channel shall not be used for exterior installations.
- Manholes, steam pits, steam tunnels, or corrosive environments: Stainless Steel Type 316.
- Field cuts: File and de-bur cut ends of support channel and paint to prevent rusting. For epoxy-painted support channel, paint cut ends to match the original color. For hot-dipped galvanized support channel, spray cut ends with cold galvanized paint.

Support Wires

- Support wires that are installed in addition to the ceiling grid support wires to provide secure support for raceways, cables assemblies, boxes, cabinets, and fittings shall be secured at both ends (e.g. the ceiling structure at the top and the ceiling grid at the bottom) per NEC 300.11(A).
- Compressed-air power-actuated fasteners may ONLY be used for the installation of separate ceiling wires required for support of conduits and aircraft cable hung light fixtures.
- Support wires shall be identified per specification section 26 05 53.

Spring Steel Clip Conduit Supports

- Above suspended ceilings: Spring steel clips with snap-close clamps may be used to support conduit from bar joist (steel truss) systems above suspended ceilings.
- Stud wall applications: Spring steel clips with push-in or snap-close conduit clamps may be used to support conduit in interior metal stud wall applications. Use screw fasteners to install conduit clamp onto stud.
- Box/conduit hanger with rod/wire clip (a.k.a. antlers): These may only be used in limited applications with the pre-approval of the State of Wisconsin DFD Electrical Inspector.

Nylon anchor applications

- Nylon anchors may only be used in limited light duty applications with the pre-approval of the State of Wisconsin DFD Electrical Inspector.
- Nylon anchors shall be designed for the construction material in which they are intended to be installed, and shall be designed for the weight in which the anchors are intended to support.

- Nylon wall plug applications may include attaching 4” square boxes or conduit straps to plaster-covered clay tile, drywall, or hollow concrete block. Screws used with nylon wall plugs shall be #10 minimum and shall be longer than the anchor.

- Nylon one-piece self-drilling anchor applications may include attaching 4” square boxes or conduit straps to hollow gypsum wallboard for light duty loads. Use No. 8 screws with one-piece self-drilling anchors designed for 3/8” to 1” thick wallboard. Use No. 6 screws with anchors designed for 3/8” to 5/8” wallboard.

END OF SECTION

**SECTION 26 05 33**
**RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS**

## PART 1 - GENERAL

### SCOPE
This section describes the products and execution requirements relating to furnishing and installing raceways and boxes and related systems as part of a raceway system for electrical, communications, and other low-voltage systems for the project. Included are the following topics:



### RELATED WORK
Applicable provisions of Division 1 govern work under this section.

Section 01 91 01 or 01 91 02 – Commissioning Process
Section 26 08 00 - Commissioning of Electrical.
Section 26 05 26 – Grounding and Bonding for Electrical Systems

Section 26 05 29 – Hangers and Supports for Electrical Systems.
Section 26 27 02 – Equipment Wiring Systems.
Section 26 27 26 – Wiring Devices.
Section 27 10 00 - Structured Cabling
Section 27 41 00 - Audio-Video Systems
Section 28 31 00 – Fire Detection and Alarm.

**REFERENCES**
Wisconsin Administrative Code SPS 316 - Electrical
ANSI/TIA-569-C-Telecommunications Pathways and Spaces

**SUBMITTALS**
Surface Raceway System - submit product data and catalog sheets for all components.

Boxes - provide product data showing configurations, finishes, dimensions, and manufacturer's instructions.

Conduits in Concrete Slabs Above Grade - provide proposed conduit routing and sizing to Structural Engineer prior to approval of installation to verify structural integrity and fire rating of concrete slab.

## PART 2 - PRODUCTS

**GENERAL**
All steel fittings and conduit bodies shall be galvanized.

All conduit transitional fittings shall be listed for installed application.

No cast metal or split-gland type fittings permitted.

Mogul-type condulets larger than 2 inch (50 mm) not permitted except as approved or detailed.

All condulet covers must be fastened to the condulet body with screws and be of the same manufacture.

C-condulets shall not be used in lieu of pull boxes.

All boxes shall be of sufficient size to provide free space for all conductors enclosed in the box and shall comply with NEC requirements.

**RIGID METAL CONDUIT (RMC) AND FITTINGS**
Conduit: Heavy wall threaded, galvanized steel, schedule 40.

Fittings and Conduit Bodies: Use all steel threaded fittings and conduit bodies.

Expansion Fittings/Expansion Joints: Expansion Fittings shall be Internal Grounding type and shall not rely on external bonding jumpers to maintain grounding continuity between raceway components.

**PVC COATED RIGID METAL CONDUIT**
PVC Externally Coated Conduit: Rigid heavy wall, schedule 40, steel conduit with external 40 mil (0.1 mm) PVC coating. Conduit must be hot dipped galvanized inside and out including threads. The PVC coating bond to the galvanized steel conduit shall be stronger than the tensile strength of the coating itself.

Fittings and Conduit Bodies: Threaded type, material to match conduit. PVC coated fittings and couplings shall have specially formed sleeves to tightly seal to conduit PVC coating. The sleeves shall extend beyond the fitting or coupling a distance equal to the pipe outside steel diameter or two inches (50 mm) whichever is greater.

**INTERMEDIATE METAL CONDUIT (IMC) AND FITTINGS**
Conduit: Galvanized [Steel] [Aluminum], threaded.

Fittings and Conduit Bodies: Use all [Steel] [Aluminum] threaded fittings and conduit bodies.

Expansion Fittings/Expansion Joints: Expansion Fittings shall be Internal Grounding type and shall not rely on external bonding jumpers to maintain grounding continuity between raceway components.

**ELECTRICAL METALLIC TUBING (EMT) AND FITTINGS**

Conduit: Steel, Unthreaded thin wall galvanized tubing.

Fittings: All steel, compression or set screw type. No push-on or indenter types permitted.
Conduit Bodies: All steel conduit bodies.

**FLEXIBLE METAL CONDUIT (FMC) AND FITTINGS**
Conduit: steel, galvanized, spiral strip.

Fittings and Conduit Bodies: All steel, galvanized or malleable iron (except as allowed in specification 26 51 13).

**LIQUIDTIGHT FLEXIBLE METAL CONDUIT (LFMC) AND FITTINGS**
Conduit: flexible, steel, galvanized, spiral strip with an outer Liquidtight, nonmetallic, sunlight-resistant jacket.

Fittings and Conduit Bodies: ANSI/NEMA FB 1, compression type. There shall be a metallic cover/insert on the end of the conduit inside the connector housing to seal the cut conduit end.

**ELECTRICAL NONMETALLIC TUBING (ENT) AND FITTINGS**
Conduit: ENT (smurf tube), UL listed and NEC recognized.

Fittings: One piece quick connect fittings for 1/2 inch to 1 inch size and schedule 40 cemented fittings for larger size. When installed in concrete, fittings shall be suitable for damp locations and shall be concrete–tight, stub-ups and stub-downs kits shall meet manufacturer's recommendations.

**RIGID POLYVINYL CHLORIDE CONDUIT (PVC) AND FITTINGS**
Conduit: Rigid non-metallic conduit, Schedule 40 PVC minimum, Listed, sunlight resistant, rated for $90^0$ C conductors. Schedule 80 for locations exposed to physical damage or as required.

Fittings and Conduit Bodies: NEMA TC 2, Listed.

**FIBERGLASS RESIN CONDUIT (RTRC) AND FITTINGS:**
Conduit: Reinforced Thermosetting Resin Conduit RTRC, Type AG (Above Ground) and XW (Exposed), and UL 2515 AG (Above Ground) or UL 2420 BG (Below Ground) listed.

The conduit shall be free from defects including delamination's, foreign inclusions, etc. It shall be nominally uniform in color, density, and physical properties. It shall be straight and the ends shall be cut square to the inside diameter. The resin system shall be epoxy anhydride-cured with no fillers. Glass shall be (E-type or E-CR).

Joining Methods: Interference Joint – the conduit shall be supplied with an integrally wound tapered bell and machine tapered spigot which shall provide a concrete tight and watertight fit with a minimum pullout strength of 500 lbs. when tested in accordance with ASTM D 2105.

Fittings: A complete line of fittings, adaptors, and elbows shall be available and shall be manufactured from the same materials and process as the conduit.

Sizes: Conduit and fittings shall be manufactured to IPS and ID trade sizes.

Flammability: Conduit and fittings shall conform with UL 2515.

Hangers and Supports: When supporting or hanging conduit on a wall or structure, the manufacturer supplying the conduit shall also supply the hangers and supports. Third party materials shall not be allowed.

Thermal:
Conduit and fittings shall conform with the following:

| | |
|---|---|
| Heat Deflection Temperature: | 312° F per ASTM D 648 |
| Continuous Operating Temperature | -40° to 250° F (-40° C to 110° C) |
| Maximum Operating Temperature | -60° to 260° F (-60° to 130° F) |
| Coefficient of Thermal Expansion | $1.25 \times 10^{-5}$ in/in/F per ASTM D 696 |

Impact Resistance: Conduit and fittings shall conform with minimum impact resistances as required by UL 2515.

Compression Resistance: Conduit shall not decrease by more than 25% during testing set forth in UL 2515.

Pipe Stiffness: Conduit stiffness shall meet or exceed the standards set forth in ASTM D2412.

**HIGH DENSITY POLYETHYLENE CONDUIT (HDPE) AND FITTINGS**
Conduit: Schedule 80; Continuous length smooth-wall HDPE conduit for electrical applications produced to ASTM F2160. Conduit shall be listed by a Nationally Recognized Testing Laboratory (NRTL) to UL Standard 651-A for smooth-wall duct to be used as electrical conduit for the installation of Listed electrical cables underground.

The recommended HDPE color for power conduits are black or black with red stripes. Red identifies the conduit as electrical and black provides UV protection for storage and at points where the conduit may exit the ground.

The HDPE color for communications conduit shall be orange. Both communications and power HDPE conduits shall be listed by a NRTL per NEC 353.6 and marked per NEC 353.120.

Fittings: Threaded Mechanical Fittings: Aluminum reverse-threaded conduit couplers designed for use with HDPE conduit. Compression Fittings and Socket Couplings designed for use with HDPE conduit may also be used.

**CONDUIT SUPPORTS**
See section 26 05 29.

**SURFACE METAL RACEWAY**
Description: Sheet metal channel with fitted cover, suitable for use as surface metal raceway.

Size: [[_____x_____] inch ([_____x_____] mm).] [As shown on Drawing.]

Finish: [Ivory] [_____] enamel.

Fittings: Couplings, elbows, and connectors designed for use with raceway system.

Boxes and Extension Rings: Designed for use with raceway systems.

**SURFACE NONMETAL RACEWAY**
Description: Nonmetallic channel with fitted cover, suitable for use as surface raceway.

Size: [[_____x_____] inch ([_____x_____] mm).] [As shown on Drawing.]

Color: [Ivory] [_____]

Fittings: Couplings, elbows, and connectors designed for use with raceway system.

Boxes and Extension Rings: Designed for use with raceway systems.

**MULTI-OUTLET ASSEMBLY**
Description: Sheet metal channel with fitted cover, [with pre-wired receptacles,] suitable for use as a multi-outlet assembly.

Size: [[_____x_____] inch ([_____x_____] mm).] [As indicated on Drawing.]

Receptacles: Provide covers and accessories to accept convenience receptacles [specified in Section 26 27 26.] [Type 5-20R, single receptacle.]

Finish: [Ivory] [_____] enamel.

Fittings: Couplings, elbows, [outlet and device boxes,] and connectors designed for use with multi-outlet system.

**AUXILIARY GUTTERS (WIREWAYS)**

Description: [General purpose] [Oil-tight and dust- tight] [Rain-tight] type wireway without knockouts.

Size: [4 x 4] [6 x 6] [8 x 8] [12 x 12] inch ([100 x 100] [150 x 150] [200 x 200] [300 x 300] mm) [As indicated on Drawings]; length as indicated on Drawings.

Cover: [Hinged] [Screw applied] cover [with full gasketing.]

Connector: [Slip-in construction;] [Flanged;] [hinged cover.] [screw applied cover.]

Fittings: Lay-in type with [removable top, bottom, and side; captive screws.] [drip shield.]

Finish: Rust inhibiting primer coat with gray enamel finish.

**CONDUIT WATER SEALANT**
Description: Conduit sealant used to prevent water from entering buildings via conduits.

Sealant shall seal conduits against water and gas intrusion, such as Polywater® FST™-250 Foam Duct Sealant, Raychem RDSS Rayflate Duct Sealing System, or approved alternate. Sealant shall be re-enterable, shall be compatible with the conduit and conductor types being used, and shall comply with NEC 225.27, 230.8, and 300.5(G).

Manufacturer names and catalog numbers are used to develop quality and performance requirements only. Products manufactured by others may be acceptable provided they meet or exceed the specifications.

**PULL AND JUNCTION BOXES**
Interior Sheet Metal Boxes: code gauge galvanized steel, screw covers, flanged and spot-welded joints and corners.

Interior Sheet Metal Boxes larger than 12 inches (300 mm) in any dimension shall have a hinged cover or a chain installed between box and cover. Boxes 9 square-feet or larger shall have hinged covers and a single cover shall not exceed 10 square-feet.

Interior Sheet Metal Boxes connected to an exterior underground raceway, shall have a drain fitting located in the bottom.

Exterior Boxes and Wet Location Installations: Type 4 and Type 6, flat-flanged, surface-mounted junction box, UL listed as rain-tight. [Galvanized cast iron][Aluminum][PVC] box and cover with ground flange, neoprene gasket, and stainless steel cover screws.

Box extensions and adjacent boxes within 48 inches of each other are not allowed for the purpose of creating more wire capacity.

Junction boxes 6 inch-by-6 inch or larger size shall be without stamped knock-outs.

Wireways shall not be used in lieu of junction boxes.

**IN GRADE HANDHOLES AND BOXES**
Handholes and Boxes: [Fiberglass] [HDPE (High Density Polyethylene)] [Polymer- Concrete].

Handhole and Box Covers: [Fiberglass] [HDPE (High Density Polyethylene)] [Polymer- Concrete] [Galvanized].

Handhole and box bottoms: [Open] [Closed] [Integral Closed].

Handholes and boxes for use in underground systems shall be designed and identified as defined in NFPA 70, for intended location and application.

Handholes and covers shall be listed for the structural load at the identified installation location.
Covers: Weatherproof, secured by tamper-resistant locking devices with non-skid finish and labeled “ELECTRIC”, “SIGNAL”, “CATV” OR “TELEPHONE” dependent on system served.

Units shall be designed to prevent frost heaving.

**OUTLET BOXES**

Sheet Metal Outlet Boxes: galvanized steel, with stamped knockouts.

Luminaire and Equipment Supporting Boxes: Rated for weight of equipment supported; include 3/8 inch male fixture studs where required.

Concrete Ceiling Boxes: Concrete type.

Cast Boxes: Cast ferroalloy or aluminum, deep type, gasketed cover, threaded hubs.

**OUTLET BOX EXTENDERS**
Outlet Box Extenders: Non-Metallic, adjustable depth.

Outlet Box Extenders may only be used in limited applications with the pre-approval of the State of Wisconsin DFD Electrical Inspector. See Part 3 – Execution for examples of applications of where Outlet Box Extenders may be allowed.

**FLOOR BOXES**
Floor Boxes for Installation in Cast-In-Place Concrete Floors: [Fully-adjustable,] [Semi-adjustable,] [cast iron.] [formed steel.] [PVC.] [As indicated on drawings.] Provide boxes with sufficient capacity to house the devices indicated on the plans.

Type: [Flush service] [Concealed service] [Flush or Concealed service as indicated on drawings].

Floor Box Cover: [Solid Aluminum with Brushed Finish] [Solid Brass with Brushed Finish] [Powder coat painted aluminum] [Polycarbonate. Color to be selected by Architect] [As indicated on drawings]. Floor plates shall meet and exceed UL scrub water exclusion requirements for concrete, tile, carpet, and wood covered floors.

Device Plate: Stainless steel or as available from manufacturer.

Configuration: As indicated on drawings.

**POKE-THROUGH ASSEMBLIES**
Description: [Assembly comprising of service fitting, poke-through component, fire stops and smoke barriers, and junction box for conduit termination] [_____].

Fire Rating: Two-hour rated, or rated to match existing floor.

Type: [Pedestal] [Flush] [Concealed Service] [As indicated on drawings].

Floor Plate: [Solid Aluminum with Brushed Finish] [Solid Brass with Brushed Finish] [Powder coat painted aluminum] [Polycarbonate. Color to be selected by Architect] [As indicated on drawings]. Floor plates shall meet and exceed UL scrub water exclusion requirements for concrete, tile, carpet, and wood covered floors.

Device Plate: Stainless steel or as available from manufacturer.

Configuration: As indicated on drawings.

**BOXES FOR AUDIO-VIDEO EQUIPMENT**
Provide floor, wall, and/or ceiling boxes for Audio-Video (AV) Equipment as indicated on the Electrical and/or Audio-Video drawings.

FLAT SCREEN MONITOR BOXES
Provide a recessed wall box for mounting behind flat screen monitors, allowing the screens to sit flush against the wall. These boxes shall provide a neat and secure environment for the audio, video, control and power connections.

The recessed wall box shall install easily between any two standard studs in the wall. Connections and cable entry can be on the top or the bottom depending on installation preference.

The recessed wall box shall be provided with one low-voltage conduit entry box and Nationally Recognized Testing Laboratory (NRTL) listed single gang box for AC power.

The recessed wall box cover shall be provided in white or black and shall be suitable for painting. The cover shall have a cable exit slot for the display connections and the excess cable can easily be hidden inside of the box making the entire installation as clean as possible. The cover screws onto the front of the box once all connections are in place.

The recessed wall box shall be designed for new or existing construction. Brackets shall be included for mounting to studs in new construction as well as surface mount clips for mounting to sheet rock or plywood in existing construction.

**BOXES FOR FIRE ALARM AUDIO-VISUAL NOTIFICATION APPLIANCES**
Recessed boxes for Fire Alarm audio, visual, and audio-visual notification appliances shall be galvanized steel sheet metal with stamped knockouts. Boxes shall be painted red.

For surface mounting, use manufacturer supplied back boxes and trim plates, painted red or off white to match device color, and shall contain no visible conduit knock-outs. Mark each device with its circuit number.

## PART 3 - EXECUTION

**CONDUIT SIZING, ARRANGEMENT, AND SUPPORT**
EMT is permitted to be used in sizes 4 inch (100 mm) and smaller for power and low-voltage systems. See CONDUIT INSTALLATION SCHEDULE below for other limitations for EMT and other types of conduit.

Size power conductor raceways for conductor type installed. Conduit size shall be 1/2 inch (16 mm) minimum except **all homerun conduits shall be 3/4 inch (21 mm),** or as specified elsewhere. **Caution: Per the NEC, the allowable conductor ampacity is reduced when more than three current-carrying conductors are installed in a raceway. Contractor must take the NEC ampacity adjustment factors into account when sizing the raceway and wiring system.**

Size communications and other low-voltage systems raceways as follows:

Communications, including Outlet Box: [1] [1 1/4] inch minimum. Conduit used for single device locations (e.g. Wireless Access Point, Video Surveillance Camera, and Wall mounted telephone) may be 3/4 inch minimum.

Control, security, signal, video, and other low-voltage applications: 3/4 inch minimum.

Fire Alarm: 1/2 inch minimum.

Floor Box and Poke-Through Assemblies:
Power: 3/4 inch minimum or as indicated on drawings.
Low-voltage: 1 inch minimum or as indicated on drawings.

Provide one raceway from each communications outlet box [to above accessible ceiling] [to cable tray].

Arrange conduit to maintain 6’-8” clear headroom and present a neat appearance.

Route exposed conduit and conduit above accessible ceilings parallel and perpendicular to walls and adjacent piping.

Maintain minimum 6 inch (150 mm) clearance between conduit and piping. Maintain 12 inch (300 mm) clearance between conduit and heat sources such as flues, steam pipes, and heating appliances.

Arrange conduit supports to prevent distortion of alignment by wire pulling operations. Fasten conduit using galvanized pipe straps, conduit racks (lay-in adjustable hangers), clevis hangers, or bolted split stamped galvanized hangers.

Group conduit in parallel runs where practical and use conduit rack (lay-in adjustable hangers) constructed of steel channel with conduit straps or clamps. Provide space for 25 percent additional conduit.

Do not fasten conduit with wire or perforated pipe straps. Before conductors are pulled, remove all wire used for temporary conduit support during construction.

Support and fasten metal conduit at a maximum of 8 feet (2.4 m) on center.

Supports shall be independent of the installations of other trades, e.g. ceiling support wires, HVAC pipes, other conduits, etc., unless so approved or detailed.

Conceal all conduits except where noted on the drawings or approved by the Architect/Engineer. Contractor shall verify with Architect/Engineer all surface conduit installations except in mechanical rooms.

Changes in direction shall be made with symmetrical bends, cast steel boxes, stamped metal boxes or cast steel conduit bodies.

For indoor conduits, no continuous conduit run shall exceed 100 feet (30 meters) without a junction box.

All conduits installed in exposed areas shall be installed with a box offset before entering box.

**CONDUIT INSTALLATION**
Cut conduit square; de-burr cut ends.

Conduit shall not be fastened to the corrugated metal roof deck.

Bring conduit to the shoulder of fittings and couplings and fasten securely.

Use conduit hubs for fastening conduit to cast boxes. Use sealing locknuts or conduit hubs for fastening conduit to sheet metal boxes in damp or wet locations.

Threads to be coated with approved electrically conductive corrosion compound per NEC 300.6. Coating to be listed for installed environment, i.e. food service.

Terminate all conduit (except for terminations into conduit bodies) using conduit hubs, or connectors with one locknut, or utilize double locknuts (one each side of box wall).

Provide bushings for the ends of all conduit not terminated in box walls. Refer to Section 26 05 26 – Grounding and Bonding for Electrical Systems for grounding bushing requirements.

Provide insulated bushings where raceways contain 4 AWG or larger conductors.

Communication and Low Voltage systems conduits shall terminate in horizontal plane.

Install no more than the equivalent of:

Three 90 degree bends between boxes for electrical systems.

Two 90 degree bends between boxes for communications and other low voltage systems. Note: Offsets shall be considered 90 degrees.

No single bend may exceed 90 degrees.

Use hydraulic one-shot conduit bender or factory elbows for bends in conduit larger than 2 inch (50 mm) size unless sweep elbows are required.

Bend conduit according to manufacturer’s recommendations. Torches or open flame shall not be used to aid in bending of PVC conduit.

Use suitable conduit caps or other approved seals to protect installed conduit against entrance of dirt and moisture.

Provide 1/8 inch (3 mm) nylon pull string in empty conduit, except sleeves and nipples.

Install listed expansion-deflection fitting or other approved means shall be used where a raceway crosses a structural joint for expansion, contraction or deflection, used in buildings, bridges, parking garages or other structurers.

**Install expansion joints where direct-buried conduit is subject to Earth Movement by settlement or frost per NEC 300.5(J), especially where conduit exits the ground exposed and enters a box, cabinet, or enclosure attached to a building or structure.**

Install expansion fitting in exterior PVC conduit runs per NEC table 352.44 utilizing a minimum temperature change of 120 degree F.

Avoid moisture traps where possible. Where moisture traps are unavoidable, provide junction boxes with drain fittings at conduit low points.

Where conduit passes between areas of differing temperatures such as into or out of cool rooms, freezers, unheated and heated spaces, buildings, etc., provide condulet or box with duct seal or other means to prevent the passage of moisture and water vapor through the conduit.

Route conduit through roof openings for piping and ductwork where possible.

Where communication cabling is to be installed in conduit to the wiring hub (e.g. Telecom Room), multiple conduits may be consolidated into fewer, larger conduits. Capacity of shared conduits shall equal the capacity of the individual conduits unless otherwise noted.

Use NRTL listed metallic grounding clamps when terminating conduit to cable tray.

Ground and bond conduit under provisions of Section 26 05 26.

Conduit is not permitted in any slab topping of two inches (50 mm) or less.

Conduits in Concrete Slab Above Grade: Provide proposed conduit routing and sizing to Structural Engineer for approval prior to installation to verify structural integrity and fire rating of concrete slab.

Maximum Size Conduit in Concrete Slabs Above Grade: 1 inch (25 mm). Do not route conduits to cross each other in slabs above grade. Minimum conduit spacing shall be 6 inches on center.

PVC conduit in concrete pole bases shall transition to galvanized rigid metal conduit 12 inches before it enters a concrete pole base. Inside the pole base, the elbow shall be galvanized rigid metal conduit. From the elbow, the conduit shall transition back to PVC as it continues up and out the top of the concrete pole base.

PVC conduit shall transition to galvanized rigid metal conduit before it enters a foundation wall or up through a concrete floor.

PVC conduits installed in exposed parking ramps shall have expansion fittings installed per NEC table 352.44, utilizing a minimum temperature change of 110 degrees F. Each conduit run shall be provided with a minimum of one expansion fitting. Proper PVC clamps shall be utilized to allow for conduit movement.

Identify conduit under provisions of Section 26 05 53.

All conduit installed underground (exterior to building) shall be buried a minimum of 24 inches below finished grade, whether or not the conduit is concrete encased. Install warning tape 12" below finish grade over all buried conduits. Underground warning tape shall be detectable, 2” wide minimum, 5 mil thickness, containing a foil core. Tape color shall be red and labeled with the words "CAUTION-BURIED ELECTRIC LINE BELOW" as manufactured by Presco or similar.

**Conduits penetrating underground foundation walls: Individual conduits or each conduit as part of a ductbank penetrating underground foundation walls (excluding manholes) shall be sealed against water intrusion into the building.**

Clean PVC conduit with solvent, and dry before application of glue. The temperature rating of glue/cement shall match weather conditions. Apply full even coat of cement/glue to entire area that will be inserted into fitting. The entire installation shall meet manufacturer’s recommendations.

**CONDUIT INSTALLATION SCHEDULE**

Conduit other than that specified below for specific applications shall not be used.

- Horizontal Directional Drilling (Directional Boring) Installations: HDPE conduit.
- Underground Installations That Penetrate Foundation Walls: Rigid metal conduit within five feet (1.5 m) of the foundation wall. Conduit may transition to Fiberglass Resin Conduit (BG) or PVC conduit five feet (1.5 m) from the foundation walls.
- Underground Installations That Do Not Penetrate Foundation Walls: Rigid metal conduit, Fiberglass Resin Conduit (BG), or PVC conduit.
- Underground Installations Emerging from Grade: Buried conduit emerging from grade shall be Rigid metal conduit extending from the minimum cover distance of 24 inches below grade to the conduit termination point above grade. Refer to DFD detail.
- Underground Installations Under Concrete Slab: Rigid metal conduit or Schedule 40 PVC conduit.
- Underground Installations Emerging through Concrete Slab: Rigid metal conduit.
- Concealed in Poured Concrete Walls: Rigid Metal Conduit, PVC conduit, or Electrical Nonmetallic Tubing (ENT).
- Concealed in Concrete Block Walls: Electrical metallic tubing, PVC conduit. Electrical Nonmetallic Tubing (ENT).
- Within Concrete Slab: Rigid Metal conduit or PVC conduit.
- Emerging from Within Concrete Slab: Rigid Metal conduit.
- Exposed Outdoor Locations: Rigid Metal conduit, Intermediate Metal conduit.
- Exposed within Parking Structures: Rigid Metal conduit, Intermediate Metal conduit, PVC conduit.
- Steam Tunnels, Steam Pits or Exposed in Manholes: PVC coated Rigid Metal Conduit [Fiberglass Resin Conduit (XW)].
- Wet Interior Locations: Exposed: [Rigid metal conduit] [Schedule 80 PVC conduit] [PVC coated Rigid metal conduit] [Fiberglass Resin Conduit (XW)].
- Concealed Dry Interior Locations: Rigid metal conduit, Intermediate metal conduit, Electrical metallic tubing, PVC conduit (Ground conductor).
- Interior Building Grounding Electrode Conductor: Schedule 80 PVC.
- Exposed Dry Interior Locations: Rigid metal conduit, Intermediate metal conduit, Electrical metallic tubing.
- Motor and equipment connections: Liquidtight flexible metal conduit (LFMC) in all locations except in Mechanical equipment plenum spaces where Flexible Metal Conduit (FMC) shall be utilized. Minimum length shall be one foot (300 mm); maximum length shall be three feet (900 mm). Conduit must be installed perpendicular to direction of equipment vibration to allow conduit to freely flex.
- Exposed Dry Interior Locations for HVAC control devices with Conduit Connections: Electrical metallic tubing, Flexible Metal Conduit (FMC). For FMC installations, Minimum length shall be one foot (300 mm), Maximum length shall be three feet (900 mm). Minimum size FMC of 3/8".
- Exposed Dry Interior Locations for HVAC control devices without Conduit Connections: Where HVAC equipment control panels or devices do not provide for the direct connection of

conduits, exposed Class 2 wiring may be extended to complete the final connections in dry locations, provided it does not exceed 18 inches in length.

- Light fixtures: Refer to specification section 26 51 13.

- Plenum Spaces: Installation shall comply with requirements of NEC 300.22.

- Medium Voltage Applications (Interior Locations): Rigid metal conduit (RMC).

**PVC COATED RIGID METAL CONDUIT INSTALLATION**
Installers of PVC Coated Rigid Metal Conduit shall be factory trained and certified in the proper installation methods for this type of conduit. Proof of such certification shall be kept on the project site at all times and shall be produced upon request.

**HIGH DENSITY POLYETHYLENE CONDUIT (HDPE) INSTALLATION**
HDPE conduit may only be used in horizontal directional drilling applications. Installation must be in accordance with NFPA 70 National Electrical Code and be direct buried or encased in concrete.

Approved joining methods for HDPE include Threaded Mechanical Fittings, Compression Fittings, and/or Heat Fusion. Heat Fusion joints shall be made using “hot irons” designed specifically for joining HDPE conduit. Any joining method employed shall be manufacturer approved. Glue and/or solvents are NOT approved.

**SURFACE METAL RACEWAY AND MULTI-OUTLET ASSEMBLY INSTALLATION**
Use flat-head screws to fasten channel to surfaces every twenty-four (24) inches. Mount plumb and level.

Use suitable insulating bushings and inserts at connections to outlets and corner fittings.

Maintain grounding continuity between raceway components to provide a continuous grounding path under provisions of Section 26 05 26.

Fastener Option: Use clips and straps suitable for the purpose.

**NONMETALLIC SURFACE RACEWAY INSTALLATION**
Use flat headed screws with appropriate anchors to fasten channel to surfaces secured every twenty-four (24) inches. Mount plumb and level. All surface mounted devices shall be fastened to the wall utilizing flat head screws along with appropriate anchors. No device shall be adhered to the wall surface using two-faced tape or any means other than as described above.

Use suitable insulating bushings and inserts at connections to outlets and corner fittings.

In areas where the walls cannot be fished, the station cable serving these outlets shall be covered with raceways. No exposed wire shall be permitted within offices, laboratories, and conference rooms or like facilities.

Non-metallic raceway shall have a screw applied base. Both the base and cover shall be manufactured of rigid PVC materials.

The raceway shall originate from a surface mounted box mounted adjacent to and at the same height as existing electrical boxes in the room, be attached to the wall and terminate above the ceiling.

All fittings including, but not limited to, extension boxes, elbows, tees, fixture bodies shall match the color of the raceway.

The raceway and all systems devices shall be UL listed and exhibit nonflammable self-extinguishing characteristics, tested to specifications of UL94V-0.

In raceway for communications and other low voltage systems, the inside bend radius minimum shall be as follows:

- Internal diameter of 2 in or less- 6 times the internal diameter.
- Internal diameter of more than 2 in- 10 times the internal diameter.

Conduit bends shall contain no kinks or other discontinuities.

**AUXILIARY GUTTERS (WIREWAYS) INSTALLATION**
Bolt auxiliary gutter to wall using two-piece hangers or steel channels fastened to the wall or in self-supporting structure.

Gasket each joint in oil-tight gutter.

Mount rain-tight gutter in horizontal position only.

Maintain grounding continuity between raceway components to provide a continuous grounding path under provisions of Section 26 05 26.

**COORDINATION OF BOX LOCATIONS**
Provide electrical boxes as shown on Drawings, and as required for splices, taps, wire pulling, equipment connections, and code compliance.

Electrical box locations shown on Contract Drawings are approximate unless dimensioned. Verify location of floor boxes and outlets in offices and work areas prior to rough-in.

No outlet, junction, or pull boxes shall be located where it will be obstructed by other equipment, piping, lockers, benches, counters, etc.

Conduit and boxes shall not be fastened to the metal roof deck. If conduit and boxes are required to be located and installed on roof decks, the conduit and boxes are required to be spaced minimum 1-5/8 inch off the lowest part of the metal roof decking material, per NEC 300.4 (E).

It shall be the Contractor's responsibility to study drawings pertaining to other trades, to discuss location of outlets with workmen installing other piping and equipment and to fit all electrical outlets to job conditions.

In case of any question or argument over the location of an outlet, the Contractor shall refer the matter to the Architect/Engineer and install outlet as instructed by the Architect/Engineer.

The proper location of each outlet is considered a part of this contract and no additional compensation will be paid to the Contractor for moving outlets which were improperly located.

Locate and install boxes to allow access to them. Where installation is inaccessible, coordinate locations and provide 18 inch (450 mm) by 24 inch (600 mm) access doors. Boxes must be installed within 12” from edge of the access door.

Locate and install to maintain headroom and to present a neat appearance.

Install boxes to preserve fire resistance rating of partitions and other elements, using approved materials and methods.

Boxes installed in the building envelop shall be sealed with caulking materials or closed with gasketing systems compatible with the construction materials and locations per IEC 502.4.3.

**PULL AND JUNCTION BOX INSTALLATION**
Pull boxes and junction boxes shall be minimum 4 inches square (100 mm) by 2 1/8 inches (54 mm) deep for use with 1 inch (25 mm) conduit and smaller. On conduit systems using 1 1/4 inch (31.75 mm) conduit, minimum junction box size shall be 4 11/16 inches square by 2 1/8 inches deep.

Where used with raceway(s) containing conductors of 4 AWG or larger, pull box shall be sized as required unless otherwise noted on the drawings.

Where used with raceway(s) containing conductors on systems over 600V, size pull box per NEC 314 Part IV unless otherwise noted as larger on the drawings.

Size pull boxes for communications per ANSI/TIA-568-C

Locate pull boxes and junction boxes above accessible ceilings, in unfinished areas or furnish and install DFD approved access panels in non-accessible ceilings where boxes are installed. All boxes are to be readily-accessible.

Provide Pull and Junction boxes for communications and other low voltage applications (a) in any section of conduit longer than 100 feet, (b) where there are bends totaling more than 180 degrees between pull points or pull boxes and (c) wherever there is a reverse bend in run. Locate boxes on straight section of raceway (e.g. do not use boxes in place of raceway bends).

Support pull and junction boxes independent of conduit.

**IN GRADE HANDHOLES AND BOXES**

Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.

Unless otherwise indicated and detailed, support units on a level bed of crushed stone or gravel, graded from 1/2 inch (12.5 mm) sieve to No. 4 (4.25 mm) sieve and compacted to same density as adjacent undisturbed earth.

Elevation: In finished areas, set so cover surface will be flush with finished grade.

Unless approved by DFD review staff, handholes and boxes shall **NOT** be installed in paved or concrete drives or walks.

Units shall be selected with depth sufficient to allow for conductor bending/ wire management and allow sufficient conduit elevation above compacted bed to prevent water infiltration in conduit.

Provide conduit sealant to seal conduits against water and gas intrusion, such as Polywater® FST™-250 Foam Duct Sealant, Raychem RDSS Rayflate Duct Sealing System, or approved alternate. Sealant shall be re-enterable, shall be compatible with the conduit and conductor types being used, and shall comply with NEC 225.27, 230.8, and 300.5(G).

**OUTLET BOX INSTALLATION**

Do not install boxes back-to-back in walls. Provide minimum 6 inch (150 mm) separation, except provide minimum 24 inch (600 mm) separation in acoustic-rated walls.

Power:

Recessed (1/4 inch maximum) outlet boxes in masonry, concrete, tile construction, or drywall shall be minimum 4 inch square, with device rings. Device covers shall be square-cut except rounded corner plaster rings are allowed in drywall applications. Angle cut plaster rings are not permitted. Coordinate masonry cutting to achieve neat openings for boxes. A single gang box can be used in drywall and masonry, for a single device location, when a single conduit enters box.

Shallow 4 inch square by 1 1/2 inch deep boxes can be used as device boxes for power provided the box and plaster ring is sized for installed device and conductors.

Low Voltage:

Recessed (1/4 inch maximum) outlet boxes in masonry, concrete, tile construction or drywall shall be minimum 4 11/16 inch square by 2 1/8 inch deep with single gang device ring (unless noted otherwise on drawings). Device covers shall be square-cut except rounded corner plaster rings are allowed in drywall applications. Angle cut plaster rings are not permitted. Coordinate masonry cutting to achieve neat openings for boxes.

Provide one conduit from each communications outlet box. Conduit runs between outlet boxes for communications are not allowed. Terminate conduit [above accessible ceiling] [above accessible ceiling in corridor] [on cable tray] [as detailed on drawings].

Provide knockout closures for unused openings.

Support boxes independently of conduit except for cast boxes that are connected to two rigid metal conduits, both supported within 12 inches (300 mm) of box.

Use multiple-gang boxes where more than one device are mounted together; do not use sectional boxes. Sectional boxes may only be used with the pre-approval of the State of Wisconsin DFD Electrical Inspector

for remodeling applications where it is impractical to install multi-gang boxes. Provide non-metallic barriers to separate wiring of different voltage systems.

Install boxes in walls without damaging wall insulation.

Coordinate mounting heights and locations of outlets mounted above counters, benches, and backsplashes.

Ceiling outlets shall be 4 inch square, minimum 2 1/8 inch (54 mm) deep except that concrete boxes and plates will be approved where applicable. Position outlets to locate luminaires as shown on reflected ceiling plans.

In inaccessible ceiling areas, position outlets and junction boxes within 6 inches (150 mm) of recessed luminaire, to be accessible through luminaire ceiling opening.

Provide recessed outlet boxes in finished areas; secure boxes to interior wall and partition studs, accurately positioning to allow for surface finish thickness. Use stamped steel stud bridges for flush outlets in hollow stud wall, and adjustable steel channel fasteners for flush ceiling outlet boxes.

Align wall-mounted outlet boxes for switches, thermostats, and similar devices.

Provide cast ferroalloy or aluminum outlet boxes in exterior and wet locations.

Surface wall outlets shall be 4 inch (100 mm) square with raised covers for one and two gang requirements. For three gang or larger requirements, use gang boxes with non-overlapping covers.

Outlet Box Extender applications:

**Outlet Box Extenders may only be used in limited applications with the pre-approval of the State of Wisconsin DFD Electrical Inspector.**

Provide box extenders for boxes that are set too far back in the wall due to un-anticipated wall finishes. **Outlet Box Extenders will NOT be allowed for installations where the EC has not accommodated for wall finishes that were expected prior to installation.** Place the box extender over the existing box face to make the box face flush with the wall finish.

**FLOOR BOX INSTALLATION**

Set boxes level and flush with finish flooring material.

Floor boxes for communications shall each be served by conduit(s) dedicated to that box. Conduit runs between floor boxes for communications are not allowed. Conduit shall be part of path that allows for cable to be terminated at wiring hub (e.g. Telecom Room) on same floor on which floor box appears unless noted otherwise.

**AUDIO-VIDEO SYSTEM BOX AND CONDUIT INSTALLATION**

Conduit requirements for AV systems cabling may differ from those of other trades. It is important that the electrical contractor become familiar with these specialized requirements. AV systems cabling must be enclosed within continuously grounded ferrous metallic conduit or raceway. PVC conduit is not acceptable. Conduit and raceway is to be furnished and installed by electrical contractor. Conduits containing different wiring classes must maintain minimum separations to minimize interferences from electrical noise. Conduits sizes and quantities shown on bid documents are minimums. Separate conduit runs specified in bid documents may not be combined for any purpose.

The following tables define the required minimum separations between the group divisions and other power services.

| Group | Description | Level | Bandwidth |
|---|---|---|---|
| A | Microphone level AV circuits | Below -30 dBμ | 20 Hz to 20 kHz |
| B | Line level AV circuits, Communication Circuits (Intercom) | -30 dBμ to +24 dBμ | 20 Hz to 20 kHz |
| C | Speaker level AV circuits, including low- and high-impedance types (70V) | Greater than +24 dBμ | 20 Hz to 20 kHz |
| D | Control Circuits Data Circuits | 0-28 volt into <50k ohm<br>2 volt peak-peak into 100 ohm | 0 Hz to 100 MHz |
| E | Video | 1 volt peak-peak into 75 ohm | 0 Hz to 10 MHz |
| F | Fiber Optic Circuits | N/A | N/A |

| Wire Class | A | B | C | D | E | F |
|---|---|---|---|---|---|---|
| A | Adjacent | 6 inches | 12 inches | 12 inches | 12 inches | Adjacent |
| B | -- | Adjacent | 12 inches | 6 inches | 6 inches | Adjacent |
| C | -- | -- | Adjacent | 6 inches | 6 inches | Adjacent |
| D | -- | -- | -- | Adjacent | Adjacent | Adjacent |
| E | -- | -- | -- | Adjacent | Adjacent | Adjacent |
| F | -- | -- | -- | -- | -- | Adjacent |
| Power Conduit <60A | 24 inches | 24 inches | 24 inches | 24 inches | 24 inches | Adjacent |
| Power Conduit 60 - 120A | 48 inches | 48 inches | 48 inches | 48 inches | 48 inches | Adjacent |
| Power Conduit >120A | 64 inches | 64 inches | 64 inches | 64 inches | 64 inches | Adjacent |

- Ninety-degree crossings in close proximity are acceptable between groups A through F
- The sizing of the conduit is to be based on the NEC requirements
- The minimum conduit size allowed for AV cables is 3/4 inch
- For conduit runs of 50 to 100 feet the installed number shall be reduced by 15% or the next larger size of conduit shall be used.
- If more than two 90 degree bends are to be used in a conduit run or if the run exceeds 100 feet, a pull box shall be inserted.

Conduit runs entering or exiting the audio equipment racks shall be electrically isolated from the racks. PVC or other non-conductive fittings shall be used to isolate the conduit from the audio equipment racks.

Provide AV boxes as shown on the Electrical and/or Audio-Video drawings. Install boxes at heights and locations as indicated on the drawings. Coordinate all box installations with the AV equipment provider.

Flat screen monitor boxes shall be installed so that all cabling is concealed behind the monitor. Coordinate box location with flat screen mounting brackets so that the box cover and cables are not blocked by the brackets.

**CONSTRUCTION VERIFICATION**
Contractor is responsible for utilizing the construction verification checklists supplied under specification Section 26 08 00 in accordance with the procedures defined for construction verification in Section 01 91 01 or 01 91 02.

END OF SECTION

**SECTION 26 05 53**
**IDENTIFICATION FOR ELECTRICAL SYSTEMS**

## PART 1 - GENERAL

### SCOPE
The work under this section includes the products and execution requirements relating to labeling of power, control, signaling and fire alarm wiring. Further, this section includes the installation of labels, nameplates, and directories for electrical boxes, wiring devices, and equipment. Included are the following topics:

PART 1 - GENERAL
- Scope
- Related Work
- Submittals

PART 2 - PRODUCTS
- Materials

PART 3 - EXECUTION
- General
- Box Identification
- Communication Conduit Labeling
- Power, Control and Signal Wire Identification
- Wiring Device Identification
- Support Wire Identification
- Nameplate Engraving for Electrical Equipment
- Panelboard Directories

### RELATED WORK
Applicable provisions of Division 1 shall govern work under this section.

Section 26 05 19 – Low-Voltage Electrical Power Conductors and Cables
Section 26 05 23 – Control-Voltage Electrical Power Cables
Section 01 91 01 or 01 91 02 – Commissioning Process

### SUBMITTALS
Include schedule for nameplates.

Prior to installation, the Contractor shall provide samples of all label types planned for the project. These samples shall include examples of the lettering to be used. Samples shall be mounted on 8 1/2" x 11" sheets annotated, explaining their purposed use.

## PART 2 - PRODUCTS

### MATERIALS
Labels: All labels shall be permanent, and machine generated. NO HANDWRITTEN OR NON-PERMANENT LABELS ARE ALLOWED.

Wire Labels: All wiring labels shall be white/transparent vinyl or vinyl-cloth, self-laminating, wraparound type. Flag type labels are not allowed. The labels shall be of adequate size to accommodate the circumference of the cable being labeled and properly self-laminate over the full extent of the printed area of the label.

Tape (wiring phase identification only): Scotch #35 tape in appropriate colors for system voltage and phase.

Nameplates: Engraved three-layer laminated plastic. Normal system shall use nameplates with black letters on white background, emergency system (NEC 700) shall use white letters on red background, legally required standby system (NEC 701) shall use white letters on blue background, and optional standby system (NEC 702) shall use black letters on yellow background.

See Box Identification and Wiring Device Identification sections for allowed usage of permanent marker.

## PART 3 - EXECUTION

### GENERAL

Where mixed voltages are used in one building (e.g. 4160 volt, 480 volt, 208 volt) each switch, switchboard, junction and pull box, equipment, etc., on each system shall be labeled for voltage in addition to other requirements listed herein.

All branch circuit and power panels shall be identified with the same symbol used in circuit directory in main distribution center.

Clean all surfaces before attaching labels with the label manufacturer's recommended cleaning agent. Install all labels firmly as recommended by the label manufacturer. Labels shall be installed plumb and neatly on all equipment.

Install nameplates parallel to equipment lines. Secure nameplates to equipment fronts using screws, rivets or manufacturer approved adhesive or cement.

Embossed tape shall not be permitted for any application.

Provide all warning labels to electrical equipment as required per NEC 110.16 and 110.21. Provide available fault current labeling to service equipment as required per NEC 110.24.

Provide a sign at the service-entrance equipment indicating type and location of on-site emergency power sources and on-site legally required standby power sources, per NEC 700.7 and NEC 701.7.

Fire pump disconnecting means shall be marked as "Fire Pump Disconnecting Means", per NEC 695.4(B)(3)(c).

Provide a sign at each service disconnect indicating "Service Disconnect", per NEC 230.70(B).

**BOX IDENTIFICATION**

The following junction and pull boxes shall be identified utilizing spray painted covers:

| System | Color(s) |
|---|---|
| Secondary Power – 480Y/277V | Brown |
| Secondary Power – 208Y/120V, 240/120V | White |
| Emergency System (NEC 700) – 480Y/277V | Brown/Red |
| Emergency System (NEC 700) – 208Y/120V | White/Red |
| Legally Required Standby System (NEC 701) – 480Y/277V | Brown/Blue |
| Legally Required Standby System (NEC 701) – 208Y/120V | White/Blue |
| Optional Standby System (NEC 702) – 480Y/277V | Brown/Yellow |
| Optional Standby System (NEC 702) – 208Y/120V | Black/Yellow |
| Fire Alarm (see below) | Red |
| Temperature Control | Green |
| Door Access Control | Orange |
| Sound and Intercom Systems | Gray |
| Video Surveillance System | Yellow |
| Communications | Blue |

All boxes with power wiring shall be further identified with circuit numbers and source panel designation as follows:

- All outlet and device boxes shall use machine-generated adhesive labels, or neatly hand-written permanent marker.
- All exposed junction and pull boxes larger than 8" square shall utilize engraved nameplates with ½" minimum letter height. All exposed junction and pull boxes 8" square or smaller shall utilize machine-generated adhesive labels.
- All junction and pull boxes located above an accessible ceiling shall utilize machine-generated adhesive labels, or neatly hand-written permanent marker.

All fire alarm boxes (covers and outer sides) shall be painted red and labeled "Fire Alarm" or "FA". When red conduit is used for the alarm system installation, there is no need to paint the box sides, - paint the covers only. Non-factory device boxes shall also be painted red.

Other system boxes shall be further identified as shown on drawing details or approved shop drawings.

**COMMUNICATIONS CONDUIT LABELING**
Provide label on all conduits installed between Telecommunication Equipment Rooms. Both ends of the conduits shall be labeled. All labels shall be mechanical, no hand-written labels.

The label shall indicate the location of the far end of the conduit run and a unique conduit number. (i.e. TR-1A-01 or Room #216 – 01). Refer to agency standards where applicable.

**POWER, CONTROL AND SIGNALING WIRE IDENTIFICATION**
Provide wire labels on each conductor in panelboard gutters, all boxes, and at load connection. Identify with branch circuit or feeder number for power and lighting circuits, and with wire number as indicated on schematic and interconnection diagrams or equipment manufacturer's shop drawings for control and signaling wires.

All wiring shall be labeled within 2 to 4 inches of terminations. Each end of a wire or cable shall be labeled as soon as it is terminated, including wiring used for temporary purposes.

**WIRING DEVICE IDENTIFICATION**
Wall switches, receptacles, occupancy sensors, photocells, poke-through fittings, access floor boxes, and time clocks shall be identified with circuit numbers and source (ex. Panel ABC-3). In exposed areas, identifications should be made inside of device covers, unless directed otherwise. Use machine-generated adhesive labels, or neatly hand-written permanent marker.

**SUPPORT WIRE IDENTIFICATION**
Support wires that are installed in addition to the ceiling grid support wires to provide secure support for raceways, cables assemblies, boxes, cabinets, and fittings shall be distinguishable from the ceiling grid support wires per NEC 300.11(A). This identification shall be either approximately 6 inches of fluorescent orange paint, or orange tape flags 3/4 inches high-by-2 inches wide (minimum) within 12 inches of the bottom of the support wires.

**NAMEPLATE ENGRAVING FOR ELECTRICAL EQUIPMENT**
Provide nameplates of minimum letter height as scheduled below.

All Panelboards (Distribution, Branch, Sub-feed, and Feed-Through), Switchboards and Motor Control Centers: 1 inch (25 mm); identify equipment designation. 1/2 inch (13 mm); identify voltage rating, source and room location of the source. Panelboards serving NEC 700, 701 or 702 loads shall identify which branch they serve. Both panels in a double tub application shall be labeled.

Circuit Breakers, Switches, and Motor Starters in Distribution Panelboards, Switchboards and Motor Control Centers: 1/2 inch (13 mm); identify circuit number and load served, including location.

Individual Circuit Breakers, Disconnect Switches, Enclosed Switches, and Motor Starters: ½ inch (13 mm); identify source and load served.

Transformers: 1 inch (25 mm); identify equipment designation. 1/2 inch (13 mm); identify primary and secondary voltages, primary source and location, and secondary load and location.

**PANELBOARD DIRECTORIES**
Typed directories for panelboards shall be covered with clear plastic, and have a metal frame. Room number on directories shall be Owner's numbers, not Plan numbers unless Owner so specifies.

END OF SECTION

**SECTION 26 08 00**
**COMMISSIONING OF ELECTRICAL**

## PART 1 - GENERAL

### 1.01 SCOPE OF WORK

A. This section includes commissioning for construction verifications and functional performance testing.

### 1.02 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

B. Owner's Project Requirements (OPR), Basis of Design (BoD), and the Commissioning Plan contain documentation requirements that apply to this Section.

### 1.03 SUMMARY

A. This Section includes requirements for commissioning the Electrical and Lighting Control systems.

B. Related Sections:
   1. Division 01 Section "General Commissioning Requirements" for general commissioning process requirements.

### 1.04 DEFINITIONS

A. OPR: Owner’s Project Requirements (Design Intent).

B. BoD: Basis of Design.

C. CxA: Commissioning Authority.

D. Commissioning Plan: A document that outlines the organization, schedule, allocation of resources, and documentation requirements of the commissioning process.

E. EC: Electrical Contractor.

F. Electrical Systems: This term shall refer to Electrical Power Systems as well as Electrical Low-Voltage Systems scheduled for commissioning as applicable.

I. Lighting Control Systems: This term shall refer to Occupancy Sensors, Lighting Control Relay Panels, Dimming Systems, and Daylight Harvesting Systems as applicable.

### 1.05 CONTRACTOR'S RESPONSIBILITIES

A. Provide and install electrical equipment, furnish necessary tools to complete installation per the design documents.

B. Attend Commissioning meetings as directed by the CxA.

C. Complete pre-functional checklists on electrical equipment and systems as directed by the CxA.

D. Conduct startup of electrical equipment and systems.

E. Assist CxA with conducting commissioning performance tests on the electrical equipment and systems as directed by the CxA.

F. Coordinate equipment installations and connections with contractors of other disciplines, and with other electrical and mechanical systems being installed.

G. Provide information requested by the CxA for final commissioning documentation.

### 1.06 CxA'S RESPONSIBILITIES

A. Provide project-specific pre-functional checklists and commissioning performance test forms for electrical and lighting control systems scheduled for commissioning.

B. Direct functional performance testing.

C. Provide adequate documentation and reports pertinent to commissioning testing.

**1.07 COMMISSIONING DOCUMENTATION**

A. Pre-Functional Checklists: CxA shall develop checklists for electrical systems scheduled for commissioning. Pre-functional checklists shall be completed by Contractor and submitted to CxA for review prior to functional performance testing. Contractor shall sign and date all checklists when complete.

B. Performance Test Forms: CxA shall develop test forms for electrical systems scheduled for commissioning. CxA shall record test results and observations while witnessing performance tests. Those involved and present for test shall sign and date test form.

C. Any deficiencies discovered during testing shall be recorded and communicated by the CxA to the Commissioning Team.

D. Issues Log: Construction issues that are discovered or encountered during the commissioning process shall be recorded and documented by the CxA. The Issues Log showing outstanding unresolved issues shall be periodically updated and sent to the Commissioning Team.

E. Commissioning Reports: Commissioning test results or Cx walk-through observations shall be recorded in a Commissioning Report by the CxA and distributed to the Commissioning Team.

F. Contractor shall provide the following information to the CxA for inclusion in the commissioning plan:
   1. Shop drawing submittals, system installation, operation, and maintenance manuals, and other related documents and reports.
   2. Identification of installed systems, assemblies, equipment, and components including design changes that occurred during the construction phase.
   3. Process and schedule for completing construction checklists and manufacturer's prestart and startup checklists for systems, assemblies, equipment, and components to be verified and tested.
   4. Certificate of completion certifying that installation, prestart checks, and startup procedures have been completed.
   5. Certificate of readiness certifying that systems, subsystems, equipment, and associated controls are ready for testing.
   6. Test and inspection reports and certificates.
   7. Corrective action documents.

**PART 2- PRODUCTS (Not Used)**

**PART 3- EXECUTION**

**3.01 TESTING PREPARATION**

A. Prerequisites for Testing:
   1. Commissioning of Electrical Equipment requires use of proper test equipment. Special tools and instruments for recording measurements of equipment performance may be required. Electrical testing equipment should be of sufficient quality and accuracy to measure system's performance with tolerance levels specified in the manufacturer's specifications and design documents.

      a. Calibration – All test equipment used in the project must be calibrated within one year, prior to the beginning of the testing procedure.
      b. Data Logging (As Applicable) – Data logging instruments and software shall be used to measure the electrical systems performance over a specified time period, to ensure they are functioning in accordance with the design intent and specifications.

B. Verification and Pre-Functional Checklists:
   1. The objective of verification and pre-functional checklists is to ensure that the specified

equipment, subsystem, or system is installed correctly, and is ready for functional performance tests.

2. These checklists are based on design intent documentation, equipment submittals and quality construction procedures. The checklists should at a minimum ensure:
   a. All related equipment has been installed correctly and pre-functional checklists have been submitted and approved prior to functional testing.
   b. Required Architectural/Engineering (A/E) punch list items, for designated equipment, have been corrected as applicable.
   c. Functional test procedures have been reviewed and approved by the installing contractor.
   d. Sufficient clearance around equipment is provided for servicing and maintenance.
   e. Other operational, safety, alarm checks, and startup have been completed successfully.

## 3.02 FUNCTIONAL TESTING PROCEDURES

A. Contractor may begin testing procedures after pre-functional checklists for systems, subsystems, and equipment, have been approved.

B. Upon satisfactory completion of all verified tests, the building electrical equipment and systems must be returned to the condition required by the contract documents as a complete and operational system. Deficiencies should be corrected by the installing contractor and the equipment, subsystems, or systems re-tested.

C. Perform tests using design conditions whenever possible.
   1 Simulate conditions by imposing an artificial load when it is not practical to test under design conditions and when approval for simulated conditions is received from CxA. Before simulating conditions, calibrate testing instruments. Set and document simulated conditions and methods of simulation. After tests, return settings to normal operating conditions.
   2 Alter set points when simulating conditions is not practical and when approval is received from CxA.

D. Detailed Testing Procedures: CxA, with Electrical Contractor, shall prepare detailed testing plans, procedures, and checklists for Electrical systems, subsystems, and equipment.

E. Deferred Testing:
   1. If tests cannot be completed because of a deficiency outside the scope of the Electrical system, the deficiency shall be documented and reported to Owner. Deficiencies shall be resolved and corrected by appropriate parties and test rescheduled.

F. Testing Reports:
   1 Reports shall include measured data, data sheets, and a comprehensive summary describing the operation of systems at the time of testing.
   2 Prepare a preliminary test report. Deficiencies will be evaluated to determine corrective action. Deficiencies shall be corrected and test repeated.

G. If it is determined that the system is not constructed according to the Contract Documents, Owner shall decide whether modifications required to bring the performance of the system to the Design Intent/OPR and BoD documents shall be implemented or if tests will be accepted as submitted. If corrective work is performed, Owner will decide if tests shall be repeated and a revised report submitted.

## 3.03 ELECTRICAL FUNCTIONAL TESTING

A. Electrical Functional Testing shall be conducted as outlined in other Division 26 specifications and as outlined below.
   1. Low Voltage Power Cable (below 600V)
      a. As specified in other Division 26 specifications.
   2. Electrical Feeders and Branch Circuits (600V or below)
      a. Test each circuit for continuity to insure correct cable connection. (As directed)
      b. Examine grounding installation to ensure that the equipment grounding conductor, grounding electrode conductor, and bonding ground jumpers are properly installed and firmly connected.

c. Using a calibrated torque wrench, perform torque test for every conductor that is part of the tested circuit and terminated in an overcurrent device or bolted type connection. Torque all connections per manufacturer's recommendations and record the results on a tabular form.
d. Verify conductor color coding with applicable specifications and the National Electrical Code.

3. Service Entrance and Distribution Switchboard
   a. Perform a visual inspection. Ensure that all electrical connections are secure and look to be in order.
   b. Check proper fuse/breaker sizes and types.
   c. Check grounding to ensure that equipment grounding conductor is properly installed and firmly connected.
   d. Perform neutral-to-ground resistance test.
   e. Conductors must be labeled with proper color code at each termination point.
   f. Ensure that nameplates label each switchboard branch load. See specifications.
4. Dry-Type Transformers
   a. Obtain a copy of factory testing document.
   b. Perform visual inspection.
   c. Perform ground resistance tests between the main ground system and all major electrical equipment frames, system neutral, and/or derived neutral points. Resistance shall be no greater than 5 ohms.
   d. Confirm that the neutral is grounded only at the service equipment.
5. Panelboards
   a. Record phase-phase voltages and neutral-ground voltage (must be less than 6V).
   b. Record current readings on each phase including neutral current.
   c. Check all panel boards for proper load balance between phase conductors and adjust the loads as necessary to bring unbalanced phases within 20% of average load.
   d. Ensure that circuit directories are typed and up-to-date.
   e. Check torque and tighten all accessible connections to manufacturer's specifications.
6. Receptacles and Devices
   a. Test receptacles for open ground, reverse polarity, open hot, open neutral, hot and ground reversed, and neutral and hot open. Note receptacles that do not pass these tests and retest after correction has been made.
   b. Test GFCI receptacles or each GFCI circuit breaker to ensure that the ground-fault circuit interrupter will not operate when subjected to a ground fault current of less than 4 milliamperes, and will operate when subjected to a ground-fault current exceeding 6 milliamperes. Perform testing with an instrument specifically designed and manufactured for testing ground-fault circuit interrupters. Pushing the receptacle or circuit breaker "TEST" button operation is not acceptable as a substitute for this test. GFCI receptacles or circuit breakers that do not shut off power at 5 milliamperes within 1/40th of a second shall be replaced.
7. Lighting Controls
   a. Occupancy Sensors: Do Performance Tests on occupancy sensors to ensure that lights are turning on and off automatically. Adjust time delay and sensitivity settings as needed. Record any blind spots or issues with sensors not performing.
   b. Lighting Control Relay Panel: Verify that time clock has been programmed with correct lighting zones – on/off control. Simulate times to witness lights turning on and off. Check override switch operation. Record any issues observed during testing.

END OF SECTION.

**SECTION 26 27 28**
**DISCONNECT SWITCHES**

## PART 1 - GENERAL

### 1.01 SCOPE OF WORK
A. Base Bid: The work under this section includes disconnect switches and enclosures.

### 1.02 SECTION INCLUDES
A. Disconnect Switches

### 1.03 RELATED WORK
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specifications Sections, apply to this section.
B. Section 26 28 13 – Fuses

### 1.04 SUBMITTALS
A. Include outline drawings with dimensions, and equipment ratings for voltage, ampacity, horsepower, and short circuit.

### 1.05 OPERATION AND MAINTENANCE DATA
A. All operations and maintenance data shall comply with the submission and content requirements specified under section GENERAL REQUIREMENTS.

### 1.06 PROJECT COORDINATION
A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
B. Disconnect switch manufacturer shall be the same manufacturer as switchboards, distribution panelboards, branch circuit panelboards and motor starters.

## PART 2 – PRODUCTS

### 2.01 DISCONNECT SWITCHES
A. Fusible Switch Assemblies (use only when overcurrent protection is required):UL 09 and NEMA KSI, horsepower rated Type HD, Heavy Duty; quick-make, quick-break, load interrupter, enclosed knife switch with externally operable handle interlocked to prevent opening front cover with switch in ON position. Handle lockable in OFF position. Fuse Clips: designed to accommodate Class R cartridge type fuses.
B. Nonfusible Switch Assemblies: UL 89 and NEMA KSI, horsepower rated Type HD Heavy Duty; quick-make, quick-break, load interrupter, enclosed knife switch with externally operable handle interlocked to prevent opening front cover with switch in ON position. Handle lockable in OFF position.
C. Enclosure: NEMA Type [3R.] as noted on Drawings.
D. Provide manufacturer’s equipment ground kit in all disconnect switches.
E. Provide [one] [two] NO/NC (form C) auxiliary contacts arranged to activate before switchblades open. Provide internally mounted neutral bar where used with 4 wire circuits.
F. Provide UL Listed service rating where required.

## PART 3 – EXECUTION

### 3.01 INSTALLATION
A. Install disconnect switches where indicated on Drawings.
B. Provide identification as specified in Section 26 05 53.

**3.02 CONSTRUCTION VERIFICATION CHECKLISTS**

A. Contractor is responsible for utilizing the construction verification checklists supplied under these specifications in accordance with the procedures defined for construction verification checklists.

END OF SECTION

# DUCTWORK SYMBOL LIST

| SYMBOL | DESCRIPTION |
|---|---|
| | DUCTWORK OR DUCT EQUIPMENT TO BE REMOVED |
| | EXISTING DUCTWORK OR EQUIPMENT |
| | NEW DUCTWORK OR EQUIPMENT |
| — C — | CONDENSER WATER FLOW |
| — CR — | CONDENSER WATER RETURN |
| — HWS — | HOT WATER SUPPLY |
| — HWR — | HOT WATER RETURN |
| — CH — | CHILLED WATER SUPPLY |
| — CHR — | CHILLED WATER RETURN |
| — D — | DRAIN LINE |
| — RL — | REFRIGERANT LIQUID LINE |
| — RS — | REFRIGERANT SUCTION LINE |
| — RD — | REFRIGERANT DISCHARGE LINE |
| — MU — | MAKE UP WATER |
| — B — | BRINE SUPPLY |
| — BR — | BRINE RETURN |
| — A — | COMPRESSED AIR PIPING |
| — HPS — | HIGH PRESSURE STEAM SUPPLY PIPING |
| — MPS — | MEDIUM PRESSURE STEAM SUPPLY PIPING |
| — LPS — | LOW PRESSURE STEAM SUPPLY PIPING |
| — HPR — | HIGH PRESSURE STEAM RETURN PIPING |
| — MPR — | MEDIUM PRESSURE STEAM RETURN PIPING |
| — LPR — | LOW PRESSURE STEAM RETURN PIPING |
| — CPD — | CONDENSATE PUMP DISCHARGE PIPING |
| — FW — | FEED WATER PUMP PIPING |
| | BUTTERFLY VALVE |
| | GATE VALVE |
| | CHECK VALVE |
| | CALIBRATED BALANCE VALVE |
| | AUTOMATIC TWO-WAY CONTROL VALVE (ELECTRIC) |
| | AUTOMATIC THREE-WAY CONTROL VALVE (ELECTRIC) |
| | AUTOMATIC TWO-WAY CONTROL VALVE (PNEUMATIC) |
| | AUTOMATIC THREE-WAY CONTROL VALVE (PNEUMATIC) |
| | GLOBE VALVE |
| | BALL VALVE |
| | RELIEF VALVE |
| | PIPE ANCHOR |
| | THERMOMETER |
| | STEAM TRAP |
| | PRESSURE GAUGE |
| | MANUAL AIR VENT |
| | ELBOW TURNED UP |
| | ELBOW TURNED DOWN |
| | TEE - TOP OUTLET |
| | TEE - BOTTOM OUTLET |
| | SCREWED UNION |
| | FLANGED UNION |
| | PRESSURE REDUCING VALVE |
| | CONCENTRIC REDUCER |
| | ECCENTRIC REDUCER |
| | STRAINER |
| | GAGE COCK |
| | PIPE GUIDE |
| | CAP OR PLUG FOR ≤ 2", BLIND FLANGE FOR > 2" |
| | VACUUM BREAKER |
| | FLOW MEASURING DEVICE |
| | FLEXIBLE PUMP OR PIPE CONNECTION |
| | SUPPLY OR OUTDOOR AIR DUCT |
| | RETURN AIR DUCT |
| | EXHAUST OR RELIEF AIR DUCT |
| | ROUND DUCT |
| ## / ## SA | SUPPLY — FIRST NUMBER IS SIDE SHOWN, SECOND NUMBER IS SIDE NOT SHOWN, SAME NOTATION FOR OA AND EA |
| ## / ## RA | RETURN |

| | |
|---|---|
| CD-1 / 12" / 300 CFM | TAG / SIZE / CFM — GRILLE, REGISTER, OR DIFFUSER TAG |
| | TURNING VANES |
| | MANUAL VOLUME DAMPER |
| BD | BACKDRAFT DAMPER |
| M | MOTORIZED DAMPER |
| G | GRAVITY BACKDRAFT DAMPER |
| FD — SD | FIRE DAMPER / SMOKE DAMPER |
| | RECTANGULAR-TO-ROUND TRANSITION |
| | DUCT CAP |
| | FLEXIBLE DUCT CONNECTION |
| | FLEXIBLE DUCT |
| AP | ACCESS PANEL |
| AD | ACCESS DOOR |
| IR | INCLINED RISE (IN DIRECTION OF AIR FLOW) |
| ID | INCLINED DROP (IN DIRECTION OF AIR FLOW) |
| SB | DUCT MOUNTED SECURITY BARRIER |
| | DUCTWORK WITH ACOUSTICAL LINING. |
| | AIRFLOW DIRECTION |
| UCD | 1" UNDER CUT DOOR (BY DIV 8) |
| SA | SUPPLY AIR |
| RA | RETURN AIR |
| EA | EXHAUST AIR |
| OA | OUTSIDE AIR |
| △ P | PRESSURE DROP |
| | OVER SIZES |
| T | DUCT MOUNTED TEMPERATURE SENSOR |
| T | ROOM TEMPERATURE SENSOR |
| P | ROOM PRESSURE SENSOR |
| T | THERMOSTAT |
| H | HUMIDISTAT |
| O | OCCUPANCY SENSOR |
| S | STARTER |
| $CO_2$ | CARBON DIOXIDE SENSOR |
| SP | DUCT STATIC PRESSURE SENSOR |
| SD | SMOKE DETECTOR |
| MC | MOTOR CONTROL |
| XXX / Y | EQUIPMENT |
| UP | DUCTWORK/PIPING UP |
| DN | DUCTWORK/PIPING DOWN |
| | DEMOLITION BEGINNING/END POINT |
| | NEW CONNECTION TO EXISTING BEGINNING/END POINT |

NOTE: ALL SYMBOLS MAY NOT BE USED FOR THIS PROJECT

# HVAC ABBREVIATIONS

| | |
|---|---|
| °F | DEGREE FAHRENHEIT |
| AC | AIR CURTAIN |
| AC | AIR COMPRESSOR |
| ACC | AIR COOLED CONDENSER |
| ACCU | AIR COOLED CONDENSING UNIT |
| ACU | AIR CONDITIONING UNIT |
| AD | ACCESS DOOR |
| AFF | ABOVE FINISHED FLOOR |
| AHU | AIR HANDLING UNIT |
| AL | ALUMINUM |
| ALT | ALTERNATE |
| AMB | AMBIENT |
| AFMS | AIR FLOW MEASURING STATION |
| APD | AIR PRESSURE DROP |
| APRX | APPROXIMATE |
| ARCH | ARCHITECT / ARCHITECTURAL |
| AWT | AVERAGE WATER TEMPERATURE |
| B | BOILER |
| B/N | BETWEEN |
| BC | BOOSTER COIL |
| BDD | BACKDRAFT DAMPER |
| BHP | BRAKE HORSEPOWER |
| BTU | BRITISH THERMAL UNIT |
| BTUH | BTU PER HOUR |
| C | CONVECTOR |
| CAP | CEILING ACCESS PANEL |
| CAP | CAPACITY |
| CAV | CONSTANT AIR VOLUME |
| CB | CHILLED BEAM |
| CC | COILING COIL |
| CD | CEILING DIFFUSER |
| CEF | CEILING EXHAUST FAN |
| CFH | CUBIC FEET PER HOUR |
| CFM | CUBIC FEET PER MINUTE |
| CFR | CONSTANT FLOW REGULATOR |
| CKTS | CIRCUITS |
| CMU | CONCRETE MASONRY UNIT |
| C/MAG | COMBINATION MAGNETIC |
| COND | CONDENSATE |
| CONN | CONNECTION |
| CONT | CONTINUATION |
| CONTR | CONTRACTOR |
| COP | COEFFICIENT OF PERFORMANCE |
| CPU | CENTRAL PROCESSING UNIT |
| CR | CONDENSER WATER RETURN |
| CRU | COMPUTER ROOM UNIT |
| CS | CONDENSER WATER SUPPLY |
| CU FT | CUBIC FEET |
| CU IN | CUBIC INCHES |
| CUH | CABINET UNIT HEATER |
| CWR | CHILLED WATER RETURN |
| CWS | CHILLED WATER SUPPLY |
| D | DEHUMIDIFIER |
| DAP | DUCT ACCESS PANEL |
| DB | DRY BULB |
| dB | DECIBEL |
| DDC | DIRECT DIGITAL CONTROLS |
| DEC | DIRECT EVAPORATIVE COOLING |
| DG | DOOR GRILLE |
| DIA | DIAMETER |
| DISCH | DISCHARGE |
| DIV | DIVISION |
| DIV 21 | FIRE PROTECTION WORK |
| DIV 22 | PLUMBING WORK |
| DIV 23 | HVAC WORK |
| DIV 26 | ELECTRICAL WORK |
| DN | DOWN |
| DP | DIFFERENTIAL PRESSURE |
| DR | DRAIN |
| DS | DUCT SILENCER |
| EA | EXHAUST AIR |
| EAT | ENTERING AIR TEMPERATURE |
| EBB | ELECTRIC BASE BOARD |
| EC | ELECTRICAL CONTRACTOR |
| ECH | EACH |
| EDB | ELECTRIC DUCT HEATER |
| EER | ENERGY EFFICIENCY RATIO |
| EF | EXHAUST FAN |
| EFF | EFFICIENCY |
| EG | EXHAUST GRILLE |
| EG | ETHYLENE GLYCOL |
| EL | ELEVATION |
| ELEC | ELECTRIC/ELECTRICAL |
| ENTH | ENTHALPY EQUIP EQUIPMENT |
| ESP | EXTERNAL STATIC PRESSURE |
| ET | EXPANSION TANK |
| EUH | ELECTRIC UNIT HEATER |
| EVAP | EVAPORATIVE |
| EWH | ELECTRIC WALL HEATER |
| EWT | ENTERING WATER TEMPERATURE |
| EXIST | EXISTING |
| F | FILTER OR FURNACE |
| FA | FACE AREA |
| FCU | FAN COIL UNIT |
| FD | FIRE DAMPER |
| FLA | FULL LOAD AMPS |
| FLEX | FLEXIBLE |
| FOR | FUEL OIL RETURN |
| FOS | FUEL OIL SUPPLY |
| FOV | FUEL OIL VENT |
| FPM | FEET PER MINUTE |
| FS | FLOW SWITCH |
| FT | FEET |
| FTR | FINNED TUBE RADIATION |
| FV | FACE VELOCITY |
| GA | GAUGE |
| GAL | GALLON |
| GBD | GRAVITY BACKDRAFT DAMPER |
| GC | GENERAL CONTRACTOR |
| GPM | GALLONS PER MINUTE |
| H | HUMIDIFIER |
| HC | HEATING COIL |
| HD | HEAD |
| HF | HEAT FAN HG HOT GAS |
| HGB | HOT GAS BYPASS |
| H-O-A | HAND-OFF-AUTO |
| HP | HORSEPOWER |
| HPC | HIGH PRESSURE CONDENSATE |
| HPG | HIGH PRESSURE GAS |
| HPS | HIGH PRESSURE STEAM HR HOUR |
| HVAC | HEATING, VENTILATING, AIR CONDITIONING |
| HW | HOT WATER |
| HWC | HOT WATER COIL |
| HWR | HEATING HOT WATER RETURN |
| HWS | HEATING HOT WATER SUPPLY |
| HX | HEAT EXCHANGER |
| HZ | HERTZ |
| IAW | IN ACCORDANCE WITH |
| ID | INSIDE DIAMETER |
| IDEC | INDIRECT EVAPORATIVE COOLING |
| IN | INCHES |
| IN WC | INCHES WATER COLUMN |
| IRH | INFRARED HEATER |
| KW | KILOWATT |
| L | LOUVER |
| LAT | LEAVING AIR TEMPERATURE |
| LB | POUND |
| LD | LINEAR SLOT DIFFUSER |
| LF | LINEAR FEET |
| LPC | LOW PRESSURE CONDENSATE |
| LPG | PROPANE |
| LPS | LOW PRESSURE STEAM |
| LRA | LOCKED ROTOR AMPS |
| LWT | LEAVING WATER TEMPERATURE |
| MAG | MAGNETIC |
| MAN | MANUAL |
| MAU | MAKE-UP AIR UNIT |
| MAX | MAXIMUM |
| MBH | THOUSAND BTU PER HOUR |
| MC | MECHANICAL CONTRACTOR |
| MCA | MINIMUM CIRCUIT AMPACITY |
| MERV | MINIMUM EFFICIENCY REPORTING VALUE |
| MCC | MOTOR CONTROL CENTER |
| MFR | MANUFACTURER |
| MFS | MAXIMUM FUSE SIZE |
| MIN | MINIMUM |
| MOD | MOTOR OPERATED DAMPER |
| MOCP | MAXIMUM OVERCURRENT PROTECTION |
| MPC | MEDIUM PRESSURE CONDENSATE |
| MPS | MEDIUM PRESSURE STEAM |
| MU | MAKE UP WATER |
| MVD | MANUAL VOLUME DAMPER |
| NC | NORMALLY CLOSED |
| NC | NOISE CRITERIA |
| NFPA | NATIONAL FIRE PROTECTION ASSOC. |
| NG | NATURAL GAS |
| NO | NORMALLY OPEN |
| NO | NUMBER |
| NPSH | NET POSITIVE SUCTION HEAD |
| OA | OUTSIDE AIR |
| OD | OUTSIDE DIAMETER |
| OHP | OVERHEAT PROTECTION |
| OLP | OVERLOAD PROTECTION |
| OPR | WT OPERATING WEIGHT |
| OPNG | OPENING |
| OZ | OZONE |
| P | PUMP |
| PC | PLUMBING CONTRACTOR |
| PC | PUMPED CONDENSATE |
| PD | PRESSURE DROP |
| PH | PHASE |
| POC | POINT OF CONNECTION |
| PRESS | PRESSURE |
| PRV | POWER ROOF VENTILATOR |
| PRV | PRESSURE REDUCING VALVE |
| PRLV | PRESSURE RELIEF VALVE |
| PSI | POUNDS PER SQUARE INCH |
| PSIG | PSI GAUGE |
| PTAC | PACKAGED TERMINAL AIR CONDITION UNIT |
| PVC | POLYVINYLCHLORIDE |
| QTY | QUANTITY |
| RA | RETURN AIR |
| RC | REHEAT COIL |
| RD | REFRIGERANT DISCHARGE PIPING |
| REF | RETURN EXHAUST FAN |
| REQD | REQUIRED |
| RF | RELIEF FAN |
| RG | RETURN GRILLE |
| RH | RELATIVE HUMIDITY |
| RL | REFRIGERANT LIQUID LINE |
| RLA | RUNNING LOAD AMPS |
| RPM | REVOLUTIONS PER MINUTE |
| RS | REFRIGERANT SUCTION PIPING |
| RTU | ROOFTOP UNIT |
| RTCU | ROOFTOP CONDENSING UNIT |
| SA | SUPPLY AIR |
| SAT | SATURATED |
| SB | SECURITY BARRIER |
| SCFM | CFM, STANDARD CONDTIONS |
| SD | SMOKE DAMPER |
| SEC GR | SECURITY GRILLE |
| SEER | SEASONAL ENERGY EFFICIENCY RATIO |
| SF | SUPPLY FAN |
| SFD | COMBINATION SMOKE/FIRE DAMPER |
| SG | SUPPLY GRILLE |
| SP | STATIC PRESSURE |
| SPEC | SPECIFICATION |
| SQ FT | SQUARE FEET |
| SS | STAINLESS STEEL |
| SST | SATURATED SUCTION TEMPERATURE |
| START | STARTER |
| TCP | TEMPERATURE CONTROL PANEL |
| TEMP | TEMPERATURE |
| TG | TRANSFER GRILLE |
| TS | TIP SPEED |
| TSP | TOTAL STATIC PRESSURE |
| TURB | TURBULATORS |
| TYP | TYPICAL |
| UCD | UNDERCUT DOOR |
| UH | UNIT HEATER |
| UM | UNIT MANUFACTURER |
| UON | UNLESS OTHERWISE NOTED |
| UV | UNIT VENTILATOR |
| UV | ULTRA VIOLET |
| VAV | VARIABLE AIR VOLUME |
| VEL | VELOCITY |
| VFD | VARIABLE FREQUENCY DRIVE |
| VIF | VERIFY IN FIELD |
| W | WATTS |
| W/ | WITH |
| W/N | WITHIN |
| WAC | WINDOW AIR CONDITIONER |
| WAP | WALL ACCESS PANEL |
| WB | WET BULB |
| WC | WATER COLUMN |
| WG | WATER GAUGE |
| WPD | WATER PRESSURE DROP |

NOTE: ALL ABBREVIATIONS MAY NOT BE USED FOR THIS PROJECT

GENERAL WORK NOTES:

1.) THIS CONTRACTOR SHALL VERIFY THE CONDITIONS AT THE PROJECT SITE BEFORE SUBMITTING COST PROPOSAL. CONTRACTOR IS ADVISED THAT ALL LOCATIONS ARE APPROXIMATE.

2.) SEE SPECIFICATIONS & MECHANICAL SHEETS FOR CONSTRUCTION PHASING REQUIREMENTS. DURING EACH PHASE, AS MUCH WORK AS POSSIBLE MUST BE PERFORMED WITHIN THE BOUNDARIES OF THAT PHASE.

3.) THESE DRAWINGS ARE NECESSARILY DIAGRAMMATIC IN NATURE. NOT ALL FITTINGS, OFFSETS, VENTS, OR DRAINS ARE SHOWN. THE CONTRACTOR SHALL VISIT THE SITE PRIOR TO BIDDING AND INCLUDE ALL FITTINGS, OFFSETS, VENTS, AND DRAINS AS REQUIRED TO PROVIDE A COMPLETE AND FUNCTIONING SYSTEM. THIS CONTRACTOR SHALL VISIT THE SITE TO VERIFY COMPONENTS, LOCATIONS AND SIZES SHOWN OR NOT SHOWN.

## MECHANICAL DRAWING LIST




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Project: #******

REVISIONS

| NO. | DATE | DESCRIPTION |
|---|---|---|
| 1 | 6/18/2020 | SCHEMATIC DESIGN MEETING |
| 2 | 7/7/2020 | DDs |
| 3 | 8/6/2020 | CDs |

Dane Co. 911 Server Cooling

SYMBOLS, NOTES, AND ABBREVIATIONS

ADDRESS:
210 Martin Luther King Blvd
Madison, WI, 53703

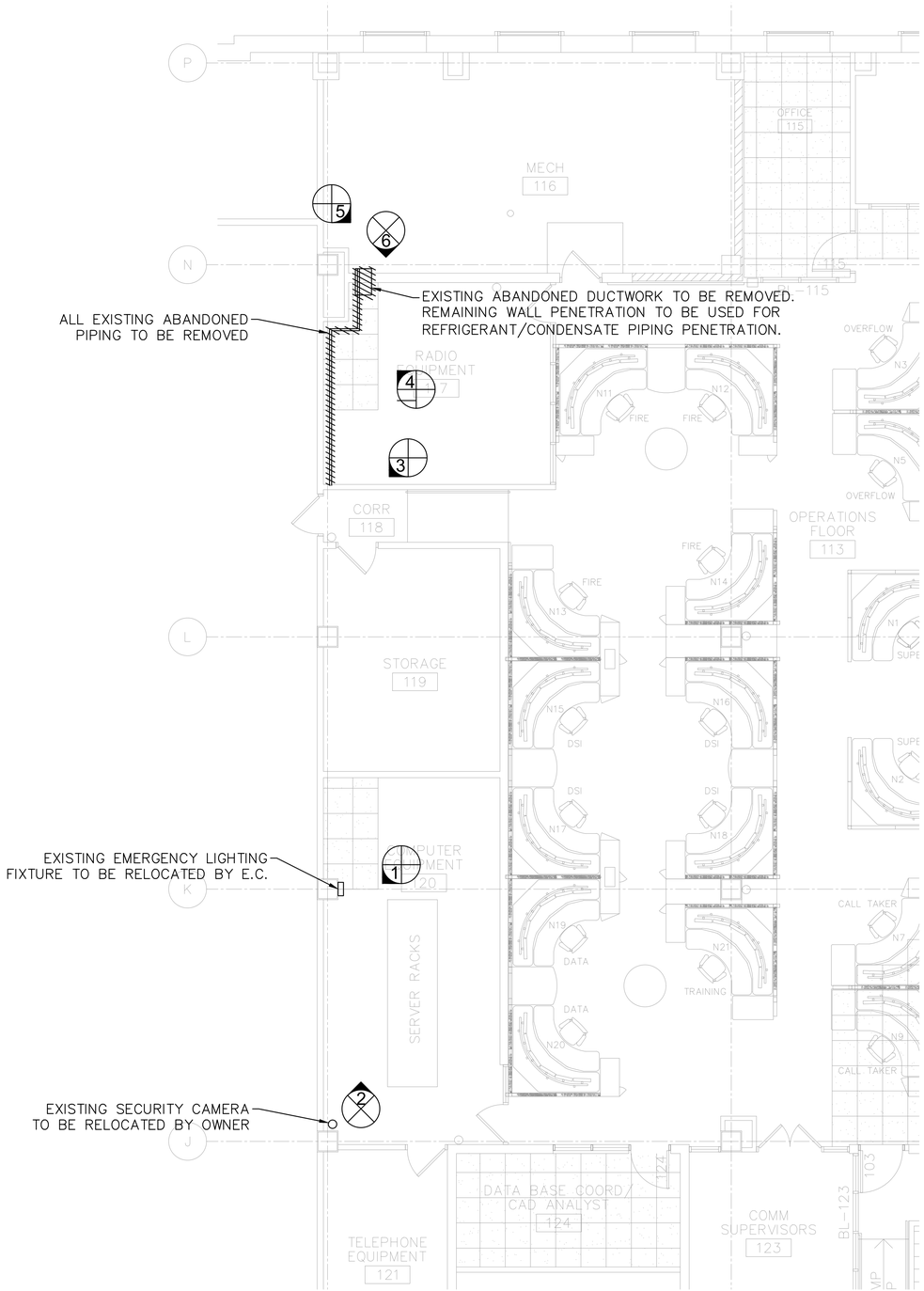
PROJECT NUMBER
200085

DATE
07-07-2020

DRAWN BY
IED

CHECKED BY
MLH

SHEET NUMBER
M001

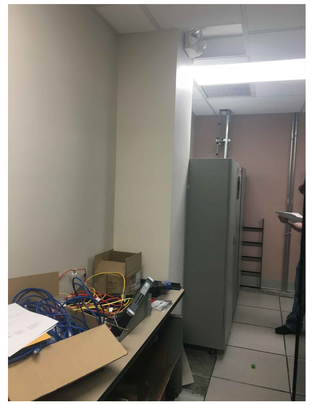



## DEMOLITION FLOOR PLAN – MECHANICAL

3/16"=1'-0"

NORTH

① 

② 

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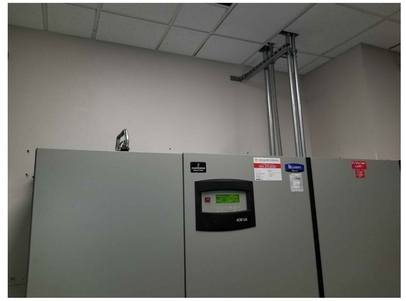
④ 

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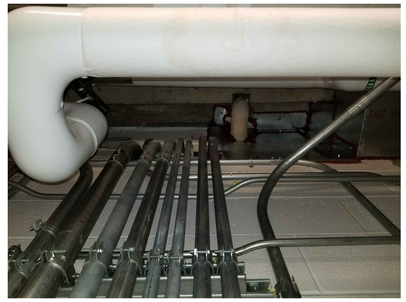
⑥ 

GENERAL NOTES:

1. ALL EXISTING ABANDONED PIPING AND CONDUIT TO BE REMOVED ABOVE CEILING FOR INSTALLATION OF NEW PIPING

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| 1 | 6/18/2020 | SCHEMATIC DESIGN MEETING |
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Dane Co. 911 Server Cooling

DEMOLITION FLOOR PLAN - MECHANICAL

ADDRESS:
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Madison, WI, 53703

PROJECT NUMBER
200085

DATE
07-07-2020

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IED

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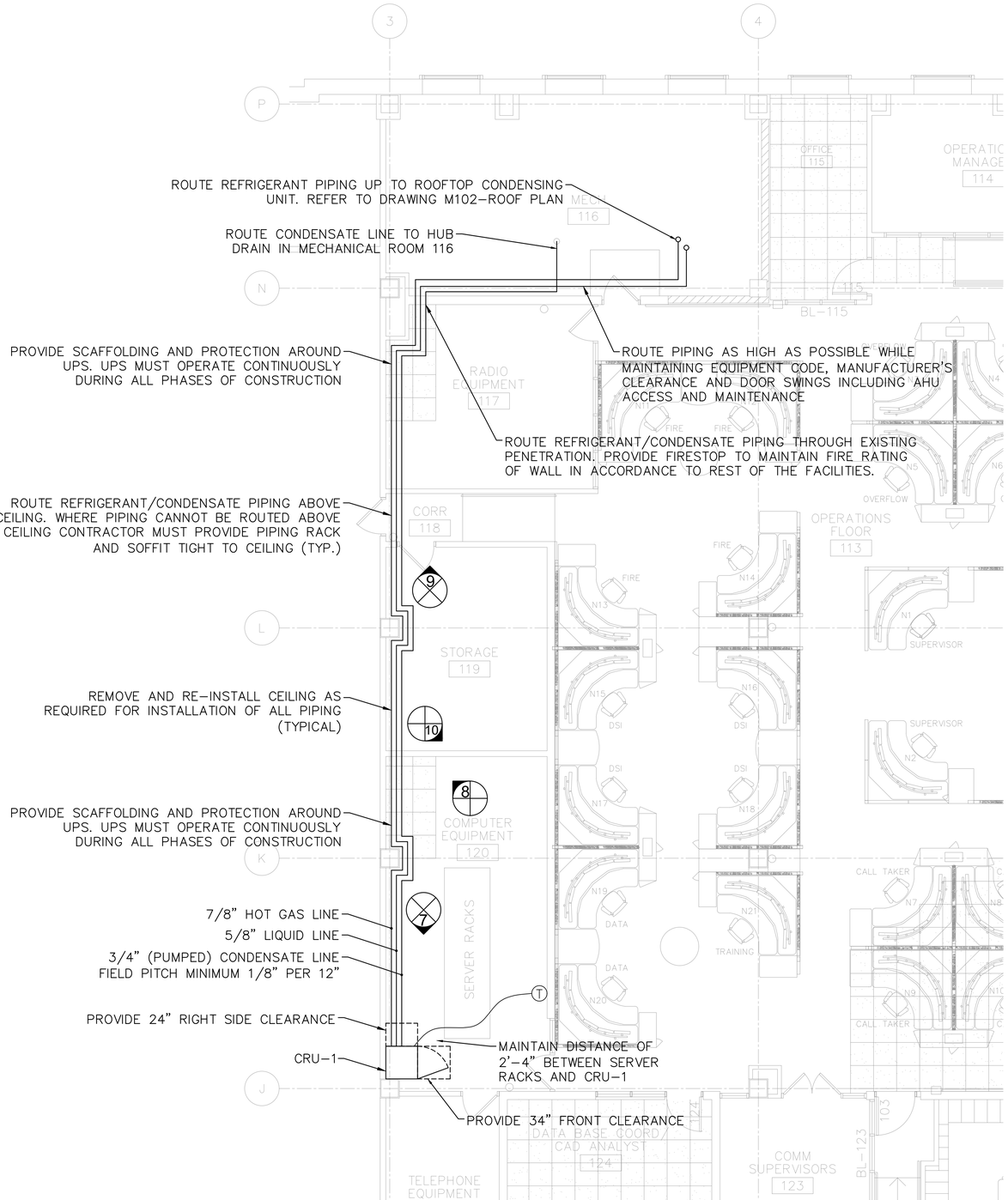
MLH

SHEET NUMBER
M100

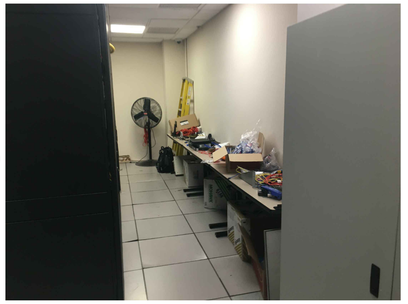



NEW WORK FLOOR PLAN – MECHANICAL

3/16"=1'-0"

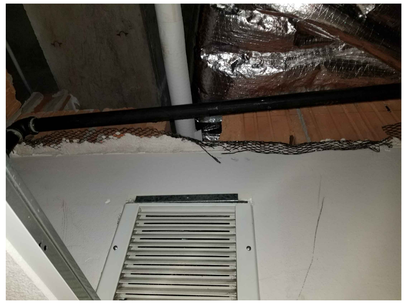
NORTH

⑦



⑧

⑨



⑩

GENERAL NOTES:

1. ROUTE REFRIGERANT/CONDENSATE PIPING ABOVE CEILING. WHERE PIPING CANNOT BE ROUTED ABOVE CEILING CONTRACTOR MUST PROVIDE PIPING RACK AND SOFFIT TIGHT TO CEILING.
2. THIS DRAWING IS DIAGRAMMATIC AND IS NOT INTENDED TO INDICATE ALL ELBOWS/FITTINGS. VERIFY ROUTING BEFORE BIDDING AND PROVIDE ALL REQUIRED ELBOWS/FITTINGS TO ROUTE THROUGH THESE AREAS. REMOVE AND REINSTALL CEILING TILE AS REQUIRED FOR INSTALLATION OF PIPING
3. MAINTAIN ALL ELECTRICAL CLEARANCE REQUIREMENTS OF SERVER RACKS

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REVISIONS

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| 1 | 6/18/2020 | SCHEMATIC DESIGN MEETING |
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| 3 | 8/6/2020 | CDs |

Dane Co. 911 Server Cooling

FLOOR PLAN – MECHANICAL

ADDRESS:
210 Martin Luther King Blvd
Madison, WI, 53703

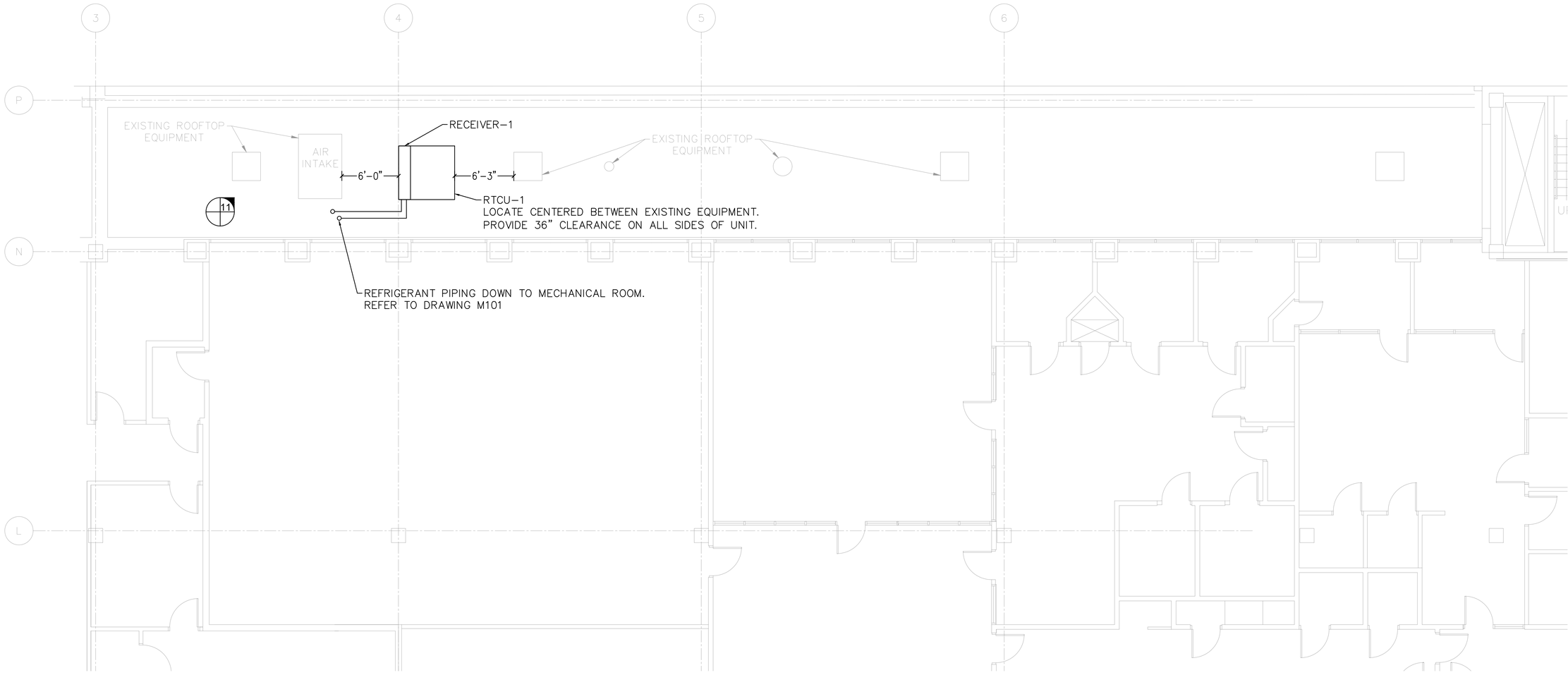
PROJECT NUMBER 200085

DATE 07-07-2020

DRAWN BY IED

CHECKED BY MLH

SHEET NUMBER M101




## NEW WORK ROOF PLAN – MECHANICAL

3/16"=1'-0"

NORTH

11

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REVISIONS

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Dane Co. 911 Server Cooling

ROOF PLAN – MECHANICAL

ADDRESS:
210 Martin Luther King Blvd
Madison, WI, 53703

PROJECT NUMBER
200085

DATE
07-07-2020

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SHEET NUMBER
M102

## BACKUP COMPUTER ROOM UNIT SCHEDULE

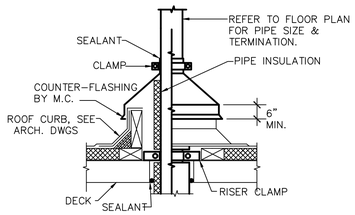
| MARK | MANUFACTURER | MODEL | TYPE | NOMINAL CAP. (BTUH) | SUPPLY CFM | FILTER TYPE | UNIT DIMENSIONS | FAN MOTOR | | | | EAT | | NOTES |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | VOLTS | PHASE | HP | FLA | DB °F | WB °F | |
| CRU-1 | LIEBERT | PX029UA1A8 | VERTICAL FLOOR MOUNTED UPFLOW | 101,000 | 4300 | MERV 8 | 34"W x 33"D x 77.5"H | 460 | 3 | 4.15 | 20.4 | 75 | 50 | 1, 2 |

NOTES
1. PROVIDE WITH UPFLOW UNIT PLEUM 2-WAY
2. PROVIDE WITH DUAL-FLOAT CONDENSATE PUMP

## AIR COOLED CONDENSING UNIT SCHEDULE

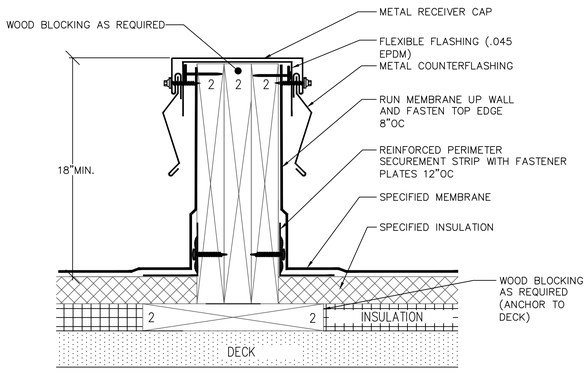
| MARK | MANUFACTURER | MODEL | OPERATING TEMP. (°F) | MAX EQUIV. PIPING LENGTH | NOMINAL CAP. (BTUH) | AMB. TEMP °F | SEER | UNIT DIMENSIONS (INCLUDES RECEIVER) | UNIT ELECTRICAL DATA | | | NOTES |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | VOLTS | PHASE | FLA | |
| RTCU-1 | LIEBERT | MCL055E1AD | -30 TO +100 | 300 FT. | 188,000 | | | 68"W x 71"D x 44"H | 460 | 3 | 2.8 | 1, 2 |

NOTES
1. PROVIDE WITH LOW AMBIENT OUTDOOR HEATED REFRIGERANT RECEIVER (REQUIRES 120V)
2. PROVIDE MINIMUM 36" CLEARANCE ON EACH SIDE OF UNIT

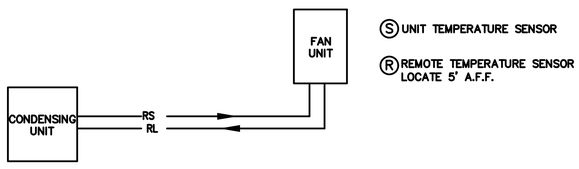



SEAL ALL OPENINGS WITH NON-HARDENING CAULK ; IF OPERATING SURFACE TEMPERATURE WILL EXCEED 180 DEGREES F USE METALBESTOS P-600 OR P-2000E JOINT SEALANT.

1 PIPE PENETRATION THROUGH ROOF DETAIL
NO SCALE



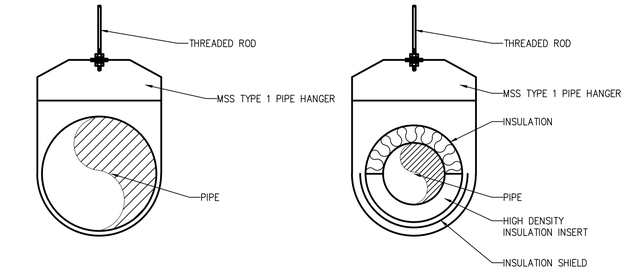

2 WOOD BUILD SLEEPER CURB DETAIL
NO SCALE




CONTROL SEQUENCE:

UNIT THERMOSTAT SHALL CYCLE THE SPLIT SYSTEM COOLING UNIT TO MAINTAIN 72°F (ADJ.) ROOM TEMPERATURE. PROVIDE FACTORY MOUNTED LOW AND HIGH LIMIT CONTROLS TO STOP THE UNIT SAFELY UNTIL LIMITS ARE MET. SMOKE DETECTOR IN UNIT BY MANUFACTURER SHALL BE DIRECTLY WIRED THROUGH MOTOR CONTROL CIRCUIT TO STOP THE UNIT UPON DETECTION OF SMOKE. IN A FIRE ALARM CONDITION ALL SYSTEMS SHALL BE DEENERGIZED. COORDINATE FIRE ALARM INSTALLATION WITH E.C.

4 COMPUTER ROOM SPLIT SYSTEM CONTROL SEQUENCE
NO SCALE




3 PIPE HANGERS AND SUPPORTS DETAIL
NO SCALE

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| 1 | 6/18/2020 | SCHEMATIC DESIGN MEETING |
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Dane Co. 911 Server Cooling
MECHANICAL DETAILS AND SCHEDULES
ADDRESS: 210 Martin Luther King Blvd Madison, WI, 53703

PROJECT NUMBER 200085
DATE 07-07-2020
DRAWN BY IED
CHECKED BY MLH
SHEET NUMBER M200

## SYMBOLS:

(ALL SYMBOLS SHOWN MAY NOT APPEAR ON DRAWINGS)

- FLUORESCENT LIGHTING FIXTURE – CEILING MOUNTED, RECESSED, SURFACE, SUSPENDED
- FLUORESCENT LIGHTING FIXTURE – WALL MOUNTED
- FLUORESCENT INDUSTRIAL LIGHT
- INCANDESCENT, FLUORESCENT OR H.I.D. LIGHTING FIXTURE – CEILING SURFACE, SUSPENDED
- INCANDESCENT, FLUORESCENT OR H.I.D. LIGHTING FIXTURE – WALL SURFACE
- INCANDESCENT, FLUORESCENT OR H.I.D. LIGHTING FIXTURE – CEILING RECESS
- INCANDESCENT, FLUORESCENT OR H.I.D. LIGHTING FIXTURE – WALL RECESS
- LIGHT TRACK
- OUTDOOR POLE MOUNTED FIXTURE – SEE LIGHTING POLE AND FIXTURE SCHEDULE
- EMERGENCY BATTERY UNIT
- REMOTE HEAD
- EXIT LIGHT – CEILING MOUNTED
- EXIT LIGHT – WALL MOUNTED
- BOLLARD – GROUND MOUNTED – OUTDOOR
- SINGLE POLE SWITCH – TOGGLE TYPE
  - K a
  - SWITCH DESIGNATION
  - SWITCH TYPE
    - (2) DOUBLE POLE
    - (3) 3 WAY
    - (4) 4 WAY
    - (K) KEY OPERATED
    - (P) WITH PILOT LIGHT INDICATION
- DLS – INDICATES DUAL LEVEL SWITCHING – SEE DUAL LEVEL SWITCHING DETAIL
- SINGLE POLE TOGGLE SWITCH WITH DUPLEX RECEPTACLE COMBINATION MOUNT AT 48'' AFF, UNLESS NOTED OTHERWISE
- WALL BOX DIMMER
- SURGICAL LIGHT CONTROL
- 2 – MOMENTARY CONTACT SWITCH – MOUNT AT 48'' AFF
  - NUMBER INDICATES CONTACTOR CONTROLLED
- X [L] LOW VOLTAGE SWITCH STATION – SEE LOW VOLTAGE SWITCHING STATION SCHEDULE
  - "X" DENOTES SPECIFIC UNIT
- [D] DIMMING SYSTEM CONTROL STATION – SEE DIMMING SYSTEM SCHEDULE
- [T] TIME CLOCK – SEE TIME CLOCK SCHEDULE
- [C] CONTACTOR – SEE CONTACTOR SCHEDULE
- [P] PHOTO–CELL
- X [Os] OCCUPANCY SENSOR
  - "X" DENOTES SPECIFIC UNIT
- [Ms] MOTION DETECTOR
- X [Ss] SWITCH STATION – SEE SWITCH STATION SCHEDULE
  - "X" DENOTES SPECIFIC UNIT
- LCP / 1 – LIGHTING CONTROL PANEL
- DUPLEX RECEPTACLE
  - (CM) COFFEE MAKER
  - (DD) DOUBLE DUPLEX
  - (DVD) MOUNTED ADJACENT TO DVD/VCR PLAYER
  - (EW) ELECTRIC WATER COOLER
  - (GFI) GROUND FAULT INTERRUPTING
  - (IG) ISOLATED GROUND
  - (MW) MOUNTED ADJACENT TO MICROWAVE OVEN
  - (PM) MOUNTED ADJACENT TO PHYSIOLOGICAL MONITORING OUTLET
  - (REF) REFRIGERATOR
  - (SH) SWITCHED TOP HALF
  - (TD) TRIPLE DUPLEX
  - (TV) MOUNTED ADJACENT TO TELEVISION
  - (TR) TAMPER RESISTANCE
  - (VB) VIEW BOX
  - (WP) WEATHERPROOF W/ GFI RECEPTACLE
- DUPLEX RECEPTACLE – MOUNTED 6'' ABOVE COUNTER BACKSPLASH
- 48" – DUPLEX RECEPTACLE – MOUNTED AT SPECIAL MOUNTING HEIGHT INDICATED ON DRAWING OR AS INDICATED IN THE ASSOCIATED ARCHITECTURAL ELEVATION.
  - INDICATES MOUNTING HEIGHT WHEN SHOWN
- SPECIAL PURPOSE OUTLET & MOTOR CONNECTION
- DISCONNECT SWITCH
- MOTOR STARTER – MANUAL TYPE
- MOTOR STARTER – MAGNETIC TYPE
- MOTOR STARTER – COMBINATION TYPE
- GENERATOR
- T / 1 – TRANSFORMER
- JUNCTION BOX
- [M] METER SOCKET
- DISTRIBUTION PANEL – SEE PANEL SCHEDULE
- 1 / A – INDICATES DESIGNATION

## SYMBOLS: CONTINUE

(ALL SYMBOLS SHOWN MAY NOT APPEAR ON DRAWINGS)

- MO A / 5 6'' – MULTI–OUTLET ASSEMBLY (SEE DETAIL)
- G – #8 – NUMBER OF CONDUCTORS IN A RACEWAY
  - INDICATES CONDUCTOR SIZE (WHEN SHOWN) FOR PHASE & NEUTRAL CONDUCTORS
  - INDICATES NUMBER OF PHASE CONDUCTORS
  - INDICATES NEUTRAL CONDUCTOR
  - INDICATES GREEN GROUND CONDUCTOR (NUMBER INDICATES CONDUCTOR SIZE)
- W / CP – INFANT PROTECTION SYSTEM CONTROL PANEL
- PUSHBUTTON SWITCH
- BELL
- 1 – SEE NOTE SYMBOL
  - (INDICATES DETAIL DESIGNATION)
- A / E1 – SEE DETAIL SYMBOL
  - (INDICATES SHEET NUMBER)
- KEYED NOTE SYMBOL
- SYSTEMS EQUIPMENT CABINETS
- X / X
  - DENOTES THE FOLLOWING:
    - (C4) CODE FOUR
    - (CLK) CLOCK SYSTEM
    - (FA) FIRE ALARM
    - (HP) HOSPITAL PAGING
    - (IN) INTERCOM
    - (LP) LOCAL PAGING
    - (MS) MUSIC SYSTEM
    - (NC) NURSE CALL
    - (P1) PROCEDURE ROOM–TWO WAY COMMUNICATION SYSTEM
    - (P2) PROCEDURE ROOM–MUSIC SYSTEM
    - (SA) SECURITY ACCESS
    - (WR) WIRED RADIO
    - (RA) RESCUE ASSISTANCE
  - DENOTES THE FOLLOWING:
    - (AN) ANNUNCIATOR
    - (CP) CONTROL PANEL
    - (TC) TERMINAL CABINET
- LP – LIGHTNING PROTECTION
  - XXX
  - DENOTES THE FOLLOWING:
    - (ATH) AIR TERMINAL ROOF DECK
    - (ATV) AIR TERMINAL PARAPET
    - (GRD) GROUND TO DOWN CONDUCTOR
    - (GRS) GROUND TO BUILDING STEEL
    - (RPD) ROOF PENETRATION TO DOWN CONDUCTOR
    - (RPS) ROOF PENETRATION TO BUILDING STEEL

## ABBREVIATIONS:

(ALL ABBREVIATIONS SHOWN MAY NOT APPEAR ON DRAWINGS)

| | |
|---|---|
| ABV | ABOVE |
| AFF | ABOVE FINISHED FLOOR |
| AFG | ABOVE FINISHED GRADE |
| ALT | ALTERNATE |
| ALT SW | ALTERNATOR SWITCH |
| ARCH | ARCHITECT |
| BFC | BELOW FINISHED CEILING |
| BFG | BELOW FINAL GRADE |
| BLDG | BUILDING |
| BPC | BOLTED PRESSURE CONTACT SWITCH |
| BRKR | BREAKER |
| BOL | BUILT IN OVERLOAD |
| CB | CIRCUIT BREAKER |
| CKT | CIRCUIT |
| CLG | CEILING |
| CP | CONTROL PANEL |
| CS | COMBINATION STARTER |
| DE | DUAL ELEMENT FUSES |
| DIR | DIRECT |
| DISC | DISCONNECT |
| DN | DOWN |
| EC | ELECTRICAL CONTRACTOR |
| ELEV | ELEVATION |
| EMER | EMERGENCY |
| EMT | ELECTRIC METALLIC TUBING |
| EOL | END OF LINE RESISTOR |
| EP | EXPLOSION PROOF |
| ER | EXISTING REMOVE FROM SERVICE |
| ERL | EXISTING RELOCATED |
| ES | EXPOSED STRUCTURE |
| ETR | EXISTING TO REMAIN |
| EX | EXISTING |
| EWC | ELECTRIC WATER COOLER |
| F | FLUSH |
| FBO | FURNISHED BY OTHERS |
| FDR | FEEDER |
| FIXT | FIXTURE |
| FLUOR | FLUORESCENT |
| FLR | FLOOR |
| FS | FLOW SWITCH |
| FVNR | FULL VOLTAGE NON–REVERSING |
| GC | GENERAL CONTRACTOR |
| GFI | GROUND FAULT INTERRUPTED |
| GRC | GALVANIZED RIGID CONDUIT |
| GRD | GROUND |
| GRDG | GROUNDING |
| GYP | GYPSUM BOARD |
| HOA | HAND–OFF–AUTO SWITCH |
| HVAC | HEATING & VENTILATING CONTRACTOR |
| HW | HEAVYWALL |
| ID | INDIRECT |
| IL | INTERLOCK |
| IMC | INTERMEDIATE METALLIC CONDUIT |
| JB | JUNCTION BOX |
| KVA | KILO VOLTAMPERE |
| LG | LAY–IN GRID |
| LTG | LIGHTING |
| LV | LOW VOLTAGE |
| LVT | LINE VOLTAGE THERMOSTAT |
| MAG | MAGNETIC STARTER |
| MAN | MANUAL STARTER |
| MCB | MAIN CIRCUIT BREAKER |
| MCC | MOTOR CONTROL CENTER |
| MDP | MAIN DISTRIBUTION PANEL |
| MLO | MAIN LUGS ONLY |
| MSB | MAIN SWITCHBOARD |
| MTD | MOUNTED |
| NIC | NOT IN CONTRACT |
| NU | NEAR UNIT |
| OU | ON UNIT |
| P | POLE |
| PB | PUSHBUTTON |
| PEND | PENDANT |
| PC | PHOTO CONTROL |
| PE SW | PNEUMATIC SWITCH |
| PLBG | PLUMBING CONTRACTOR |
| PNL | PANEL |
| PVC | POLY (VINYL CHLORIDE) |
| R | RELAY |
| RAI | REMAIN AS IS |
| RE/CKT | RECONNECT TO EXISTING CIRCUIT |
| RECEPT | RECEPTACLE |
| RM | ROOM |
| RVS | REDUCED VOLTAGE STARTING |
| S | SPLINE |
| SEL SW | SELECTOR SWITCH |
| SP SW | SPEED SWITCH |
| SURF | SURFACE |
| SW | SWITCH |
| TC | TIME CLOCK |
| TCP | TEMPERATURE CONTROL PANEL |
| TCC | TEMPERATURE CONTROL CONTRACTOR |
| TYP | TYPICAL |
| UG | UNDERGROUND |
| UNIV | UNIVERSAL |
| USS | UNIT SUBSTATION |
| WP | WEATHERPROOF |
| XFMR | TRANSFORMER |

## DRAWING INDEX




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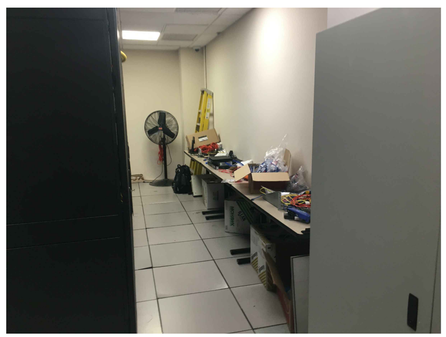
| 1 | 6/18/2020 | SCHEMATIC DESIGN MEETING |
| 2 | 7/7/2020 | CDs |
| 3 | 8/6/2020 | CDs |

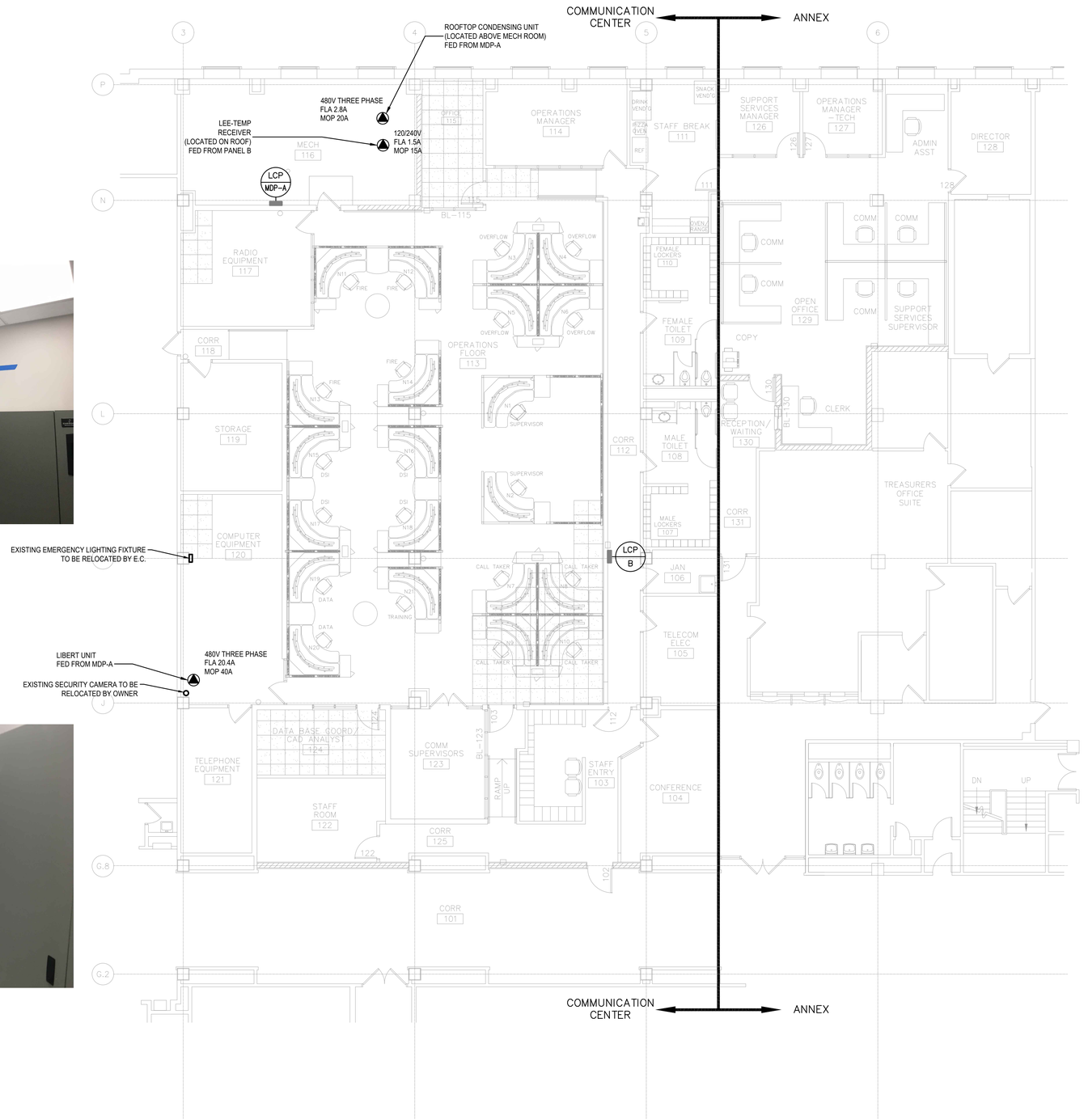
Dane Co. 911 Server Cooling

ELECTRICAL SYMBOLS, ABBREVIATIONS AND SHEET INDEX

ADDRESS:
210 Martin Luther King Blvd
Madison, WI, 53703

PROJECT NUMBER: 200085
DATE: 07-07-2020
DRAWN BY: SG
CHECKED BY: MLH
SHEET NUMBER: E001






NOTES

1) REFER TO HVAC DRAWINGS REFRIGERANT PIPING TO ROUTE CONDUIT
2) NEW CAMERA AND EMERGENCY LIGHT LOCATION TO BE DETIRMINED BY OWNER
3) OUTDOOR ELECTRICAL BOXES TO BE NEMA 3R OR EQUIVALENT

NORTH

# ELECTRICAL FLOOR PLAN

1/8"=1'-0"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ELECTRICAL FLOOR PLAN

ADDRESS:
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Madison, WI, 53703

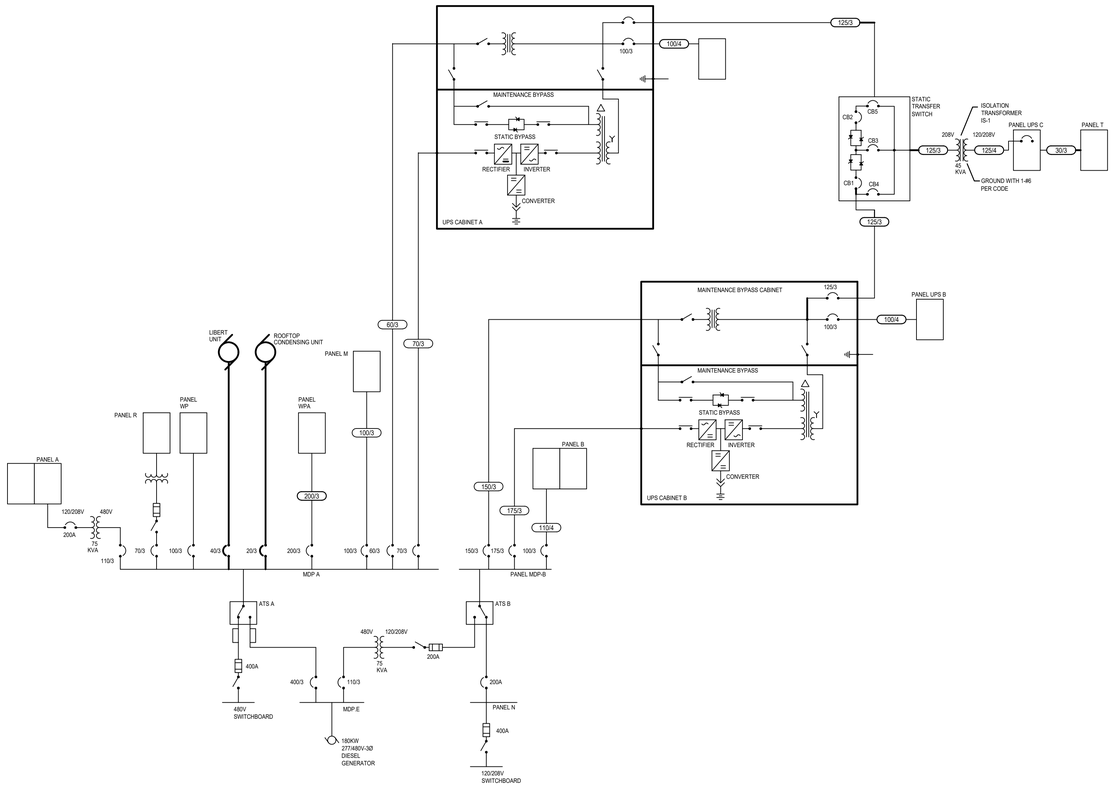
PROJECT NUMBER 200085

DATE 07-07-2020

DRAWN BY SG

CHECKED BY MLH

SHEET NUMBER E100




ELECTRICAL ONE-LINE DIAGRAM

# PANEL MDP-A

| 400 AMPS MAIN 400 | | | 480Y VOLT, THREE PHASE, FOUR WIRE | | | | | | | LOCATION: MECHANICAL ROOM | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MOUNTING TYPE: WALL | | | SHORT CIRCUIT INTERRUPING RATING: 42 K.A.I.C | | | | | | | | | |
| CIRCUIT BKR. | | | LOAD | CIRCUIT | | PHASE LOADS | | | CIRCUIT | | LOAD | | CIRCUIT BKR. | |
| AMPS | POLES | CIRCUIT DESCRIPTION | TYPE | WATTS | # | A | B | C | # | WATTS | TYPE | CIRCUIT DESCRIPTION | AMPS | POLES |
| 110 | 3 | Transformer (Exisitng) | X | 3612 | | 16016 | | | | 12404 | X | | | |
| | | | X | 3612 | 1 | | 16016 | | 2 | 12404 | X | Panel WP (Existing) | 100 | 3 |
| | | | X | 3612 | | | | 16016 | | 12404 | X | | | |
| 40 | 3 | Spare (Exisiting) | O | 0 | | 11066 | | | | 11066 | X | | | |
| | | | O | 0 | 3 | | 11066 | | 4 | 11066 | X | Panel R (Existing) | 100 | 3 |
| | | | O | 0 | | | | 11066 | | 11066 | X | | | |
| 15 | 3 | Humidifier (Exising) | X | 7003 | | 15461 | | | | 8458 | X | | | |
| | | | X | 7003 | 5 | | 15461 | | 6 | 8458 | X | Panel M (Existing) | 100 | 3 |
| | | | X | 7003 | | | | 15461 | | 8458 | X | | | |
| 15 | 3 | CRU 2 (Exisiting) | X | 0 | | 1500 | | | | 1500 | X | | | |
| | | | X | 0 | 7 | | 1500 | | 8 | 1500 | X | UPS A (AC Input) (Exisiting) | 70 | 3 |
| | | | X | 0 | | | | 1500 | | 1500 | X | | | |
| 20 | 3 | CRU 3 (Exisiting) | X | 0 | | 0 | | | | 0 | X | | | |
| | | | X | 0 | 9 | | 0 | | 10 | 0 | X | UPS A (Bypass) (Existing) | 60 | 3 |
| | | | X | 0 | | | | 0 | | 0 | X | | | |
| 20 | 3 | CRU 1 (Existing) | X | 0 | | 5417 | | | | 5417 | A | | | |
| | | | X | 0 | 11 | | 5417 | | 12 | 5417 | A | New Liebert Unit | 40 | 3 |
| | | | X | 0 | | | | 5417 | | 5417 | A | | | |
| 200 | 3 | Panel WPA (Existing) | X | 33767 | | 34510 | | | | 743 | A | | | |
| | | | X | 33767 | 13 | | 34510 | | 14 | 743 | A | New Rooftop Unit | 20 | 3 |
| | | | X | 33767 | | | | 34510 | | 743 | A | | | |
| | | | | | | 83970 | 83970 | 83970 | | | | PANEL TOTAL LOAD = | 251.9 | KW |
| | | | | | | | | | | | | | 303.0 | AMP |

NOTES:

1) 0 Watts indicates a non concurent load, therefore it is not taken into consideration w hen claculating panel load.
2) XXX
3) XXX

| LOAD CLASSIFICATION | CONNECTED LOAD (VA) | DEMAND FACTOR (VA) | ESTIMATED DEMAND (VA) | PANEL TOTALS | |
|---|---|---|---|---|---|
| LIGHTING | 0 | 0 | 0 | | |
| RECEPTACLES | 0 | 0 | 0 | TOTAL CONN. LOAD: | 251.9 KVA |
| COMPUTERS | 0 | 0 | 0 | TOTAL EST. DEMAND: | 256.5 KVA |
| KITCHEN | 0 | 0 | 0 | TOTAL CONN. CURRENT: | 303.0 A |
| WELDING | 0 | 0 | 0 | TOTAL EST. DEMAND CURRENT: | 308.6 A |
| EQUIPMENT | 0 | 0 | 0 | | |
| HEATING | 0 | 0 | 0 | | |
| A/C | 18480 | 23100 | 23100 | | |
| VENTILATING | 0 | 0 | 0 | | |
| OTHER SWITCHGEAR | 0 | 0 | 0 | | |
| EXISTING LOADS | 233430 | 233430 | 233430 | | |
| OTHER | 0 | 0 | 0 | | |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DRAWN BY SG
CHECKED BY MLH
SHEET NUMBER E200

# PANEL B (LEFT)

| 100 AMPS MAIN 225 | | | 208Y/120 VOLT, THREE PHASE, FOUR WIRE | | | | | | | | LOCATION: CORRIDOR | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MOUNTING TYPE: FLUSH MOUNTING TRIM | | | SHORT CIRCUIT INTERRUPTING RATING: 22 K.A.I.C | | | | | | | | | | |
| CIRCUIT BKR. | | | LOAD | CIRCUIT | | PHASE LOADS | | | CIRCUIT | | LOAD | | CIRCUIT BKR. | |
| AMPS | POLES | CIRCUIT DESCRIPTION | TYPE | WATTS | # | A | B | C | # | WATTS | TYPE | CIRCUIT DESCRIPTION | AMPS | POLES |
| 20 | 1 | Counsel DP20 | | | 1 | 0 | | | 2 | | | Counsel DP03 | 20 | 1 |
| 20 | 1 | Counsel DP19 | | | 3 | | 0 | | 4 | | | Counsel DP07 | 20 | 1 |
| 20 | 1 | Counsel DP21 | | | 5 | | | 0 | 6 | | | Counsel DP09 | 20 | 1 |
| 20 | 1 | Counsel DP8 | | | 7 | 0 | | | 8 | | | Counsel DP5 | 20 | 1 |
| 20 | 1 | Counsel SS12 | | | 9 | | 0 | | 10 | | | Counsel DP10 | 20 | 1 |
| 20 | 1 | Counsel SS11 | | | 11 | | | 0 | 12 | | | Counsel DP06 | 20 | 1 |
| 20 | 1 | Counsel DP16 | | | 13 | 0 | | | 14 | | | Counsel DP02 | 20 | 1 |
| 20 | 1 | Counsel DP15 | | | 15 | | 0 | | 16 | | | Counsel DP04 | 20 | 1 |
| 20 | 1 | Counsel DP17 | | | 17 | | | 0 | 18 | | | Counsel DP13 | 20 | 1 |
| 20 | 1 | Lee Temp Receiver - Roof Top Unit | | 168 | 19 | 168 | | | 20 | | | Counsel DP01 | 20 | 1 |
| 20 | 1 | Spare | | | 21 | | 0 | | 22 | | | Counsel DP14 | 20 | 1 |
| 20 | 1 | Spare | | | 23 | | | 0 | 24 | | | Counsel DP18 | 20 | 1 |
| 20 | 1 | Spare | | | 25 | 0 | | | 26 | | | Counsel DP03 | 20 | 1 |
| 20 | 1 | Spare | | | 27 | | 0 | | 28 | | | Counsel DP07 | 20 | 1 |
| 20 | 1 | Spare | | | 29 | | | 0 | 30 | | | Spare | 20 | 1 |
| 20 | 1 | Spare | | | 31 | 0 | | | 32 | | | Spare | 20 | 1 |
| 20 | 1 | Spare | | | 33 | | 0 | | 34 | | | Spare | 20 | 1 |
| 20 | 1 | Spare | | | 35 | | | 0 | 36 | | | Spare | 20 | 1 |
| 20 | 1 | Spare | | | 37 | 0 | | | 38 | | | Spare | 20 | 1 |
| 20 | 1 | Spare | | | 39 | | 0 | | 40 | | | Spare | 20 | 1 |
| 20 | 1 | Spare | | | 41 | | | 0 | 42 | | | Spare | 20 | 1 |
| | | | | | | 168 | 0 | 0 | | | | PANEL TOTAL LOAD = | 0.2 | KW |
| | | | | | | | | | | | | | 0.5 | AMP |

NOTES:

1) XXX
2) XXX
3) XXX

| LOAD CLASSIFICATION | CONNECTED LOAD (VA) | DEMAND FACTOR (VA) | ESTIMATED DEMAND (VA) | PANEL TOTALS | |
|---|---|---|---|---|---|
| LIGHTING | 0 | 0 | 0 | | |
| RECEPTACLES | 0 | 0 | 0 | TOTAL CONN. LOAD: | 0.0 KVA |
| COMPUTERS | 0 | 0 | 0 | TOTAL EST. DEMAND: | 0.0 KVA |
| KITCHEN | 0 | 0 | 0 | TOTAL CONN. CURRENT: | 0.0 A |
| WELDING | 0 | 0 | 0 | TOTAL EST. DEMAND CURRENT: | 0.0 A |
| EQUIPMENT | 0 | 0 | 0 | | |
| HEATING | 0 | 0 | 0 | | |
| A/C | 0 | 0 | 0 | | |
| VENTILATING | 0 | 0 | 0 | | |
| OTHER SWITCHGEAR | 0 | 0 | 0 | | |
| EXISTING LOADS | 0 | 0 | 0 | | |
| OTHER | 0 | 0 | 0 | | |




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DRAWN BY SG

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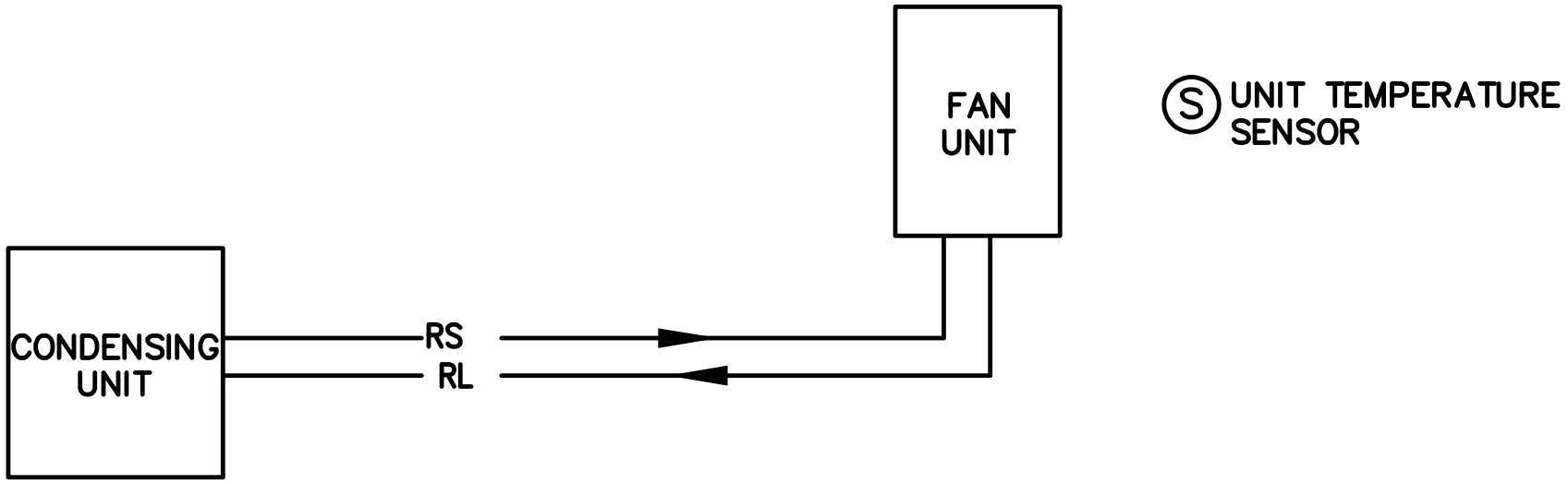
SHEET NUMBER E201




CONTROL SEQUENCE:

UNIT THERMOSTAT SHALL CYCLE THE SPLIT SYSTEM COOLING UNIT TO MAINTAIN 72°F (ADJ.) ROOM TEMPERATURE. PROVIDE FACTORY MOUNTED LOW AND HIGH LIMIT CONTROLS TO STOP THE UNIT SAFELY UNTIL LIMITS ARE MET. SMOKE DETECTOR IN UNIT BY MANUFACTURER SHALL BE DIRECTLY WIRED THROUGH MOTOR CONTROL CIRCUIT TO STOP THE UNIT UPON DETECTION OF SMOKE. IN A FIRE ALARM CONDITION ALL SYSTEMS SHALL BE DEENERGIZED. COORDINATE FIRE ALARM INSTALLATION WITH E.C.

4 COMPUTER ROOM SPLIT SYSTEM CONTROL SEQUENCE

NO SCALE