

REQUEST FOR BID

Sauk County Buildings Services

Sauk County West Square Office & Courthouse Toilet Rooms Renovations

November 30, 2022

- I. Point of contact: Ian Crammond
Sauk County Building Services
510 Broadway
Baraboo, Wisconsin 53913
(608) 355-4415

- II. Bid Due Date: Bids must be received, and date stamped no later than 1:00 p.m., Central Standard Time, Tuesday, December 21, 2022. Faxes are not acceptable. Bids or amendments received by Sauk County after that time will not be considered. A Public Opening of Bids will be conducted on Tuesday, December 21, 2022, at 1:10 p.m. in the Sauk County Courthouse – EMBS Meeting Room (C128) at 510 Broadway, Baraboo, Wisconsin 53913.

III. **ALL PROPOSALS MUST BE ADDRESSED TO:**

**Sauk County Clerk
Sauk County West Square Building
505 Broadway
Baraboo, Wisconsin 53913**

The words "**Sauk County West Square Office & Courthouse Toilet Rooms Renovation**" **must** be clearly marked on the sealed envelope alongside the County's address information.

PART ONE
INTRODUCTION AND GENERAL INFORMATION

1.0 INTRODUCTION

1.1 This document constitutes a request for competitive Bids for the renovation of the Sauk County West Square Office, 505 Broadway & Courthouse toilet rooms, 510 Broadway, Baraboo, Wisconsin 53913

2.0 ORGANIZATION

2.1 This document, referred to as a Request for Bid (RFB), has been divided into the following parts for the convenience of the vendor:

- Part One - - Introduction and General Information
- Part Two - - Scope of Work –
 - 1. Drawings
 - 2. Project Manual
- Part Three - - General Requirements
- Part Four - - Evaluation Information
- Part Five- - Pricing and Information

3.0 DEFINITIONS

3.1 For the purpose of this RFB the entity submitting the Bid will be referred to as Vendor and Sauk County will be referred to as County.

4.0 BACKGROUND INFORMATION

4.1 Sauk County is one of 72 units of county government in the State of Wisconsin and is a municipal corporation existing pursuant to the authority of Chapter 59 of the Wisconsin Statutes. County operations include a skilled nursing facility, a Human Services Department, a State Circuit Court System, a Highway Department, Sheriff's Department, a tax administration and collection effort, and other government related functions.

5.0 TENTATIVE SCHEDULE OF EVENTS

<u>EVENT</u>	<u>DATE</u>	<u>TIME (CST)</u>
Request for Bid released	November 30, 2022	
Pre-Bid Conference Rm. 128 Sauk County Courthouse	December 6, 2022	9:00 a.m.
Bids Due	December 21, 2022	1:00 p.m.
Bids opened	December 21, 2022	1:10 p.m.
Contract Awarded	January 4, 2023	6:00 p.m.

Questions regarding the project can be sent to Ian Crammond at ian.crammond@saukcountywi.gov

* Responses to all questions to be e-mailed, Bid vendors shall provide an email address to Ian Crammond at the above referenced email address to receive said updates.

6.0 OPPORTUNITY TO INSPECT

In order to fully understand the project, Bidders will have an opportunity to meet at the job site, located at the Sauk County Courthouse, EMBS Meeting Room (C128) at 510 Broadway, Baraboo, WI 53913 on December 6th, 2022 at 9:00 a.m. Attendance is not necessary in order to bid on the project. Summarized minutes of the meeting will be circulated to attendees. In addition, blueprints of the facility can be inspected at <https://www.questcdn.com/> project # 8348743.

PART TWO
SCOPE OF WORK

As outlined in the following Documents produced by InSite Consulting Architects, LLC
Project Number SCW 22-001

1. Drawing Set – Issued for Bid, Dated November 30, 2022
 - a. All Sheets referenced on Cover Sheet A001
2. Project Manual, Dated November 30, 2022
 - a. All Sections Referenced in Table of Contents 0 01 10

Documents can be viewed at <https://www.questcdn.com/> project # 8348743

Documents can be downloaded from this location for a nonrefundable fee of \$15.

PART THREE
GENERAL REQUIREMENTS

STANDARD TERMS AND CONDITIONS (REQUESTS FOR BID)

- 1.0 SPECIFICATIONS:** The specifications in this request are the minimum acceptable. When specific manufacturer and model numbers are used, they are to establish a design, type of construction, quality, functional capability and/or performance level desired. When alternates are proposed, they must be identified by manufacturer, stock number, and such other information necessary to establish equivalency, Sauk County shall be the sole judge of equivalency. Bidders are cautioned to avoid Bid alternates to the specifications which may result in rejection of their Bid.
- 2.0 QUALITY:** If supplies are furnished, unless otherwise indicated in the request, all material shall be first quality. Items which are used, demonstrators, obsolete, seconds, or which have been discontinued are unacceptable without prior written approval by Sauk County.
- 3.0 QUANTITIES:** The quantities shown on this request are based on estimated needs. The County reserves the right to increase or decrease quantities to meet actual needs.
- 4.0 PRICING AND DISCOUNT:** Sauk County qualifies for governmental discounts; unit prices shall reflect these discounts.
- 4.1 Unit prices shown on the Bid or contract shall be the prices per unit of sales (e.g., gal., cs., dos., ea., etc.,) as stated on the request or contract. For any given item, the quantity multiplied by the unit prices shall establish the extended price. If an apparent mistake exists in the extended price, the unit price shall govern in the Bid evaluation and contract administration.
- 4.2 Prices established in continuing agreements and term contracts may be lowered due to general market conditions, but prices shall not be subject to increase for ninety (90) calendar days from the date of award. Any increase proposed shall be submitted to the contracting agency thirty (30) calendar days before the proposed effective date of the price increase and shall be limited to fully documented cost increases to the vendor, which are demonstrated to be industry wide. The conditions under which price increases may be granted shall be expressed in Bid documents and contracts or agreements.

- 5.0 ACCEPTANCE-REJECTION:** Sauk County reserves the right to accept or reject any or all Bids, to waive any technicality in any Bid submitted, and to accept any part of a Bid as deemed to be in the best interests of Sauk County.
- 5.1 Bids MUST be date stamped by Sauk County Clerk, 505 Broadway, Room 144, Baraboo, WI 53913, on or before the date and time that the Bid is due. Bids dated and time stamped in another office will be rejected. Receipt of a Bid by the mail system does not constitute receipt of a Bid by the County Clerk's office.
- 5.2 Bids shall be submitted on company letterhead and signed by an officer of the company. Mark sealed envelope: "**Sauk County West Square Office & Courthouse Toilet Rooms Renovation**" alongside the County's address information.
- 6.0 METHOD OF AWARD:** Award shall be made to the lowest responsible, responsive bidder unless otherwise specified. Sauk County reserves the right to award based upon the evaluation of the Bids, which the county deems to be in its best interest.
- 7.0 ORDERING:** Purchase order shall be placed directly to the vendor by an authorized agency. No other purchase orders are authorized.
- 8.0 PAYMENT TERMS AND INVOICING:** Sauk County normally will pay properly submitted vendor invoices within forty-five (45) days of receipt providing goods and/or services have been delivered, installed (if required), and accepted as specified.
- 9.0 TAXES:** Sauk County and its agencies are exempt from payment of all federal tax and Wisconsin state and local taxes on its purchases except Wisconsin excise tax as described below which is excepted by State Statutes.
- 9.1 Sauk County, including all its agencies, is required to pay the Wisconsin excise or occupation tax on its purchase of beer, liquor, wine, cigarettes, tobacco products, motor vehicle fuel, and general aviation fuel. However, it is exempt from payment of Wisconsin sales or use tax on its purchases. Sauk County may be subject to other states' taxes on its purchases in that state depending on the laws of that state.
- 10.0 ENTIRE AGREEMENT:** These Standard Terms and Conditions shall apply to any contract or order awarded as a result of this request except where special requirements are stated elsewhere in the request; in such cases, the special requirements shall apply. Further, the written contract and/or order with referenced parts and attachments shall constitute the entire agreement and no other terms and conditions in any document, acceptance, or acknowledgment shall be effective or binding unless expressly agreed to in writing by the contracting authority. The successful Bid/bidder will be required to sign the contract document attached hereto.
- 11.0 GUARANTEED DELIVERY:** Failure of the vendor to adhere to delivery schedules as specified or to promptly replace rejected materials shall render the vendor liable for all costs in excess of the contract price when alternate procurement is necessary. Excess costs shall include the administrative costs.
- 12.0 APPLICABLE LAW:** The vendor shall at all times comply with and observe all federal and state laws, local laws, ordinances, and regulations which are in effect during the period of this contract and which in any manner affect the work of its conduct. The Sauk County Circuit Court shall be the court of exclusive jurisdiction for any litigation between the parties arising out of the performance of this contract. This contract shall be interpreted in accordance with the laws of the State of Wisconsin.
- 13.0 ANTITRUST ASSIGNMENT:** The vendor and Sauk County recognize that in actual economic practice, overcharges resulting from antitrust violations are in fact usually borne by Sauk County (purchaser). Therefore, vendor hereby assigns to Sauk County any and all claims for such overcharges as to goods, materials or services.
- 14.0 ASSIGNMENT:** No right or duty in whole or in part of the vendor under this contract may be assigned or delegated without the prior written consent of Sauk County.
- 15.0 SUBVENDORS:** If sub-Vendors are planned to be used, this should be clearly explained in the Bid. However, the prime vendor will be responsible for contract performance whether or not sub-Vendors are used.

16.0 Mediation. If a dispute arises between or among the Parties, the Parties shall first proceed in good faith to submit the matter to mediation. Costs related to mediation shall be mutually shared between or among the Parties. Unless otherwise agreed in mediation. If the matter is not resolved via mediation the parties retain all rights to seek redress in the circuit court pursuant to Section 13.0 herein.

17.0 NONDISCRIMINATION: In connection with the performance of work under this contract, the vendor agrees not to discriminate against any employee or applicant for employment because of age, race religion, color, handicap, sex, physical condition, sexual orientation, national origin, or developmental disability, as defined in s. 51.01(5), Wis. Stats. This provision shall include, but not be limited to, the following: employment, upgrading, demotion or transfer; recruitment or recruitment advertising; lay-off or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship.

17.1 Failure to comply with the conditions of this clause may result in the vendor becoming declared an "ineligible" vendor, termination of the contract, or withholding of payment.

18.0 SAFETY REQUIREMENTS: All employer practices, employee practices, materials, equipment, and supplies provided to Sauk County must comply fully with all safety requirements as set forth by the Wisconsin Administrative Code, Rules of the Industrial Commission on Safety, and all applicable OSHA Standards.

19.0 WARRANTY: Unless otherwise specifically stated by the Bid/bidder; equipment purchased as a result of this request shall be warranted against defects by the Bid/bidder for ninety (90) days from date of receipt. The equipment manufacturer's standard warranty shall apply as a minimum and must be honored by the vendor.

20.0 HOLD HARMLESS: Vendor agrees to indemnify, hold harmless, and defend Sauk County, its officers, agents and employees from any and all liability including claims, demands, losses, costs, expenses and damages of every kind arising out of or in connection with services provided pursuant to this contract where such liability is founded upon or grows out of acts or omissions of any agents or employees of the vendor.

21.0 INSURANCE RESPONSIBILITY: The vendor performing services for Sauk County shall:

21.1 Maintain workers compensation insurance, as required by Wisconsin Statutes, for all employees engaged in the work.

21.2 Maintain general liability and owners and vendors protection in the following amounts. Sauk County shall be named as an additional named insured:

General Liability:

General Aggregate	\$1,000,000.00
Products-Comp/Op Agg	\$1,000,000.00
Personal & Adv. Injury	\$1,000,000.00
Each Occurrence	\$1,000,000.00

Automobile: (Combined single limit) \$1,000,000.00

Excess Liability: (Umbrella) \$ 1,000,000.00. (Each occurrence and aggregate.)

21.3 Provide policy, countersigned by an insurer licensed to do business in the State of Wisconsin, covering the period of the agreement/contract indicating that Sauk County is an additional named insured on public liability, professional liability and property damage insurance required above.

21.4 Provide insurance certificates indicating required coverage, countersigned by an insurer licensed to do business in Wisconsin, covering the period of the agreement/contract. The insurance certificate is required to be presented prior to the issuance of the purchase order or before commencement of the contract.

- 22.0 CANCELLATION:** Sauk County reserves the right to cancel any contract in whole or in part without penalty due to non-appropriation of funds, or for failure of the vendor to comply with the terms, conditions, and specifications of this contract.
- 23.0 TERMINATION FOR CONVENIENCE:** Sauk County reserves the right to terminate this contract for convenience upon 90 days notice.
- 24.0 DATE OF COMPLETION:** Sauk County requires that all work under this contract shall be completed by the date of completion stated in the bid. Consideration will be given to time of completion when reviewing the submitted bids. In order to be considered a responsive bid, the bid must state a date of completion. It is Sauk County's desire to have the project substantially completed by June 15, 2023. Final completion of the project shall be completed not later than July 1st, 2023.

In the event the contractor does not perform the work described in this contract by the final completion date of July 1st, 2023, and no time extensions have been granted in writing, \$250.00 per calendar day shall be forfeited, as liquidated damages, against the Contractor for each and every day of delay beyond July 1st, 2023. The amount of the penalty shall be tracked until the work is completed to the satisfaction of the County. Any penalty to be collected by the County shall be withheld from any amounts due to the contractor or it shall be paid by the Contractor to the County by a certified check within 10 days notification of the penalty. Any delay of review time or any unreasonable delay of responding to requests for more information to complete a task that is caused by the County shall not count against the Contractor in determining this penalty. This paragraph shall not apply, however, if the delay is caused by general strikes, acts of God or casualty beyond Contractor's control. The parties agree that failure of Contractor to comply with the work schedule shall cause damages to the County, however, it is difficult for the parties to estimate the amount of damages. The parties specifically agree that the damages set out herein are reasonable and are in no way punitive. The damages liquidated under this paragraph shall apply only in cases of failure to comply with the schedule. In the case of any other breach of contract by Contractor, any and all damages available at law or in equity shall be available to County.

- 25.0 TERMINATION FOR DEFAULT:** Sauk County reserves the right to terminate this contract for default if, after twenty days written notice to cure default, vendor fails to satisfactorily cure the default.
- 26.0 AUDIT:** During the term of the contract, the vendor shall, upon the request of the Sauk County Controller, make available at reasonable times and places, such information as may be required for the purpose of auditing submitted bills for the service provided under the contract.
- 27.0 INDEPENDENT VENDOR STATUS:** None of the officers, employees, or agents of the vendor are employees of Sauk County for any purpose, including but not limited to compensation, fringe benefits, or insurance coverage.
- 28.0 PUBLIC RECORDS ACCESS:** It is the intention of the county to maintain an open and public process in the solicitation, submission, review, and approval of procurement activities.
- 28.1 Bid openings are public unless otherwise specified. Records may not be available for public inspection prior to issuance of the notice of intent to award or the award of the contract.
- 28.2 If awarded this contract, Vendor shall assist Sauk county in complying with any open records request.
- 29.0 PROPRIETARY INFORMATION:** Any restrictions on the use of data contained within a request must be clearly stated in the Bid itself. Proprietary information submitted in response to a request will be handled in accordance with applicable Sauk County procurement regulations and the Wisconsin public records law. Proprietary restrictions normally are not accepted. However, when accepted, it is the vendor's responsibility to defend the determination in the event of an appeal or litigation.
- 29.1 Data contained in a Bid, all documentation provided therein, and innovations developed as a result of the contracted commodities or services cannot be copyrighted or patented. All data, documentation, and innovations become the property of the Sauk County.
- 29.2 Any material submitted by the vendor in response to this request that the vendor considers confidential and proprietary information, and which qualifies as a trade secret, as provided in s. 19.36(5), Wis. Stats., or material which can be kept confidential under the Wisconsin public records law, must be identified. Bid prices cannot be held confidential.
- 30.0 DISCLOSURE:** If a public official (s. 19.42, Wis. Stats.), a member of the public official's immediate family, or any organization in which a public official or a member of the official's immediate family owns or controls a ten percent (10%) interest, is a party to this agreement, and if this agreement involves payment of more than three thousand

dollars (\$3,000.00) within a twelve (12) month period, this contract is voidable by the County unless appropriate disclosure is made according to s. 19.45(6), Wis. Stats., before signing the contract.

31.0 RECYCLED MATERIALS: Sauk County desires to purchase products incorporating recycled materials whenever technically and economically feasible. Vendors/bidders are encouraged to Bid/propose products with recycled content, which meet specifications.

32.0 PATENT INFRINGEMENT: The vendor selling to Sauk County the articles described herein guarantees the articles were manufactured or produced in accordance with applicable federal labor laws. Further, that the sale or use of the articles described herein will not infringe any United States patent. The vendor covenants that it will at its own expense defend every suit which shall be brought against Sauk County (provided that such vendor is promptly notified of such suit, and all papers therein are delivered to it) for any alleged infringement of any patent by reason of the sale or use of such articles, and agrees that it will pay all costs, damages, and profits recoverable in any such suit.

- 33.0 MATERIAL SAFETY DATA SHEET:** If any item(s) on an order(s) resulting from this award(s) is a hazardous chemical, as defined under 29CFR 1910.1200, provide one (1) copy of Material Safety Data Sheet for each item with the shipped container(s) and one (1) copy with the invoice(s).
- 34.0 SUBMISSION OF SAFETY POLICIES/MANUALS.** The vendor will be required to submit a copy of the company's safety policies and manuals to the Sauk County Buildings Services Department for review.
- 35.0 SUBSTANCE ABUSE PROGRAM.** The contractor is required to fully comply with Wis. Stat. § 103.503. This includes, but is not limited to:
- 35.1 The Contractor shall have in place a written program for the prevention of substance abuse among its employees and such written program shall be provided to Sauk County with the contract documents and before any work may be started on the project. The contents of this program shall conform to Wis. Stat. § 103.503.
- 35.2 The Contractor shall be responsible for the cost of developing, implementing, and enforcing this program as laid out in Wis. Stat. § 103.503 (3) (b).
- 36.0 PERFORMANCE BOND/PAYMENT BOND**
- 36.1 The selected Bidder shall furnish Bonds covering the faithful performance of the Contract and payment of all obligations to subcontractors and others who provide materials or labor. ("Bonds"). Bonds may be secured through the Bidder's usual source. Cost of Bonds shall be included in the Bid.
- 36.2 Both Bonds shall be written in the amount of the Contract Sum. The Bidder shall deliver the required Bonds to the Owner with the executed Contract.
- 36.3 A Surety licensed to do business in Wisconsin shall issue the Bonds. Bonds shall be dated on or after the date of the Contract.
- 36.4 If using a Power of Attorney, the Bidder shall require the Attorney-in-Fact who executes the required Bonds on behalf of the surety to affix thereto a certified and current copy of the power of attorney. It shall state the monetary limit of the power. In addition, a certified and effective dated copy of the power of attorney shall be affixed to each Bid or Bonds by the Attorney-in-Fact executing documents.
- 37.0 BID BOND.** Bids shall be accompanied by a security deposit as follows:
- 37.1 A Bid bond in the amount equal to 5% of the proposers bid. Use AIA A310 Bid Bond Form.
- 37.2 Endorse the Bid Bond in the name of the Owner as obligee, signed and sealed by the principal (Contractor) and surety.
- 37.3 The security deposit will be returned after delivery to the Owner of the required Performance and Payment Bond(s) by the accepted bidder.
- 37.4 Include the cost of bid security in the Bid Amount.
- 37.5 After a bid has been accepted, all securities will be returned to the respective bidders and other requested enclosures.
- 37.6 If no contract is awarded, all security deposits will be returned.
- 38.0 LIST OF SUBCONTRACTORS:** Bidder agrees, to the extent practicable, to maintain a list of all subcontractors, suppliers, and service providers performing, furnishing, or procuring labor, services, materials, plans, or specifications under the contract.
- 39.0 FEES FOR CHANGES IN THE WORK:** Include the following with the bid form:

39.1 The overhead and profit fees on own Work and Work by subcontractors, applicable for Changes in the Work, whether additions to or deductions from the Work on which the Bid Amount is based.

39.2 The fees proposed for subcontract work for changes (both additions and deductions) in the Work. Contractor shall apply fees as noted, to the subcontractors' gross (net plus fee) costs on additional work.

40.0 CONTRACTOR ACKNOWLEDGMENT OF STANDARD TERMS & CONDITIONS:

CONTRACTOR

AUTHORIZED SIGNATURE OF CONTRACTOR

DATE

PART FOUR
EVALUATION INFORMATION

1.0 EVALUATION PROCESS

- 1.1 The award of a contract resulting from this Request for Bid shall be based on the lowest responsible bidder in combination with the pricing.
- 1.2 In the event that only one Bid is received in response to this Request for Bid, Sauk County reserves the right to negotiate the terms and conditions, including the price, as proposed in the vendors Bid. In addition, as part of such negotiations, Sauk County reserves the right to require supporting cost, pricing and other data from the vendor in order to determine the reasonableness and acceptability of the Bid.
- 1.3 Sauk County reserves the right to reject any and all Bids or portions thereof.
- 1.4 All Vendors must provide proof of previous experience in completing similar work as it relates to the scope of work.
- 1.5 All Vendors must sign and return PART THREE of this document with their Bid.
- 1.6 All Vendors must sign and complete PART FIVE Pricing & Information document with their Bid.

PART FIVE
PRICING & INFORMATION

BASE BID 1: Lump sum cost to complete all work identified in PART 2 Scope of Work Drawings Volume 1 (Sauk County West Square Office & Courthouse Toilet Rooms Renovation, 505 & 510 Broadway, Baraboo, Wisconsin) and Project Manual for the sum of:

(\$ _____)

Other cost not included in Lump Sum Base Bid 1 Scope of Work Bid: _____

Please explain: _____

ESTIMATED DATE OF COMPLETION

Assuming a January 9th, 2023 start of construction, please provide your estimated date of completion of the work identified in PART 2 Scope of Work:

Estimated date of completion

SAUK COUNTY PROVIDED MATERIALS

Any materials and/or services that Sauk County will need to provide to Vendor to complete this project must be listed below:

The Vendor hereby agrees to provide the services and/or items at the prices quoted, pursuant to the requirements of this document and further agrees that when this document is countersigned by an authorized official of Sauk County, a binding contract, as defined herein, shall exist between the Vendor and Sauk County.

CONTRACTOR

AUTHORIZED SIGNATURE OF CONTRACTOR

DATE

PRINTED NAME, TITLE

SAUK COUNTY OFFICIAL

DATE

The Bidder has examined and carefully prepared the Bid from the plans and specifications and has checked the same in detail before submitting the Bid to Sauk County, including the Standard Terms and Conditions. The Vendor has had the opportunity to view the installation site and had obtained all necessary information to properly complete this bid:

(Company Name/Firm)

(Witness)

(Company Representative)

(County Representative)

(Signature)

(Signature)

STATE OF _____)

)ss.

COUNTY OF _____)

Personally came before me this _____ day of _____, 2021 , the above named _____ to me known to be the person who executed the foregoing instrument and acknowledge the same.

Signature of Notary Public

Typed or Printed Name of Notary Public
My Commission (expires) (is) _____

CONTRACT

THIS CONTRACT, made this day _____ of _____, 2021, by Sauk County hereinafter called "COUNTY" or "OWNER" acting herein through its Building Services Department, and _____ doing business as *(an individual) (a partnership) (a joint venture) (a corporation)(other: describe _____ located in the *(City) (County) of _____ County of _____, and State of _____, hereinafter called "CONTRACTOR."

WITNESSETH: That for and in consideration of the payments and agreements hereinafter mentioned, to be made and performed by the COUNTY, the CONTRACTOR hereby agrees with the COUNTY to commence and complete the project described as follows: **Project (Sauk County West Square Office & Courthouse Toilet Rooms Renovation)**, hereinafter called the PROJECT, for the sum of

_____ Dollars (\$) _____) and all extra work in connection therewith, under the terms as stated in the bidding documents, specifications and contractor's bid; and at its own proper cost and expense to furnish all the materials, (except materials which the contract documents specifically require to be purchased by the County) supplies, machinery equipment, tools, superintendence, labor, insurance, and other accessories and services necessary to complete the said project in accordance with the conditions and prices stated in the Contract Documents.

The CONTRACTOR further agrees to complete the project by _____. A contract extension shall be at the discretion of the Facilities Director.

The COUNTY agrees to pay the CONTRACTOR in current funds for the performance of the contract, subject to additions and deductions, as provided in herein, and to make payments on account thereof as provided in the Estimates and Payments sections.

IN WITNESS WHEREOF, the parties to these presents have executed this contract in two (2) counterparts, each of which shall be deemed an original, in the year and day first above mentioned.

AGREED:

SAUK COUNTY, WISCONSIN

By: Brent Miller
County Administrator

[SIGNATURES CONTINUE ON THE NEXT PAGE]

CONTRACTOR:

By:

(Name)

(Title)

(Address)

(City and State)

Project Manual
West Square Office Suite Remodel Design

Sauk County Buildings Services

ISSUED FOR BID

November 30, 2022



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SECTION 01 11 00
SUMMARY OF WORK

PART 1: GENERAL

1.1. WORK INCLUDED

- a. This statement is given only for the purpose of familiarizing prospective Bidders with the Project and is not intended to give Bidders a complete description of all the Work or materials. It is intended only as an aid for understanding the scope of the Project. All dimensions and existing conditions are to be verified by the Bidder.

Roofing:

- i. Coordinate all operations with the Owner and Architect.
- ii. Perform all Work in accordance with all Federal, State and Local ordinances.
- iii. Furnish and install all contingent work as necessary and required to fully complete the Project per the intent of this Project Manual.

1.2. RELATED DOCUMENTS/SECTIONS

- a. Section 01 50 00 - Construction Facilities and Controls
- b. Section 02 41 00 - Demolition
- c. Section 07 90 00 - Sealants

1.3. QUALITY ASSURANCE

- a. All work described in these Specifications or shown on the Drawings and all work necessary to complete finish of the work as described or shown is to be executed in a thoroughly substantial and workmanlike manner. All work shall be done by persons who are thoroughly experienced in their particular trade or crafts.

1.4. CONSTRUCTION PROGRESS SCHEDULE

- a. The work shall be performed in phases according to the Construction Progress Schedule, which in part states:
- | | |
|--------------------|---|
| i. January 9, 2023 | Begin Renovation Work |
| ii. June 15, 2023 | Substantial Completion of Renovation Work |

1.5. CONSTRUCTION PERIOD

- a. Work shall be performed during the day and must be coordinated with the Architect and Owner.
- b. For materials that are delivered to the Project, the Contractor shall make arrangements with the Owner, at least 24 hours in advance of such delivery. All deliveries shall take place during normal business hours.

PART 2: PRODUCTS

2.0. NOT USED.

PART 3: EXECUTION

3.1. CLARIFICATION OF INFORMATION

- a. Should it appear that the work intended to be described, or any of the matters relative thereto, are not sufficiently detailed or explained on the Drawings, or in the Project Manual, the Contractor shall consult the Architect for such further drawings or explanations as necessary. These drawings and explanations shall conform to the same as far as they shall be consistent with original Drawings. In the event of any questions arising with respect to the true meaning of the Drawings and Specifications, reference shall be made to the Owner whose decision shall be final and conclusive.

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In no case shall any work proceed in uncertainty.

- b. It is the intention of the Drawings and the Project Manual to provide a job complete in every respect. Contractor shall be responsible for this result and shall turn over the Project in complete operating condition regardless of whether the Drawings and Project Manual cover every individual item in minute detail.
- c. On all Drawings, figures take precedence over measurements by scale. Large-scale details take precedence over small-scale details. In the event of a conflict between wording in the Project Manual and on the Drawings, the wording in the Project Manual will take precedence.
- d. Certain schedules of materials, diagrams of mains and risers accompany the Drawings in order to accommodate the Contractor and to avoid a confusing amount of lettering on the Drawings. Such diagrams are intended for use in conjunction with the Drawings and Specifications but are not to be interpreted as in any manner modifying or restricting such Drawings or the Specifications. Schedules of materials are furnished as a convenience only, and there is no guarantee that any schedule includes all of the work or materials required by the Drawings and the Project Manual.

3.2. COORDINATION OF WORK

- a. Contractor shall perform all cutting, fitting or patching of work that may be necessary to make its several parts fit together properly to receive or be received by work or others shown upon, or reasonably implied by Drawings and Specifications for the Work. Any cost caused by defective or ill-timed work shall be borne by party responsible therefore.
- b. Contractor shall not endanger any work by cutting, excavating, or otherwise altering the work and shall not cut or alter the work of others save with the consent of the Project Manager.
- c. The Contractor shall perform cutting necessary to the completion of the Work including cutting not specifically shown on the Drawings.
- d. Patching and repairing of the finished work made necessary by cutting shall be performed and paid for by the Contractor requiring such work.
- e. Contractor shall obtain written approval from Owner and Architect before cutting any structural element.

END OF SECTION 01 11 00

SECTION 01 20 00
CHANGES AND PAYMENTS

PART 1: GENERAL

1.1. SECTION INCLUDES

- a. This Section references administrative documents that are to be completed by the Owner and Contractor throughout the course of construction for changes to the Work and for applications for payment.
 - i. Construction Change Directive, Construction Change Proposal and Item Summary Worksheet Forms
 - ii. Application for Payment
 - iii. Interim Lien Waiver and Release
 - iv. Off-Site Stored Material and Payment Form

1.2. RELATED DOCUMENTS AND SECTIONS

- a. Document 00 41 00 - Bid Form
- b. Document 00 72 00 - General Conditions of the Contract

1.3. QUALITY ASSURANCE

- a. Contractor shall complete and submit these administrative documents in accordance with the Contract Documents and ensure the completeness and accuracy of same.

PART 2: PRODUCTS

2.1. CONSTRUCTION CHANGE DIRECTIVE, PROPOSAL REQUEST, AND CHANGE ORDER

- a. The Owner may request changes to the Work by issuance of a Construction Change Directive, construction change Proposal Request, and/or Change Order.
- b. Definition
 - i. A Construction Change Directive shall instruct the Contractor to proceed with the described work and to submit actual costs within 14 days after the work is complete. Contractor shall supply supporting documentation as required by the Contract Documents including, but not limited to, a detailed labor and material breakdown submitted on the Item Summary Worksheet AIA Document G714 (Construction Change Directive).
 - ii. A construction change Proposal Request shall instruct the Contractor to submit a price for the described work prior to its performance. If the price is acceptable, the Owner will approve the Proposal and the work may proceed. If not acceptable, the work may be modified, the price may be negotiated to a price acceptable to both the Owner and the Contractor, the Proposal may be voided, or the Proposal may be reissued as a Directive. The Contractor shall supply supporting documentation on the Item Summary Worksheet in the same fashion as a Directive AIA Document G709 (Proposal Request).
 - iii. A Change Order is an authorization by the Owner to make a change in the Contract Documents and/or Contract. It is signed by the Owner, Contractor, and Architect AIA Document G701 (Change Order).

2.2. APPLICATION FOR PAYMENT

- a. The Owner shall make payments in accordance with the Contract Documents upon receipt of a properly completed AIA Document G702 (Application for Payment) and G703 (Continuation Sheet). Submit Applications for Payment via US Mail to the Architect.
- b. Computerized reproductions of this document are acceptable via email to the Project Manager and cc Office Manager kerry@icsarc.com.

2.3. INTERIM LIEN WAIVER AND RELEASE

- 60 a. Interim lien waivers from the Contractor, Subcontractors and Suppliers are to be submitted with
61 Applications for Payment.
62
63
64

65 2.4. OFF-SITE STORED MATERIALS AND PAYMENT FORM
66

- 67 a. The Owner may make payment for materials stored off-site if a properly completed Off-Site Stored
68 Materials Payment Form is submitted by the Contractor.
69

70 **PART 3: EXECUTION**
71

72 3.1. CONSTRUCTION CHANGE DIRECTIVE AND CONSTRUCTION CHANGE PROPOSAL
73

- 74 a. Construction Change Directives and Construction Change Proposals will be issued by the
75 Architect.
76 b. The Owner will complete the upper portion as follows
77 i. Number, in sequential order.
78 ii. Project, Contractor, Contract Number, Contract For, Prepared By and Date.
79 iii. Description of the work to be completed, organized by item.
80 c. The Contractor shall complete the lower portion of the document in accordance with the provisions
81 of the Contract Documents.
82 i. The Cost Adjustment section shall be broken down by Contractor, summing the totals
83 from each Item Summary Worksheet completed for that individual Contractor, dividing
84 Self-Performed Work from Subcontracted Work.
85 ii. Overhead and profit can be added for Non-Unit Price Work only.
86 iii. Overhead and profit for Unit Price Work shall be inclusive of those as contracted and
87 stated in the Bidding Documents.
88 iv. Contractor shall sign, date and submit in accordance with the Contract Documents.
89 d. Directives and Proposals will be reviewed and either approved, voided or reissued by the Architect.
90

91 3.2. ITEM SUMMARY WORKSHEET
92

- 93 a. The Owner will issue one copy of the Item Summary Worksheet with each Directive or Proposal.
94 The Contractor shall make additional copies as required.
95 b. The Item Summary Worksheet shall be completed for work performed by each Contractor or
96 Subcontractor, for each item listed of in the Directive or Proposal.
97 c. The Item Summary Worksheet shall be submitted with the appropriate Directive or Proposal and
98 completed as follows:
99 i. Item number and Contractor performing the work.
100 ii. Non-Unit Price section to be used for any Non-Unit Price labor.
101 iii. Non-Unit Price Material and Equipment section to be used for any Non-Unit Price
102 Material and Equipment.
103 iv. Unit Price section to be used for all added/deleted units of work, which a contracted Unit
104 Price has been quoted and contracted.
105

106 3.3. APPLICATIONS FOR PAYMENT
107

- 108 a. The Contractor shall complete Applications for Payment in accordance with the provisions of the
109 Contract Documents. Submit Applications for Payment via US Mail to the Architect.
110

111 3.4. INTERIM LIEN WAIVER AND RELEASE
112

- 113 a. The Contractor shall submit Interim Lien Waivers in accordance with the provisions of the Contract
114 Documents. Submit Lien Waivers with the Applications for Payment via US Mail to the Architect.
115

116 3.5. OFF-SITE STORED MATERIALS AND PAYMENT FORM
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- 118 a. The Contractor shall submit Off-Site Stored Material and Payment Form in accordance with the

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provisions of the Contract Documents with each Application for Payment when such payments are requested.

END OF SECTION 01 20 00

SECTION 01 33 00
SUBMITTAL PROCEDURES

PART 1: GENERAL

1.1. PROCEDURES

- a. Email all submittals to the Architect's Project Manager.
- b. Deliver all samples to the Architect at the office of InSite Consulting Architects, LLC (ICA):
744 Williamson Street, Suite 101, Madison, WI 53703.
- c. Identify submittals with Contractor's name, Project name and date of submittal.
- d. **Submit ALL required submittals as one (1) full package that is 100% complete.**
- e. **No partial submittals will be accepted. Partial submittals will be immediately rejected and returned to Contractor.**
- f. **Submit submittals within ten (10) days of fully executed Contract. Failure to do so will result in forfeiture of Bid Bond.**
- g. Make any corrections to the submittals required by Architect and resubmit until approved. Note specific attention in writing to revisions on re-submittals other than the corrections requested by the Architect.

1.2. SUBMITTAL SCHEDULE

- a. Schedule and make all submittals **as one (1) full package that is 100% complete** so as to cause no delay in the Work or in the work of other Contractors.
- b. Ensure submittals are made far enough in advance of the related Work activity to provide time required for reviews, revisions, re-submittals, approvals, placing orders and securing materials and equipment.
- c. In scheduling, allow at least ten (10) days for review following receipt of a submittal by the Architect. Allow five (5) days for review of a re-submittal.

1.3. CONSTRUCTION SCHEDULE

- a. Submit work schedule in graph or tabular form for the various phases of the Work including delivery of materials to site, set-up, start-up, tear off (if applicable), recover, phased work (with area designation and key plan), detail reconstructions (if applicable), metal work, etc.
- b. Should any activity critical to the full completion date be, in the judgment of the Engineer, behind schedule by seven (7) or more days, the Architect may direct the Contractor to expedite the Work to regain compliance with the schedule. If so directed, the Contractor shall promptly expedite the Work by whatever means required including but not limited to, increasing the work force, adding additional shifts and working overtime. Such expediting shall be at no additional cost to the Owner. The Architect is not required to make such directions.
- c. Submit documents to claim conflicts with the work schedule due to weather, labor, etc. within ten (10) working days of said incident(s) for proper evaluation and action by the Architect.

1.4. SHOP DRAWINGS AND SAMPLES

- a. Submit all drawings, diagrams, illustrations, schedules, performance charts, instructions, specifications and other product data illustrating portions of the Work as required by the Specification sections. Such submittals, whether or not referred to as shop drawings, shall comply with the requirements for shop drawings herein prescribed.
- b. Submit all samples of materials, equipment and workmanship as required by the Specification sections.
- c. Unless the precise color and pattern is specifically specified in the Specification sections, and whenever a color or pattern is available in a specified product, submit accurate color and pattern charts and samples for review and selection.
- d. Review, stamp with approval and submit all shop drawings and samples required by the Specification sections. Shop drawings or samples submitted without the Contractor's approval stamp will be returned without review.
- e. By approving and submitting shop drawings and samples, the Contractor thereby represents that he has determined and verified all field measurements, field construction criteria, materials, catalog numbers and similar data and that he has checked and coordinated each shop drawing and sample with the requirements of the Work and of the Contract Documents.

- 63 f. Shop drawings and samples will be reviewed and approved by the Owner and/or Architect to
64 determine in general if they are in compliance with the Contract Documents. Such approval shall
65 not relieve the Contractor of responsibility for any deviations from the requirements of the Contract
66 Documents or from the responsibility for errors or omissions in the shop drawings or samples.
67 g. Do not commence any portion of the Work requiring a shop drawings or sample submittal until the
68 submittal has been approved as prescribed herein. All such portions of the Work shall be in
69 accordance with approved shop drawings or samples.
70

71 1.5. MATERIAL SAFETY DATA SHEETS
72

- 73 a. Submit "Material Safety Data Sheets".
74

75 1.6. CERTIFICATES OF COMPLIANCE
76

- 77 a. Submit in duplicate, certificates of compliance for each product specified, prior to installation of
78 applicable product.
79 b. Certificates of compliance shall include certified laboratory test reports, manufacturer's certificates
80 or other evidence sufficient to verify compliance with the products specified.
81 c. Submit all warranties, guarantees, manuals, etc. as described more fully in subsequent sections.
82
83

END OF SECTION 01 33 00

SECTION 01 42 00
REFERENCES

REFERENCES

The standards and Manufacturers' association requirements issued by the following agencies are considered a part of these Specifications. Should conflict occur between Project Specifications and references, Project Specifications shall govern. Referenced material and modifications to each are indicated in each section they apply to. The following is a list of these organizations:

The following acronyms or abbreviations as referenced in the Contract Documents are defined to mean the associated names. Both names and Internet websites are subject to change and are believed to be, but are not assured to be, accurate and up-to-date as the date of the Contract Documents.

AA	Aluminum Association, Inc. www.aluminum.org
AGA	American Gas Association www.aga.org
AAMA	Architectural Aluminum Manufacturers Association www.aamanet.org
ACI	American Concrete Institute www.concrete.org
ACIL	American Council of Independent Laboratories www.acil.org
AIA	American Institute of Architects www.aia.org
AITC	American Institute of Timber Construction www.aitc-glulam.org
ANSI	American National Standards Institute www.ansi.org
ASHRAE	American Society of Heating, Refrigeration and Air Conditioning Engineers www.ashrae.org
ASME	American Society of Mechanical Engineers www.ashrae.org
ASPE	American Society of Plumbing Engineers www.aspe.org
ASTM	American Society for Testing and Materials www.astm.org
AWI	Architectural Woodwork Institute www.awinet.org
AWS	American Welding Society www.aws.org
BHMA	Builders Hardware Manufacturers Association www.buildershardware.com

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61	BIA	Brick Industry Association (The)
62		www.gobrick.com
63		
64	FM	Factory Mutual Engineering Corporation
65		www.fmglobal.com
66		
67	ILI	Indiana Limestone Institute of America, Inc
68		www.ilai.com
69		
70	FS	Federal Specification (General Services Admin.)
71		www.gsa.gov
72		
73	MAS	Masonry Advisory Council
74		www.maconline.org
75		
76	MCAA	Mechanical Contractors Association of America
77		www.mcaa.org
78		
79	MIL	Military Standardization Documents (U.S. Dept. of Defense)
80		www.defenselink.gov
81		
82	MRCA	Midwest Roofing Contractors Association
83		www.mrca.org
84		
85	NAAMM	The National Association of Architectural Metal Manufacturers
86		www.naamm.org
87		
88	NCMA	National Concrete Masonry Association
89		www.ncma.org
90		
91	NECA	National Electrical Contractors Association
92		www.necanet.org
93		
94	NEMA	National Electrical Manufacturers Association
95		www.nema.org
96		
97	NFPA	National Fire Protection Association
98		www.nfpa.org
99		
100	NIA	National Insulation Association
101		www.insulation.org
102		
103	NRCA	National Roofing Contractors Association
104		www.nrca.net
105		
106	OSHA	Occupational Safety and Health Administration
107		(U.S. Department of Labor)
108		www.osha.gov
109		
110	PDI	Plumbing and Drainage Institute
111		www.pdionline.org
112		
113	SDI	Steel Deck Institute
114		www.sdi.org
115		
116	SJI	Steel Joist Institute
117		www.steeljoist.org
118		
119	SMACNA	Sheet Metal and Air Conditioning Contractors' National Association

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121
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UL

www.smacna.org

Underwriters Laboratories, Inc.

www.ul.com

END OF SECTION 01 42 00

SECTION 01 50 00
CONSTRUCTION FACILITIES AND CONTROLS

PART 1: GENERAL

1.1. TEMPORARY POWER

- a. Contractors may use electric services available in the project area. Owner will pay costs of energy used.
- b. The Contractors shall provide and maintain their own extension cords and other necessary equipment as required to perform their work properly and as required by applicable governing codes and regulations.
- c. Any Contractor who requires temporary electrical service for tools and equipment other than lighting and fractional horse power motors shall make installation arrangements with an electrical Contractor. Contractors with equipment, which utilizes 3/4 HP or larger motors and/or 3-phase power, shall make similar arrangements. Any Contractor who requires these special power connections shall arrange and pay for the cost of installation and removal of such services upon completion of the Work.

1.2. TEMPORARY STORAGE

- a. Contractors are advised that there is limited storage at the Project site. Contractors shall bring only the amount of product necessary for the completion of the immediate work.
- b. Off-site storage may be necessary.
- c. The Owner shall coordinate on-site storage.
- d. Storage trailers or buildings may be permitted upon approval of the Owner. The storage trailers or buildings shall be kept in good condition, free from visible damage, rust, and deterioration, and shall meet all applicable safety standards. Trailers shall be roadworthy and comply with all appropriate state and local vehicle requirements. Failure to maintain storage trailers or buildings shall result in the removal of non-complying units at the Contractor's expense. Storage trailers or buildings shall be anchored to resist high winds.
- e. Construct a temporary, minimum 6-foot high chain link fence around the storage trailers and materials. Include plastic strip inserts so that visibility through the fence is obstructed

1.3. TELEPHONE SERVICE

- a. Contractors will not be permitted to use the Owner's telephones. Public pay telephones or Contractor's mobile telephone service shall be used.

1.4. WATER SERVICE

- a. Contractors may use available water service.
 - i. The Owner will pay for reasonable use of water for construction purposes.

1.5. TOILET FACILITIES

- a. The Contractor shall provide adequate toilet facilities for Contractor's use. Toilets used by the Contractor's personnel shall be kept clean and sanitary at all times.

1.6. FIRST AID FACILITIES

- a. Each Contractor shall provide and maintain adequate first aid facilities for any persons for whom Contractors are responsible.

1.7. OWNER'S PROPERTY AND EQUIPMENT

- a. Contractors shall not use any of the Owner's equipment, including but not limited to, ladders, lift trucks, shopping carts and dollies.
- b. Contractors shall provide, and bring to the project, all materials required for completion of the

work and shall not use the Owner's merchandise for such purposes.

- c. Contractors shall not use, abuse or otherwise mishandle the Owner's property.
- d. Failure to comply with Paragraphs A, B and C above may result in expulsion from the Project and/or prosecution by the Owner.

1.8. PROTECTION OF WORK AND PROPERTY

- a. Each Contractor shall be responsible for care and protection of the Work, equipment and adjacent property until installation is complete and accepted by Owner.
- b. Each Contractor shall be responsible for appropriate measures to protect and barricade the Work.
- c. Do not cut and patch structural elements in a manner that would reduce their load-carrying capacity or load-deflection ratio. Damage to the structural members of the building by any Contractor shall be made good at that Contractor's expense. Contractors shall obtain written approval from the Owner before cutting, drilling or driving anchors into columns and before penetrating any beams.
- d. Where damage occurs and responsibility for damage can be determined, the cost shall be charged to the party responsible. If responsibility cannot be determined, the cost shall be prorated among all Contractors in proportion to their activities at the building at the time the damage was done, as determined by the Owner.

1.9. CUTTING AND PATCHING OF WORK

- a. Remove, cut and patch work in a manner to minimize damage and to provide means of restoring products and finishes to specified condition.
- b. Any work that is damaged, lifted, discolored, or shows other imperfections as a result of Contractors' work shall be repaired or replaced by the Contractor who caused such damage.

1.10. CLEANING DURING CONSTRUCTION

- a. Each Contractor must maintain orderly and clean housekeeping conditions at all times.
 - i. During the course of construction, work areas, passageways and stairs in and around the buildings and structures must be kept clear of debris.
 - ii. Construction materials shall be stored in an orderly manner.
 - iii. All storage areas and walkways on the site shall be maintained free of obstructions and debris.
- b. Control accumulation of waste materials and rubbish. Each Contractor shall remove all packing case lumber, packing material, and wrappings daily. Each Contractor shall participate in project cleanup during construction.
- c. Conduct rubbish and debris to ground level in chutes, slides or buckets.
- d. Each Contractor shall clean work areas at the end of each workday or prior to moving into another area upon completion of the work in that area.
 - i. Cleaning shall consist of removal of all debris from site.
- e. The Contractor responsible for such materials shall remove volatile wastes and other flammable materials from the job site daily.
 - i. Do not burn or bury any materials at the work site. Do not dump volatile fluid and flammable wastes (such as mineral spirits, oil or paint thinner) in storm or sanitary sewer systems nor into waterways.
 - ii. Dispose of all waste at legally accepted public or private dumping locations off the Owner's property.
- f. The Contractor shall contain dust to the work area and shall provide necessary protections against dust penetration into the building outside the work area.

1.11. HOUSEKEEPING

- a. Contractor shall clean work areas at the end of each workday prior to moving into another area upon completion of the work in that area.
- b. Cleaning shall consist of removal of all debris from site.
- c. The Contractor shall provide waste receptacles for all non-hazardous waste materials.

- 119 d. The Contractor shall, daily, remove volatile wastes and other flammable materials from the
120 project site.
121 e. Contractor shall dispose of all such volatile waste and flammable materials at legally accepted
122 public or private disposal facilities off the Owner's property.
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124
125

126 1.12. SAFETY
127

- 128 a. Contractor agrees to conduct its work in a safe manner at all times, taking all the precautions
129 necessary to prevent injury and loss to employees at the project site, the Owner's employees,
130 as well as to members of the public who can be expected, by the nature of the Owner's
131 business, to be at or near the Project site.
132 b. Contractor will comply with all regulations and standard, laws, ordinances, codes and rules
133 with reference to safety accident prevention.
134 c. Contractor accepts responsibility for reinforcing the standards and regulations of the
135 Occupational Safety and Health Act or other acts pertaining to safety.
136 d. Contractor shall provide and maintain adequate first aid facilities for any persons for whom the
137 Contractor is responsible.
138

139 1.13. FIRE PROTECTION
140

- 141 a. Each Contractor shall be responsible for the maintenance of the following fire protection steps:
142 i. **SMOKING is not allowed** per the Owner's policy.
143 ii. Each Contractor shall recognize the utmost importance of extraordinary precautions
144 necessary to prevent a fire in, or adjacent to, the functioning and occupied building.
145 Each Contractor, all Subcontractors and workmen shall provide sufficient fire fighting
146 devices, watchman, standby helpers, or other precautions while temporary heating
147 devices are being used, during operations such as welding, brazing, testing, or other
148 phases of work which present a fire hazard or potential fire hazard.
149

150 1.14. SITE RESTRICTIONS
151

- 152 a. Non-specified signage, such as billboards or advertisements will not be allowed without prior
153 approval of the Owner.
154 b. Consumption of food and beverages shall be limited to areas outside of the building at all
155 times. Each Contractor shall clean such areas after each use.
156 c. **The use of alcoholic beverages is strictly forbidden.**
157

158 1.15. TEMPORARY CONTROLS
159

- 160 a. Contractor shall be responsible for any associated costs and the maintenance of the following
161 protection/controls:
162 i. NO SMOKING as described above.
163 ii. Dust and noise control.
164 iii. Protection of adjacent areas.
165 iv. Fences, barricades, and warning lights as required for safety purposes.
166

167 **PART 2: PRODUCTS**
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169 2.1. NOT USED
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171 **PART 3: EXECUTION**
172

173 3.1. NOT USED
174
175

END OF SECTION 01 50 00

SECTION 01 70 00
CONTRACT CLOSEOUT

PART 1: GENERAL

1.1. WORK INCLUDED

- a. This Section includes the requirements and administrative procedures for closing out the Work, including procedures for the following document:
 - i. Final Lien Waiver and Release.

1.2. RELATED WORK

- a. Document 00 52 00 – Agreement
- b. Document 00 72 00 – General and Supplementary Conditions

PART 2: PRODUCTS

2.1. NOT USED.

PART 3: EXECUTION

3.1. CLEANING

- a. The Contractor shall, prior to Substantial Completion, conduct a final inspection of the adjoining, effected site related items, including all roadways, walkways, and landscaped areas. The Contractor shall also, prior to Substantial Completion, conduct a final inspection of all of the Work and adjacent construction as well as, all effected interior spaces and of accessible concealed spaces.
 - i. Replace, at Contractor's own expense, all damaged areas (exterior and interior), materials, and all other contingent items (including adjacent construction) caused by the Contractor during the course of the Work, and as required.
 - ii. Remove all marks, stains, soil, dust, and/or dirt from all of the Work.
 - iii. Repair, patch and touch-up marred surfaces to specified finish, to match adjacent surfaces.
- b. Cleaning Standards: The standard of acceptability of cleaning operations shall be equivalent to a professional janitorial cleaning service.
 - i. Employ experienced workmen or professional cleaners for this cleaning.
- c. The Contractor shall restore any damaged landscaping as required to pre-construction conditions.

3.2. FINAL INSPECTION

- a. The Architect shall determine the date(s) of Substantial Completion based on an inspection of the completed Work.
- b. Contractor shall submit written certification to the Owner that the Work is completed and ready for final inspection.
- c. The Owner and Architect shall make inspection with reasonable promptness. If Work is incomplete or defective, the Owner and Architect shall notify Contractor to remedy deficiencies.
- d. Upon re-notification of completion, the Owner will re-inspect Work.
- e. The Architect shall determine the date of final completion.

3.3. CLOSE-OUT SUBMITTALS

- a. When the Owner has determined that the Work is acceptable under the Contract Documents and the Contract fully performed, the Contractor shall prepare and submit his final Application for Payment to the Architect together with the following:
 - i. Lien and Indemnity Affidavit:
 - 1. Exhibit 1: Contractor's Final Lien Waiver and Release in the amount due under

- 60 the Contract Sum.
- 61 2. Exhibit 2: A true list of names and addresses of all Subcontractors and material
- 62 and equipment suppliers.
- 63 3. Exhibit 3: Final Lien Waivers from all Subcontractors, sub-Subcontractors and
- 64 major material suppliers identified in Exhibit 2. Lien Waivers shall be in the full
- 65 amount of the Contract involved and shall be submitted no later than 30 days
- 66 past Substantial Completion of the Work.
- 67 b. Operating and Maintenance Data, Instructions to Owner's Personnel:
- 68 i. Refer to the Individual Specification Sections for requirements for operating and
- 69 maintenance data, or instructions to Owner's personnel.
- 70 ii. Information regarding these closeout submittals is generally located in Part 1 of each
- 71 Section of Work under the article heading SUBMITTALS.
- 72 iii. Information accompanying Owner furnished materials and equipment shall be included
- 73 in this submittal.
- 74 c. Warranties and Bonds:
- 75 i. Refer to the Individual Specification Sections for requirements for work, which requires
- 76 extended written warranties.
- 77 d. Evidence of compliance with requirements of governing authorities:
- 78 i. Certificates of Inspection from all required agencies and departments.
- 79
- 80

END OF SECTION 01 70 00

SECTION 02 41 00
DEMOLITION

PART 1 – GENERAL

- 1.1 SCOPE
- 1.2 RELATED WORK
- 1.3 SUBMITTALS
- 1.4 RECORD DRAWINGS
- 1.5 SAFETY
- 1.6 PERMITS
- 1.7 DISCONNECTION OF SERVICES
- 1.8 REMOVAL/SALVAGING OF ITEMS

PART 2 – PRODUCTS

- 2.1 EQUIPMENT

PART 3 – EXECUTION

- 3.1 PROTECTION OF EXISTING WORK AND FACILITIES
- 3.2 DEMOLITION
- 3.3 BUILDING DEMOLITION
- 3.4 DEMOLITION BELOW GRADE
- 3.5 DEMOLITION BACKFILL
- 3.6 DRAIN TILE
- 3.7 TRANSPORTATION AND DISPOSAL OF DEMOLITION WASTE

PART 1 – GENERAL

1.1 SCOPE

- A. The work under this section shall consist of providing all work, materials, labor, equipment, and supervision necessary to provide for the demolition of site work and such features as required in these specifications and on the drawings.

1.2 RELATED WORK

- A. Applicable provisions of the General Conditions and Division 1 shall govern work under this section.

1.3 SUBMITTALS

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

1.4 RECORD DRAWINGS

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

1.5 SAFETY

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

1.6 PERMITS

- A. Unless otherwise noted, Contractor shall be responsible for obtaining and paying for all permits necessary to complete demolition work.
- B. If necessary, file and maintain Notification of Demolition and/or Renovation and Application for

Permit Exemption (WDNR Form 4500-113) in accordance with the Wisconsin Administrative Code Chapter NR447.

1.7 DISCONNECTION OF SERVICES

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

1.8 REMOVAL/SALVAGING OF ITEMS

- A. Carefully remove all items that are scheduled to be salvaged.
- B. Secure salvaged items to allow for future movement; provide pallets, skids and other devices as necessary. Secure all loose parts.
- C. Provide crates, padding, tarps and other measures necessary to protect salvaged items during storage. Store items in secure location, safe from vandalism, weather, dust and other adverse elements.
- D. Where salvaged items are indicated to be turned over to Owner, deliver to location on property where designated by Owner.
- E. Where indicated to be incorporated into new work, store the salvaged item in secure location until trade responsible for re-installation mobilizes his equipment and storage facilities to the site, or otherwise accepts responsibility for the salvaged item.

PART 2 – PRODUCTS

2.1 EQUIPMENT

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

PART 3 – EXECUTION

3.1 PROTECTION OF EXISTING WORK AND FACILITIES

- A. Take all measures necessary to safeguard all existing work and facilities which are outside the limits of the work.
- B. Furnish and install fencing or other barriers as shown on the plans or as otherwise necessary to protect existing features.
- C. Verify the locations of, and protect, any buildings, structures, utilities, paved surfaces, signs, streetlights, utilities, landscaping and all other such facilities that are intended to remain or be salvaged.
- D. Make such explorations and probes as necessary to ascertain any required protection measures that shall be used before proceeding with demolition.
- E. Provide and maintain adequate catch platforms, warning lights, barricades, guards, weather protection, dust protection, fences, planking, bracing, shoring, piling, signs, and other items required for proper protection.
- F. Provide protection for workmen, public, adjacent construction and occupants of existing building(s).
- G. Report damage of any facilities or items scheduled for salvaging to the Construction Representative.
- H. Repair or replace any damaged facilities that are not scheduled for demolition.
- I. Explosives shall not be used for demolition.
- J. Keep streets, walks and all other adjacent paved areas clean and swept clear of dirt, mud and debris deposited as a result of this operation.
- K. Protect surrounding area from dust. Control rodents, and other vermin associated with demolition operations.

3.2 DEMOLITION

- A. Remove all equipment, fixtures and other materials scheduled for salvage prior to beginning demolition operations.
- B. Demolish and remove all buildings and structures scheduled for demolition as shown on the plans.
- C. Salvage all materials and structural elements noted on the plans for reuse or for owner's use.
- D. Abandon gas, electric and communication utilities in accordance with local utility company

- 1 requirements, or applicable substantive requirements if considered private.
2 E. Carry out vehicle loading as necessary within the project boundaries or as defined or indicated on
3 the drawings, but not in locations that block vehicular traffic on the streets or pedestrian traffic on
4 adjacent public walks.
5 F. Dismantle each structure in an orderly manner to provide complete stability of the structure at all
6 times. Provide bracing and shoring where necessary to avoid premature collapse of structure.
7 G. Conduct demolition operations and the removal of rubbish and debris in such a way that a
8 minimum of nuisance dust is caused. Constantly sprinkle rubbish and debris with water if
9 necessary to keep nuisance dust to a minimum.
10 H. Where necessary to prevent collapse of any construction, install temporary shores, underpinning,
11 struts or bracing. Do not commence demolition work until all temporary construction is complete.
12 I. During the execution of the work, provide, operate, and maintain all pumping equipment, suction
13 and discharge lines in a number of capacity as required to keep all cellars and pits free of water
14 from any source whatsoever at all times.
15 J. Masonry and concrete shall be demolished in small sections. Use braces and shores as necessary
16 to support the structure of the building or structure and protect it from damage. Where limits of
17 demolition are exposed in the finished work, cutting shall be made with saws, providing an
18 absolutely straight line, plumb, true and square.
19 K. Operate equipment so as to cause a minimum of damage to plaster which is to remain, and so as
20 to keep dust and dirt to a minimum.
21

22 3.3 BUILDING DEMOLITION

- 23 A. Proceed with demolition in a systematic manner, from top of structure to ground. Complete
24 demolition work above each floor or tier before disturbing supporting members on lower levels.
25 B. Neatly saw or cut joints at the limits of removal; whenever possible, locate cuts at existing joints.
26 C. Cut existing plaster with power saws equipped with plaster cutting blades and dust collection
27 system.
28 D. Patch or repair any damaged surfaces or structural members at the limits of removal.
29 E. Remove structural framing members and lower to ground by hoists, derricks or other suitable
30 means.
31 F. Remove all existing flooring in accordance with plans. Leave exposed existing sub flooring or
32 surface in suitable condition for receiving new finished flooring.
33 G. Locate demolition equipment and remove structure so as to not impose excessive loads to
34 supporting walls, floors or framing.
35 H. Break up and remove for recycling concrete slabs-on-grade, where shown not to remain.
36 I. Break up and remove for recycling asphaltic paving, where shown not to remain.
37
38

39 3.4 DEMOLITION BELOW GRADE

- 40 A. Demolish foundation walls and other below grade features in accordance with the plans. Unless
41 otherwise noted, remove all below grade features to a point 4' below adjoining existing grade, or
42 proposed grade, whichever is lower. Basement and/or lowest level floors more than 4' below
43 existing grade need not be removed but must be broken up to permit drainage.
44

45 3.5 DEMOLITION BACKFILL

- 46 A. Backfill and compact below grade areas and voids resulting from demolition of structures and other
47 abandonment and demolition.
48 B. Backfilling shall not begin until demolition and abandonment has been approved and documented
49 by the Construction Representative.
50 C. Prior to placement of fill materials, ensure that areas to be filled are free of standing water, frost,
51 frozen materials, trash and debris.
52 D. Backfill type, lift thickness and compaction requirements shall be in accordance with Section 31 20
53 00 – Earthmoving.
54

55 3.6 DRAIN TILE

- 56 A. Carefully protect and/or replace drain tiles encountered during demolition which are necessary to
57 maintain site drainage conditions. Immediately repair or replace any drain tiles not scheduled for
58 demolition, but damaged. Report damage to the Construction Representative.
59 B. Repairs to drain tile or replacement drain tile shall be comparable or better than the existing drain
60 tile system.
61 C. Test drain lines with water to assure free flow before covering. Remove all obstructions which may
62 be found, retest until satisfactory.

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3.7 TRANSPORTATION AND DISPOSAL OF DEMOLITION WASTE

- A. Transport and dispose all demolition waste in accordance with local, state, and federal guidelines.
- B. Whenever possible, or otherwise required by the Contract Documents, recycle demolition waste.
- C. Demolition waste shall be disposed of at a landfill or dumpsite designed and approved to accept the given waste.
- D. Maintain records documenting recycling and disposal of demolition waste. Record description of material, date removed, quantity removed, method of transport and recycling/disposal destination.

END OF SECTION

SECTION 06 10 00
ROUGH CARPENTRY

PART 1 – GENERAL

- 1.1 SECTION INCLUDES
- 1.2 REFERENCE STANDARDS
- 1.3 DELIVERY, STORAGE AND HANDLING

PART 2 – PRODUCTS

- 2.1 GENERAL REQUIREMENTS
- 2.2 DIMENSION LUMBER FOR CONCEALED APPLICATIONS
- 2.3 ACCESSORIES
- 2.4 FACTORY WOOD TREATMENT

PART 3 – EXECUTION

- 3.1 INSTALLATION - GENERAL
- 3.2 BLOCKING, NAILERS AND SUPPORTS
- 3.3 TOLERANCES

PART 1 – GENERAL

1.1 SECTION INCLUDES

- A. Preservative treated wood materials.
- B. Concealed wood blocking, nailers, and supports.

1.2 REFERENCE STANDARDS

- A. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2009.
- B. ASTM D2898 - Standard Test Methods for Accelerated Weathering of Fire-Retardant-Treated Wood for Fire Testing; 2010.
- C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2016.
- D. AWPA U1 - Use Category System: User Specification for Treated Wood; 2012.
- E. PS 20 - American Softwood Lumber Standard; 2010.

1.3 DELIVERY, STORAGE AND HANDLING

- A. General: Cover wood products to protect against moisture. Support stacked products to prevent deformation and to allow air circulation.

PART 2 – PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. Dimension Lumber: Comply with PS 20 and requirements of specified grading agencies.
 - 1. If no species is specified, provide any species graded by the agency specified; if no grading agency is specified, provide lumber graded by any grading agency meeting the specified requirements.
 - 2. Grading Agency: Any grading agency whose rules are approved by the Board of Review, American Lumber Standard Committee (www.alsc.org) and who provides grading service for the species and grade specified; provide lumber stamped with grade mark unless otherwise indicated.
- B. Lumber fabricated from old growth timber is not permitted.

2.2 DIMENSION LUMBER FOR CONCEALED APPLICATIONS

- A. Sizes: Nominal sizes as indicated on drawings.
- B. Moisture Content: S-dry or MC19.
- C. Miscellaneous Framing, Blocking, Nailers, Grounds, and Furring:
 - 1. Lumber: S4S, No. 2 or Standard Grade.
 - 2. Boards: Standard or No. 3.

2.3 ACCESSORIES

- A. Fasteners and Anchors:
 - 1. Metal and Finish: Hot-dipped galvanized steel complying with ASTM A153/A153M for high humidity and preservative-treated wood locations, unfinished steel elsewhere.

2.4 **FACTORY WOOD TREATMENT**

- A. Treated Lumber and Plywood: Comply with requirements of AWWA U1 - Use Category System for wood treatments determined by use categories, expected service conditions, and specific applications. Metal and Finish: Hot-dipped galvanized steel complying with ASTM A153/A153M for high humidity and preservative-treated wood locations, unfinished steel elsewhere.
 - 1. Fire-Retardant Treated Wood: Mark each piece of wood with producer's stamp indicating compliance with specified requirements.
 - 2. Preservative-Treated Wood: Provide lumber and plywood marked or stamped by an ALSC-accredited testing agency, certifying level and type of treatment in accordance with AWWA standards.
- B. Fire Retardant Treatment:
 - 1. Exterior Type: AWWA U1, Category UCFB, Commodity Specification H, chemically treated and pressure impregnated; capable of providing a maximum flame spread index of 25 when tested in accordance with ASTM E84, with no evidence of significant combustion when test is extended for an additional 20 minutes both before and after accelerated weathering test performed in accordance with ASTM D2898.
 - a. Kiln dry wood after treatment to a maximum moisture content of 19 percent for lumber and 15 percent for plywood.
 - b. Do not use treated wood in direct contact with the ground.
- C. Preservative Treatment:
 - 1. Preservative Pressure Treatment of Lumber Above Grade: AWWA U1, Use Category UC3B, Commodity Specification A using waterborne preservative.
 - a. Kiln dry lumber after treatment to maximum moisture content of 19 percent.
 - b. Treat lumber exposed to weather.
 - c. Treat lumber in contact with roofing, flashing, waterproofing, or rough openings for windows, doors and other exterior wall penetrations.
 - d. Treat lumber in contact with masonry or concrete.

PART 3 – EXECUTION

3.1 **INSTALLATION - GENERAL**

- A. Select material sizes to minimize waste.
- B. Reuse scrap to the greatest extent possible; clearly separate scrap for use on site as accessory components including: shims, bracing, and blocking.
- C. Where treated wood is used on interior, provide temporary ventilation during and immediately after installation sufficient to remove indoor air contaminants.

3.2 **BLOCKING, NAILERS AND SUPPORTS**

- A. Provide framing and blocking members as indicated or as required to support finishes, fixtures, specialty items, and trim.
- B. In framed assemblies that have concealed spaces, provide solid wood fireblocking as required by applicable local code, to close concealed draft openings between floors and between top story and roof/attic space; other material acceptable to code authorities may be used in lieu of solid wood blocking.
- C. In metal stud walls, provide continuous blocking around door and window openings for anchorage of frames, securely attached to stud framing.
- D. In walls, provide blocking attached to studs as backing and support for wall-mounted items, unless item can be securely fastened to two or more studs or other method of support is explicitly indicated.
- E. Where ceiling-mounting is indicated, provide blocking and supplementary supports above ceiling, unless other method of support is explicitly indicated.

3.3 **TOLERANCES**

- A. Framing Members: 1/4 inch from true position, maximum.
- B. Variation from Plane (Other than Floors): 1/4 inch in 10 feet maximum, and 1/4 inch in 30 feet

END OF SECTION

SECTION 06 11 40
WOOD BLOCKING AND CURBING

PART 1 – GENERAL

- 1.1 SUMMARY
- 1.2 GENERAL REQUIREMENTS
- 1.3 SCOPE OF WORK
- 1.4 QUALITY ASSURANCE
- 1.5 DELIVERY, STORAGE AND HANDLING
- 1.6 GUARANTEE

PART 2 – PRODUCTS

- 2.1 MATERIALS

PART 3 – EXECUTION

- 3.1 GENERAL
- 3.2 INSPECTION
- 3.3 WORKMANSHIP
- 3.4 CLEANING

PART 1 – GENERAL

1.1 SUMMARY

- A. Drawings and general provisions of the Subcontract apply to this Section. Applicable provisions of Division 1 shall govern work of this section.
- B. Review these documents for coordination with additional requirements and information that apply to work under this Section.

1.2 GENERAL REQUIREMENTS

- A. The other Contract Documents complement the requirements of this Section. The General Requirements apply to this Section and applicable parts thereof shall be included in the work.
- B. Refer to all drawings and other Sections of these Specifications to determine the type and extent of work therein affecting the work of this Section whether such work is specifically mentioned herein.

1.3 SCOPE OF WORK

- A. The Contractor under this Section shall supply all materials, labor, equipment, and appliances required to perform all the wood blocking and curbing and related work necessary for the proper completion of the operation as required by the Contract Documents.
- B. Without limiting the generality thereof, the work shall include the following:
 - 1. Blocking and nailers.
 - 2. Fasteners, anchors, and attachments.
 - 3. Dimensional wood exposed trim.
- C. Related work is specified in, but not necessarily limited to, the following Sections of these Specifications. However, the Contractor shall make their own determination of the extent of related work and of how said work affects the work of this Section.
 - 1. Section 09 91 00 - Painting

1.4 QUALITY ASSURANCE

- A. Lumber standards and grade stamps to be appropriate for the application.

1.5 DELIVERY, STORAGE AND HANDLING

- A. All materials for the work of this Section shall be delivered, stored, and handled to preclude damage of any nature. Manufactured materials shall be delivered and stored in their original containers, plainly marked with the product's and manufacturer's name. Materials in broken containers or in packages showing watermarks or other evidence of damage, shall not be used, and shall be removed from the site.

1.6 GUARANTEE

- A. All workmanship and materials shall be guaranteed in accordance with the provisions in the General Conditions.
- B. The guarantee shall be in writing, in a form acceptable to the Architect, countersigned by the General Contractor and delivered to the Architect for transmittal to the Owner.

C. The furnishing of the guarantee shall be a condition precedent to final payment.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Lumber

1. The grades of all materials under this Section shall be as defined by the rules of the recognized associations of lumber manufacturer's producing the materials specified. Lumber shall bear the grade and trademark of the association under whose rules it is produced and a mark of mill identification. Lumber shall be of sound stock, thoroughly seasoned, kiln-dried to a moisture content not exceeding 19-percent surfaced four sides, except as specifically designated for items hereinafter.

2. Items of lumber, except those for which special materials are called for hereinafter and except as otherwise specially noted on the drawings, shall be in accordance with the following:

<u>Item</u>	<u>Grade</u>	<u>Species</u>
Miscellaneous blocking and strapping	Blocking - Number2 Strapping - Standard	Eastern Spruce Western Hemlock
Plywood shims and fillers	APA, Marine Ext., thickness as detailed	

B. Rough Hardware

1. All rough hardware shall be supplied including nails, screws, staples, bolts, anchors, saddles, straps, and other items as necessary to place and secure all carpentry and items to be installed under this Section.

PART 3 – EXECUTION

3.1 GENERAL

A. The work of this Section shall be coordinated with that of associated trades.

B. The Contractor shall be fully responsible for the proper execution and performance of the work described herein.

3.2 INSPECTION

A. The Contractor shall inspect all surfaces, areas, and other contingent construction in or to which his work is to be installed and assure himself that they are in proper condition to receive the work to be performed under this Section. The Contractor shall notify the Architect in writing before any work is installed, of any condition requiring correction. Failure to make such a report shall be construed as acceptance of the existing conditions and the responsibility to provide an acceptable installation.

3.3 WORKMANSHIP

A. All work shall be in accordance with the design and requirements of the drawings and Specifications, true to lines, levels and dimensions, squared aligned, plumbed, well nailed, bolted or screwed and securely braced. Nailing shall be in accordance with State Code nailing schedule.

B. Provide all temporary and permanent grounds for wood furring, continuous blocking, and rough bucks and framing, as indicated on the drawings and as required for the attachment of frames, and other items indicated.

C. Framing and blocking shall be set straight, plumb, level, in true alignment, closely fitted, rigidly secured in place and shall be left clean and free from warp, twist, open joints and other defects.

3.4 CLEANING

A. All work adjacent to operations under this Section shall be inspected for damage and stains and repaired or cleaned prior to the completion of work.

B. During the progress of the work, the Contractor shall keep the premises clear of debris resulting from his operations and shall remove surplus and waste materials from the site as soon as possible.

C. Upon completion of the work, the Contractor shall remove from the site all equipment and materials used on the work as well as any debris resulting from the operations.

END OF SECTION

SECTION 06 41 00
ARCHITECTURAL WOOD CASEWORK

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- PART 1 – GENERAL
 - 1.1 SECTION INCLUDES
 - 1.2 REFERENCE STANDARDS
 - 1.3 SUBMITTALS
 - 1.4 QUALITY ASSURANCE
 - 1.5 FIELD CONDITIONS
 - 1.6 MOCK-UP
 - 1.7 DELIVERY, STORAGE AND HANDLING
 - 1.8 PROJECT CONDITIONS

- PART 2 – PRODUCTS
 - 2.1 CABINETS
 - 2.2 WOOD-BASED COMPONENTS
 - 2.3 PANEL MATERIALS
 - 2.4 LAMINATE MATERIALS
 - 2.5 COUNTERTOPS
 - 2.6 ACCESSORIES
 - 2.7 HARDWARE
 - 2.8 FABRICATION
 - 2.9 FACTORY FINISHING

- PART 3 – EXECUTION
 - 3.1 EXAMINATION
 - 3.2 INSTALLATION
 - 3.3 CLEANING

PART 1 – GENERAL

1.1 SECTION INCLUDES

- A. Countertops.
- B. Cabinets.
- C. Factory finishing.

1.2 REFERENCE STANDARDS

- A. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards; 2014.
- B. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards, U.S. Version 3.0; 2016.
- C. HPVA HP-1 - American National Standard for Hardwood and Decorative Plywood; 2009.

1.3 SUBMITTALS

- A. Shop Drawings: Indicate materials, component profiles, fastening methods, jointing details, and accessories.
- B. Product Data: Provide data for hardware accessories.
- C. Samples: Submit actual samples of architectural cabinet construction, minimum 12 inches square, illustrating proposed shelf unit substrate and finish.

1.4 QUALITY ASSURANCE

- A. Fabricator Qualifications: Company specializing in fabricating the products specified in this section with minimum five years of documented experience.

1.5 FIELD CONDITIONS

- A. Store materials for not less than 48 hours prior to installation in area of installation at a temperature of 70 degrees F to achieve temperature stability.
- B. During and after installation of custom cabinets, maintain temperature and humidity conditions in building spaces at same levels planned for occupancy.

1.6 MOCK-UP

- A. Provide mock-up of typical base and wall cabinets, including finishes.
- B. Locate where directed.

1 C. Mock-up may remain as part of the Work.

2
3 **1.7 DELIVERY, STORAGE, AND HANDLING**

- 4 A. Deliver countertops and casework to the jobsite only after proper facilities are available for
5 handling, storing, and protecting items; receiving areas are broom cleaned; exterior openings are
6 closed up; wet work and mechanical and electrical rough-ins are completed.
7 B. Provide temporary protective covers for items during deliver, installation, and until final acceptance
8 of Project.
9

10 **1.8 PROJECT CONDITIONS**

- 11 A. Verify that field measurements are as indicated on Shop Drawings.
12 B. Coordinate all work with plumbing and electrical rough-in and finish.
13

14 **PART 2 – PRODUCTS**

15
16 **2.1 CABINETS**

- 17 A. Quality Standard: Custom Grade, in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI
18 (NAAWS), unless noted otherwise.
19 B. Cabinets:
20 1. Finish - Exposed Exterior Surfaces: Laminate.
21 2. Finish - Exposed Interior Surfaces: Laminate.
22 3. Finish - Concealed Surfaces: Laminate.
23 4. Casework Construction Type: Type A - Frameless.
24 5. Cabinet and Door Drawer Front Interface Style: Flush Overlay
25 6. Adjustable Shelf Loading: 50 lbs. per sq. ft.
26 a. Deflection: L/144.
27

28 **2.2 WOOD-BASED COMPONENTS**

- 29 A. Wood fabricated from old growth timber is not permitted.
30 B. Softwood Lumber: NIST PS 20; Graded in accordance with, Grade I/Premium; average moisture
31 content of 4-9 percent.
32 C. Hardwood Lumber: NHLA; Graded in accordance with, Grade III/Economy; average moisture
33 content of 4-9 percent.
34

35 **2.3 PANEL MATERIALS**

- 36 A. Particleboard: ANSI A208.1; medium density industrial type as specified in AWI/AWMAC
37 Architectural Woodwork Quality Standards Illustrated, composed of wood chips bonded with
38 moisture resistant adhesive under heat and pressure; sanded faces; thickness as required; use for
39 components indicated on drawings.
40 B. Medium Density Fiberboard (MDF): ANSI A208.2; type as specified in AWI/AWMAC Architectural
41 Woodwork Quality Standards Illustrated; composed of wood fibers pressure bonded with moisture
42 resistant adhesive to suit application; sanded faces; thickness as required.
43

44 **2.4 LAMINATE MATERIALS**

- 45 A. Manufacturers:
46 1. Wilsonart: www.wilsonart.com.
47 2. Formica Corporation: www.formica.com.
48 B. High Pressure Decorative Laminate (HPDL): NEMA LD 3, types as recommended for specific
49 applications.
50

51 **2.5 COUNTERTOPS**

- 52 A. Laminate
53 B. For Solid Surfacing Refer to Section 06 61 16 – Solid Surfacing Fabrications.
54

55 **2.6 ACCESSORIES**

- 56 A. Adhesive: Type recommended by fabricator to suit application.
57 B. Plastic Edge Banding: Extruded PVC, flat shaped; smooth finish; self-locking serrated tongue; of
58 width to match component thickness.
59 1. Color: As selected by Architect from manufacturer's standard range.
60 2. Use at all exposed shelf edges.
61 3. Use at all vertical edges.

- C. Fasteners: Size and type to suit application.
- D. Bolts, Nuts, Washers, Lags, Pins, and Screws: Of size and type to suit application; galvanized or chrome-plated finish in concealed locations and stainless steel or chrome-plated finish in exposed locations.
- E. Concealed Joint Fasteners: Threaded steel.
- F. Grommets: Standard plastic grommets for cut-outs, in color to match adjacent surface.
 - 1. Provide 2 per countertop. Install where directed by Owner.

2.7 HARDWARE

- A. Adjustable Shelf Supports: Standard side-mounted system using Shelf rests with steel pins at 1 inch on center, polished chrome finish, for nominal 1 inch spacing adjustments. Adjustment +/- 3 inches from equally spaced shelves.
- B. Butt hinges: 2-3/4", five-knuckle steel hinges made from 0.095 inch thick metal and as follows:
 - 1. Semi-concealed hinges for overlay doors: BHMA A156.9, B01521
- C. Frameless concealed hinges (European Type): BHMA A156.9, B01602, 170 degrees of opening, self-closing.
- D. Wire Pulls: Back mounted, solid metal, size as shown in finish matrix
- E. Drawer slides: BHMA A156.9
 - 1. Grade 1 and Grade 2: Side mounted; full-extension type; zinc-plated steel with polymer rollers.
 - 2. Grade 1HD-100 and Grade 1HD-200; Side mounted; full-extension type; zinc-plated-steel ball-bearing slides.
 - 3. For drawers not more than 3 inches high but not more than 6 inches high and not more than 24 inches wide, provide Grade 1HD-100.
 - 4. For drawers more than 6 inches high or more than 2 inches wide, provide Grade 1HD-200.
- F. Door and Drawer Silencers: BHMA A156.16, L03011
- G. Exposed Hardware Finishes: See finish Matrix
- H. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in BHMA A156.9.

2.8 FABRICATION

- A. Assembly Shop assemble cabinets for delivery to site in units easily handled and to permit passage through building openings.
- B. Edging: Fit shelves, doors, and exposed edges with specified edging. Do not use more than one piece for any single length.
- C. Fitting: When necessary to cut and fit on site, provide materials with ample allowance for cutting.
- D. Provide matching trim for scribing and site cutting.
- E. Plastic Laminate: Apply plastic laminate finish in full uninterrupted sheets consistent with manufactured sizes. Fit corners and joints hairline; secure with concealed fasteners. Slightly bevel arises. Locate counter butt joints minimum 2 feet from sink cut-outs.
 - 1. Cap exposed plastic laminate finish edges with plastic trim.
- F. Matching Wood Grain: Comply with requirements of quality standard for specified Grade exclusively.

2.9 FACTORY FINISHING

- A. Sand work smooth and set exposed nails and screws. On items to receive transparent finishes, use wood filler matching or blending with surrounding surfaces and of types recommended for applied finishes.
- B. Finish work in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), Section 5 - Finishing for grade specified and as follows:
 - 1. Transparent:
 - a. System - 11, Polyurethane, Catalyzed.
 - b. With UV protection applied.
 - c. Sheen: Satin.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Verify adequacy of backing and support framing.
- B. Verify location and sizes of utility rough-in associated with work of this section.

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3.2 INSTALLATION

- A. Set and secure custom cabinets in place, assuring that they are rigid, plumb, and level.
- B. Use fixture attachments in concealed locations for wall mounted components.
- C. Use concealed joint fasteners to align and secure adjoining cabinet units.
- D. Carefully scribe casework abutting other components, with maximum gaps of 1/32 inch. Do not use additional overlay trim for this purpose.

3.3 ADJUSTING

- A. Adjust work under provisions of Divisions 01 Section "general Requirements."
- B. Adjust moving or operating parts to function smoothly and correctly.

3.4 CLEANING

- A. Clean casework, counters, shelves, hardware, fittings, and fixtures.

END OF SECTION

SECTION 06 61 16
SOLID SURFACING FABRICATIONS

1
2
3
4 PART 1 – GENERAL
5 1.1 SUMMARY
6 1.2 REFERENCES
7 1.3 ADMINISTRATIVE REQUIREMENTS
8 1.4 SUBMITTALS
9 1.5 QUALITY ASSURANCE
10 1.6 DELIVERY, STORAGE AND HANDLING
11 1.7 WARRANTY
12 PART 2 – PRODUCTS
13 2.1 MANUFACTURERS
14 2.2 MATERIALS
15 2.3 COMPONENTS
16 PART 3 – EXECUTION
17 3.1 EXAMINATION
18 3.2 INSTALLATION
19 3.3 REPAIR
20 3.4 SITE QUALITY CONTROL
21 3.5 CLEANING
22 3.6 PROTECTION
23

24 **PART 1 – GENERAL**

25
26 **1.1 SUMMARY**

- 27 A. Section includes: Provide solid surfacing fabrications including but not limited to following:
28 1. Lavatory tops with undermount bowls
29 2. Millwork counter tops with sinks and cove backsplashes.
30
31 B. Related Sections: Following description of work is included for reference only and shall not be
32 presumed complete:
33 1. Provision of indoor air quality requirements: Section 01 81 19, Indoor Air Quality
34 Requirements.
35 2. Provision of finish carpentry and architectural woodwork: Section 06 41 00.
36 3. Provision of elastomeric joint sealants: Section 07 92 00 - Sealants.
37 4. Provision of plumbing and plumbing fixtures.
38

39 **1.2 REFERENCES**

- 40 A. Abbreviations and Acronyms:
41 1. MDF: Medium Density Fiberboard.
42 2. SCAQMD: South Coast Air Quality Management District; www.aqmd.gov.
43 3. VOC: Volatile Organic Compound.
44 B. Definitions:
45 1. Solid Surface: Non-porous, homogeneous material maintaining the same composition
46 throughout the part with a composition of acrylic polymer, aluminum trihydrate filler and
47 pigment.
48 C. Reference Standards:
49 ANSI/NPA A208.2-09 - Medium Density Fiberboard (MDF) For Interior Applications
50 ASTM C920-14a - Standard Specification for Elastomeric Joint Sealants
51 ASTM D638-10 - Standard Test Method for Tensile Properties of Plastics
52 ASTM D785-08 - Standard Test Method for Rockwell Hardness of Plastics and
53 Electrical Insulating Materials
54 ASTM D790-10 - Standard Test Methods for Flexural Properties of Unreinforced
55 and Reinforced Plastics and Electrical Insulating Materials
56 ASTM D5420-10 - Standard Test Method for Impact Resistance of Flat, Rigid
57 Plastic Specimen by Means of a Striker Impacted by a Falling
58 Weight (Gardner Impact)
59 ASTM E84-14 - Standard Test Method for Surface Burning Characteristics of
60 Building Materials

1	ASTM E228-11	- Standard Test Method for Linear Thermal Expansion of Solid
2		Materials with a Push-Rod Dilatometer
3	ASTM G21-13	- Standard Practice for Determining Resistance of Synthetic
4		Polymeric Materials to Fungi
5	ASTM G22-76(96)	- Standard Practice for Determining Resistance of Plastics to
6		Bacteria
7	ASTM G155-13	- Standard Practice for Operating Xenon Arc Light Apparatus for
8		Exposure of Non-Metallic Materials
9		

10 **1.3 ADMINISTRATIVE REQUIREMENTS**

- 11 A. Preinstallation Meetings: Arrange preinstallation meeting 1 week prior to commencing work with all
12 parties associated with trade as designated in Contract Documents or as requested by Architect.
13 Presided over by Contractor, include Architect who may attend, Subcontractor performing work of
14 this trade, Owner's representative, testing company's representative and consultants of applicable
15 discipline. Review Contract Documents for work included under this trade and determine complete
16 understanding of requirements and responsibilities relative to work included, storage and handling
17 of materials, materials to be used, installation of materials, sequence and quality control, Project
18 staffing, restrictions on areas of work and other matters affecting construction, to permit compliance
19 with intent of work of this Section.
20

21 **1.4 SUBMITTALS**

- 22 A. Product Data: Indicate Product description including solid surface sheets, sinks, bowls and
23 illustrating full range of standard colors, fabrication information and compliance with specified
24 performance requirements. Submit Product data with resistance to list of chemicals.
25 B. Shop Drawings: Submit Shop Drawings for work of this Section. Indicate plans, sections,
26 dimensions, component sizes, edge details, thermosetting requirements, fabrication details,
27 attachment provisions, sizes of furring, blocking, including concealed blocking and coordination
28 requirements with adjacent work. Show locations and sizes of cutouts and holes for plumbing
29 fixtures, faucets, soap dispensers, waste receptacles and other items installed in solid surface.
30 C. Coordination Drawings: Submit coordination drawings indicating plumbing and miscellaneous steel
31 work indicating locations of wall rated or non-rated, blocking requirements, locations and recessed
32 wall items and similar items.
33 D. Samples: Submit samples in accordance with Section 01 30 00. Submit minimum 6" x 6" samples.
34 Cut sample and seam together for representation of inconspicuous seam. Indicate full range of
35 color and pattern variation. Approved samples will be retained as standards for work.
36

37 **1.5 QUALITY ASSURANCE**

- 38 A. Qualifications:
39 1. Installers: Provide work of this Section executed by competent installers with minimum 5
40 years' experience in the application of Products, systems and assemblies specified and
41 with approval and training of the Product manufacturers.
42 2. Mock-Ups:
43 a. Prior to final approval of Shop Drawings, erect 1 full size mock-up at Project site
44 demonstration quality of materials and execution for Architect review.
45 b. Should mock-up not be approved, rework or remake until approval is secured.
46 Remove rejected units from Project site.
47 c. Approved mock-up will be used as standard for acceptance of subsequent work.
48 d. Approved mock-ups may remain as part of finished work.
49

50 **1.6 DELIVERY, STORAGE, AND HANDLING**

- 51 A. Delivery and Acceptance Requirements: Deliver no components to Project site until areas are
52 ready for installation.
53 B. Storage and Handling Requirements:
54 2. Store components indoors prior to installation.
55 3. Handle materials to prevent damage to finished surfaces.
56

57 **1.7 WARRANTY**

- 58 A. Manufacturer Warranty: Provide manufacturer's standard warranty for material only for period of 10
59 years against defects and/or deficiencies in accordance with General Conditions of the Contract.
60 Promptly correct any defects or deficiencies which become apparent within warranty period, to
61 satisfaction of Architect and at no expense to Owner.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturer List: Products of following manufacturers are acceptable subject to conformance to requirements of Drawings, Schedules and Specifications:
1. Corian® by DuPont; www.corian.com
 2. Samsung Chemical USA; www.staron.com
 3. Wilsonart Contract; www.wilsonartcontract.com
- B. Substitution Limitations: This Specification is based on Corian® Products. Comparable Products from manufacturers listed herein will be accepted provided they meet or exceed requirements of this Specification.

2.2 MATERIALS

- A. Description:
1. Performance/Design Criteria:

	Property	Requirement (min or max)	Test Procedure
	Solid Surface Based Products:		
a.	Tensile Strength	6000 psi min	ASTM D638
b.	Tensile Modulus	1.5 x 10 ⁶ psi min	ASTM D638
c.	Tensile Elongation	0.4% min.	ASTM D638
d.	Flexural Strength	10000 psi min	ASTM D790
e.	Flexural Modulus	1.2 x 10 ⁶ psi min	ASTM D790
f.	Hardness	>85-Rockwell "M" scale min.	ASTM D785
g.	Thermal Expansion	2.2 x 10 ⁻⁵ in./in./°F	ASTM E228
h.	Fungi and Bacteria	Does not support microbial growth	ASTM G21 & G22
i.	Microbial Resistance	Highly resistant to mold growth	UL 2824
j.	Ball Impact	No fracture - 1/2 lb. Ball: 6 mm slab - 36" drop 12 mm slab - 144" drop	NEMA LD 3, Method 3.8
k.	Weatherability	ΔE*94<5 in 1,000 hrs	ASTM G155
l.	Flammability		ASTM E84, NFPA 255 & UL 723
		All Colors	
		6 mm	12 mm
m.	Flame Spread	<25	<25
n.	Smoke Developed	<25	<25
o.	Class	A	A

- B. Solid Surface Material: Non-porous, homogeneous material maintaining the same composition throughout the part with a composition of acrylic polymer, aluminum trihydrate filler and pigment; not coated, laminated or of composite construction; meeting following criteria:
- C. Flammability: Class 1 and A when tested to UL 723.
- D. Food Equipment Material Compliance: Food Zone to NSF/ANSI 51.
- E. Ensure material has minimum physical and performance properties specified under "Performance/Design Criteria".
- F. Ensure superficial damage to a depth of 0.010" is repairable by sanding and polishing.
- G. Adhesive for Bonding to Other Products: One component silicone to ASTM C920.
- H. Sealant: A standard mildew-resistant, FDA/UL® and NSF/ANSI 51 compliant in Food Zone area, recognized silicone color matched sealant or clear silicone sealants.
- I. Sink/Bowl Mounting Hardware: Manufacturer's approved bowl clips, brass inserts and fasteners for attachment of undermount sinks/bowls.
- J. Heat Reflecting Tape: Manufacturer's standard aluminum foil tape, with required thickness, for use

- 1 with cutouts near heat sources.
2 K. Insulating Nomex® Fabric: Manufacturer's standard for use with conductive tape in insulating solid
3 surface material from adjacent heat source.
4

5 **2.3 COMPONENTS**

- 6 A. Counter Perimeter Frame: Ensure 1/2" thick, moisture resistant cores for counter tops in wet areas
7 having sinks or lavatories are 3/4" Lavatory Tops: thick exterior grade plywood with waterproof
8 adhesive, Fir or Poplar plywood, veneer core only. If MDF core: conform to ANSI/NPA A208.2
9 balanced design, manufactured from recycled materials, meeting ANSI Standards for emissions, of
10 minimum density of 48 lb/cu ft. and surface character to match sample approved by Architect.
11 Ensure fire retardant product contains fire-retardant chemicals injected with raw materials during
12 manufacturing and achieves a maximum flame-spread rating of 25 with a maximum smoke
13 development of 200 when tested to ASTM E84.
14 B. Lavatory Tops with Seamed Bowls: 1/2" thick countertop of solid surfacing material, cast to desired
15 profiles and sizes having an eased edge detail unless indicated otherwise on Drawings, conforming
16 to CSA B45.5/IAPMO Z124, complete with bowl. Provide countertops complete with backsplashes
17 of size shown on Drawings. Ensure countertop and backsplash colors match; coved connection.
18 C. Lavatory Tops with Undermount Bowls: 1/2" thick countertop of solid polymer solid surfacing
19 material, cast to desired profiles and sizes having edge details as indicated on Drawings
20 conforming to CSA B45.5/IAPMO Z124, complete with undermount bowls as indicated on Drawing.
21 Provide countertops complete with backsplashes of size shown on Drawings. Use undermount
22 hardware according to manufacturer's instructions. Ensure vanity top and backsplash match; as
23 selected by Architect.
24 D. Lavatory Tops with Integral Bowls: Molded countertop of solid polymer material, complete with
25 integrally molded bowl[s] of solid polymer material; edge details as indicated on Drawings. Provide
26 with non-coved backsplash and endsplashes as shown on Drawings.
27 E. Fabrication:
28 1. Fabricate components in shop to greatest extent practical to sizes and shapes indicated,
29 in accordance with approved Shop Drawings and solid polymer manufacturer
30 requirements. Form joints between components using manufacturer's standard joint
31 adhesive without conspicuous joints. Provide factory cutouts for plumbing fittings and bath
32 accessories as indicated on Drawings.
33 2. Where indicated, thermoform corners and edges or other objects to shapes and sizes
34 indicated on Drawings, prior to seaming and joining. Cut components larger than finished
35 dimensions and sand edges to remove nicks and scratches. Heat entire component
36 uniformly prior to forming.
37 3. Ensure no blistering, whitening and cracking of components during forming.
38 4. Fabricate backsplashes from solid surfacing material with optional radius cove where
39 counter and backsplashes meet as indicated on Drawings. Backsplashes for most colors
40 may be fabricated by traditional means discussed in K-25294 Backsplashes. \
41 5. Fabricate joints between components using manufacturer's standard joint adhesive.
42 Ensure joints are inconspicuous in appearance and without voids. Attach 50 mm (2") wide
43 reinforcing strip of solid polymer material under each joint. Reinforcing strip of solid
44 polymer material is not required when using DuPont™ Joint Adhesive 2.0.
45 6. Provide holes and cutouts for plumbing and bath accessories as indicated on Drawings.
46 7. Rout and finish component edges to a smooth, uniform finish. Rout cutouts, then sand
47 edges smooth. Repair or reject defective or inaccurate work.
48 8. Finish: Ensure surfaces have uniform finish: matte, semi-gloss, or polished, selected by
49 owner.
50 9. Fabrication Tolerances:
51 a. Variation in Component Size: +/-1/8".
52 b. Location of Openings: +/-1/8" from indicated location.
53

54 **PART 3 – EXECUTION**

55
56 **3.1 EXAMINATION**

- 57 A. Verification of Conditions:
58 1. Examine substrates and conditions, with fabricator present for compliance with
59 requirements for installation tolerances and other conditions affecting performance of
60 work. Proceed with installation only after unsatisfactory conditions have been corrected.
61 2. Verify actual site dimensions and location of adjacent materials prior to commencing work.

- 1 3. Examine cabinets upon which counter tops are to be installed. Verify cabinets are level to
2 within 1/8" in 10' - 0".
3 4. Notify Architect in writing of any conditions which would be detrimental to installation.
4 B. Evaluation and Assessment: Commencement of work implies acceptance of previously completed
5 work.
6

7 **3.2 INSTALLATION**

- 8 A. Install components plumb, level, rigid, scribed to adjacent finishes in accordance with reviewed
9 Shop Drawings and Product installation details.
10 B. Fabricate field joints using manufacturer's recommended adhesive, with joints being inconspicuous
11 in finished work. Exposed joints/seams are not permitted. Keep components and hands clean when
12 making joints. Reinforce field joints as specified herein. Cut and finish component edges with clean,
13 sharp returns.
14 C. Route radii and contours to template. Anchor securely to base component or other supports. Align
15 adjacent components and form seams to comply with manufacturer's written recommendations
16 using adhesive in color to match work. Carefully dress joints smooth, remove surface scratches
17 and clean entire surface.
18 D. Install countertops with no more than 1/8" sag, bow or other variation from a straight line.
19 E. Adhere sinks/bowls to countertops using manufacturer's recommended adhesive and mounting
20 hardware.
21 F. Seal between wall and components with joint sealant as specified.
22 G. Provide backsplashes and endsplashes as indicated on Drawings. Adhere to countertops using a
23 standard color-coordinated silicone sealant. Adhere applied sidesplashes to countertops using a
24 standard color-matched silicone sealant. Provide coved backsplashes and sidesplashes at walls
25 and adjacent millwork. Fabricate radius cove at intersection of counters with backsplashes to
26 dimensions shown on reviewed Shop Drawings. Adhere to countertops using manufacturer's
27 standard color-coordinated joint adhesive.
28 H. Keep components and hands clean during installation. Remove adhesives, sealants and other
29 stains. Ensure components are clean on date of Substantial Completion of the Work.
30 I. Coordinate connections of plumbing fixtures.
31

32 **3.3 REPAIR**

- 33 A. Repair minor imperfections. Replace areas of cracked seams or severely damaged surfaces in
34 accordance with manufacturer's "Technical Bulletins".
35

36 **3.4 SITE QUALITY CONTROL**

- 37 A. Non-Conforming Work: Replace damaged work which cannot be satisfactorily repaired, restored or
38 cleaned, to satisfaction of Architect at no cost to Owner.
39

40 **3.5 CLEANING**

- 41 A. Remove excess adhesive and sealant from visible surfaces.
42 B. Clean surfaces in accordance with manufacturer's "Care and Maintenance Instructions".
43

44 **3.6 PROTECTION**

- 45 A. Provide protective coverings to prevent physical damage or staining following installation for
46 duration of Project.
47 B. Protect surfaces from damage until date of Substantial Completion of the Work.
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49

END OF SECTION

SECTION 07 84 00
FIRESTOPPING

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- PART 1 – GENERAL
 - 1.1 SECTION INCLUDES
 - 1.2 RELATED SECTIONS
 - 1.3 REFERENCES
 - 1.4 SUBMITTALS
 - 1.5 QUALITY ASSURANCE
 - 1.6 DELIVERY, STORAGE, AND HANDLING
 - 1.7 PROJECT CONDITIONS
- PART 2 – PRODUCTS
 - 2.1 MANUFACTURERS
 - 2.2 SYSTEM REQUIREMENTS
 - 2.3 ACCESSORIES
- PART 3 – EXECUTION
 - 3.1 EXAMINATION
 - 3.2 PREPARATION
 - 3.3 INSTALLATION
 - 3.4 FIELD QUALITY CONTROL
 - 3.5 CLEANING AND PROTECTION

PART 1 – GENERAL

1.1 SECTION INCLUDES

- A. Firestopping for the following:
 - 1. Openings in fire rated walls, both empty and those containing penetrations such as cables, conduits, cable trays, pipes, ducts, and similar penetrating items.
 - 2. Gaps between floor slabs and exterior walls.
 - 3. Openings at each floor level in fire rated shafts or stairwells.
 - 4. Gaps between the tops of fire rated walls and underside of floor or roof assemblies.

1.2 RELATED SECTIONS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.3 REFERENCES

- A. ASTM E 814 - Test Method of Fire Tests of Through Penetration Firestops; 2002.
- B. ASTM E 1966 - Standard Test Method for Fire-Resistive Joint Systems; 2001.
- C. UL 1479 - Fire Tests of Through-Penetration Firestops; 2003.
- D. UL 2079 - Tests for Fire Resistance of Building Joint Systems; 1998.
- E. ULC-S115 - Fire Tests of Firestop Systems; 1995 (R2001).

1.4 SUBMITTALS

- A. Product Data: Manufacturer's data sheets on each product to be used, including:
 - 1. Tested systems or design for each different firestopping condition.
 - 2. Product data for specified products indicating product characteristics, performance, and limitation criteria.
 - 3. Preparation instructions and recommendations.
 - 4. Storage and handling requirements and recommendations.
 - 5. Installation instructions and methods.
 - 6. Manufacturer's certification, if requested.
- B. Shop Drawings: Submit shop drawings showing typical installation details including reinforcement, anchorage, fastenings and method of installation for each type of firestopping condition.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications:
 - 1. Company specializing in manufacturing products of this section with minimum 3 years documented experience.
 - 2. Company quality management system registered in accordance with the requirements of

- 1 ISO 9001:1994.
2 B. Installer Qualifications:
3 1. Company with minimum 3 years' experience in the installation of specified materials on
4 comparable projects.
5 2. Written approval of firestopping material manufacturer.
6

7 **1.6 DELIVERY, STORAGE, AND HANDLING**

- 8 A. Deliver materials in manufacturer's sealed and labeled containers. Handle and store materials in
9 accordance with manufacturer's instructions.
10 B. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in
11 accordance with requirements of local authorities having jurisdiction.
12

13 **1.7 PROJECT CONDITIONS**

- 14 A. Comply with manufacturer's recommended requirements for temperature, relative humidity, and
15 substrate moisture content during application and curing of materials.
16 B. Ventilate solvent based materials in accordance with manufacturer's instructions by natural means
17 or, if necessary, by forced air circulation.
18

19 **PART 2 – PRODUCTS**

20
21 **2.1 MANUFACTURERS**

- 22 A. Acceptable Manufacturers:
23 1. A/D Fire Protection Systems; 420 Tapscott Rd., Scarborough, Ontario M1B 1Y4. ASD.
24 Tel: (800) 263-4087 or (416) 292-2361. Fax: (416) 298-5887. www.adfire.com.
25 2. Hilti USA - Hilti firestop systems
26

27 **2.2 SYSTEM REQUIREMENTS**

- 28 A. Firestopping - General: Provide complete systems of asbestos-free firestopping capable of
29 maintaining an effective barrier against flame, smoke and gases, listed by UL, WH, ULC, or FM, or
30 other independent testing agency, and acceptable to authorities having jurisdiction.
31 1. Fire Resistance Ratings: In accordance with applicable building code.
32 2. Materials: Provide materials of type, thickness, width and density to provide and maintain
33 fire resistance rating.
34 3. Through Penetrations: Provide systems meeting UL 1479, ULC-S115 or ASTM E 814,
35 completely filling annular spaces to prevent the passage of flame, smoke and gases
36 through the opening in the fire separation in which it is installed.
37 4. Building Joints: Provide systems meeting UL 2079 or ASTM E 1966.
38 5. Compatibility: Provide materials which are compatible with all materials used in the system
39 including materials used in or on penetrants as well as all construction materials used in
40 conjunction or contiguous with the system.
41

42 **2.3 ACCESSORIES**

- 43 A. Accessories: Provide components needed to install each firestopping system. Use only
44 components specified by the firestopping manufacturer and listed in the design for the fire
45 resistance rated system.
46 B. Damming and Backup Materials, Supports and Anchoring Devices: Non-combustible, to
47 manufacturer's recommendations and in accordance with the tested system being installed as
48 acceptable to jurisdictional authorities.
49 C. Primers: As required by firestopping manufacturer and compatible with selected system and
50 contiguous materials.
51 D. Water: Potable.
52 E. Tape: Pressure sensitive masking tape as recommended by the firestopping manufacturer.
53

54 **PART 3 – EXECUTION**

55
56 **3.1 EXAMINATION**

- 57 A. Examine substrates, openings, voids, adjoining construction and project conditions. Confirm
58 compatibility of surfaces scheduled to receive firestopping.
59 B. Verify that work within opening has been completed before installing firestopping. Coordinate with
60 work of other trades so that firestopping applications can be inspected prior to being covered by
61 subsequent construction.

- 1 C. Verify that penetrating elements are securely fixed and properly located with the proper space
- 2 allowance between penetrations and surfaces of openings.
- 3 D. Do not proceed until substrate and project conditions are satisfactory.
- 4

5 **3.2 PREPARATION**

- 6 A. Clean surfaces to receive firestopping thoroughly. Verify that surfaces are free of dirt, dust, grease,
- 7 oil, rust, loose materials, form release agents, frost, moisture or any other matter which would
- 8 impair the bond of firestopping material.
- 9 B. Prime substrates in accordance with manufacturer's written instructions or recommendations.
- 10 Confine primers to areas of bond; do not allow spillage or migration onto exposed surfaces.
- 11 C. Do not apply firestopping and smoke seals to surfaces previously painted or treated with sealers,
- 12 curing compounds, water repellent or other coatings unless tests have been performed to ensure
- 13 compatibility of materials. Remove coatings as required.
- 14 D. Provide anchoring devices, back-up materials, clips, sleeves, supports and other related materials
- 15 used in the actual fire tests.
- 16 E. Mask where necessary to prevent firestopping materials from contacting adjoining surfaces that will
- 17 remain exposed upon completion of work. Remove tape as soon as it is possible to do so without
- 18 disturbing firestoppings seal with substrates.
- 19 F. Verify that submittals have been completed before starting installation.
- 20

21 **3.3 INSTALLATION**

- 22 A. Install in strict accordance with manufacturer's instructions for the specified or selected designs for
- 23 the type of assembly being firestopped, the type of penetrant, and the condition of the opening in
- 24 each case. Obtain the manufacturer's instructions for conditions not fully covered by printed
- 25 instructions. Record in writing all oral instructions received.
- 26 B. Install firestopping with sufficient pressure to properly fill and seal openings for effective smoke
- 27 seal.
- 28 C. Remove excess firestopping material promptly.
- 29 D. Damming Boards: Install forming or damming materials and other accessories required to support
- 30 fill materials during their application; position to produce the shapes and depths required to achieve
- 31 fire ratings of through-penetration firestop systems.
 - 32 1. Combustible Type: For temporary dams only, remove after firestopping material has
 - 33 cured, unless permitted as permanent by design and by code.
 - 34 2. Non-Combustible Type: For temporary or permanent dams. Provide non-combustible type
 - 35 wherever damming material cannot be removed after applying firestopping materials.
- 36 E. Fill, Void, and Cavity Materials: Use materials recommended by the firestopping manufacturer to
- 37 seal gaps created by non-combustible type damming boards and to seal around cables, conduits,
- 38 pipes, and where void filler material becomes part of the fire rated assembly.
- 39 F. Sealant: Use non-sagging type where void cannot be dammed sufficiently to contain sealant until
- 40 cured.
 - 41 1. Install damming material or mineral wool as required.
 - 42 2. Apply sealant to minimize air voids and to ensure sealant is in full contact with penetrating
 - 43 items and surrounding surfaces.
 - 44 3. Tool non-pourable sealant to ensure substrate contact if required.
 - 45 4. Remove excess sealant in accordance with manufacturer's recommendations. Do not
 - 46 exceed minimum system or design thickness by more than 25 percent.
- 47 G. Mortar: Install damming material as required. Mix mortar in strict accordance with manufacturer's
- 48 instructions. Fill openings to minimum thickness as recommended by manufacturer and by tested
- 49 system or selected design to achieve required fire rating.
- 50 H. Firestopping Mineral Wool: Install by compressing material to the minimum compression required
- 51 tested system or selected design. Apply firestopping in sufficient thickness, depth and density so as
- 52 to achieve the required fire resistance rating.
- 53 I. Firestopping Devices, Collars, and Pillows: Install in accordance with manufacturer's instructions, to
- 54 achieve specified fire resistance.
- 55

56 **3.4 FIELD QUALITY CONTROL**

- 57 A. Inspect completed installations prior to concealing or enclosing an area containing firestopping
- 58 materials.
- 59 B. Notify authorities having jurisdiction prior to concealing or enclosing an area containing firestopping
- 60 materials.
- 61 C. Repair defective and damaged work as required to ensure compliance with the Contract

1 Documents.

2

3

3.5 **CLEANING AND PROTECTION**

4

A. Upon completion of this work, remove all unused materials, equipment and debris from the site.

5

B. Protect installed work from damage or contamination until Substantial Completion.

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7

END OF SECTION

SECTION 07 90 00

SEALANTS

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PART 1 – GENERAL

- 1.1 SUMMARY OF WORK
- 1.2 QUALITY CONTROL
- 1.3 SUBMITTALS
- 1.4 MATERIAL HANDLING
- 1.5 WARRANTIES

PART 2 – PRODUCTS

- 2.1 MANUFACTURERS
- 2.2 MATERIALS
- 2.3 TYPICAL PERFORMANCE CHARACTERISTICS

PART 3 – EXECUTION

- 3.1 EXAMINATION
- 3.2 SEQUENCING/SCHEDULING
- 3.3 SUBSTRATE PREPARATION
- 3.4 SEALANT APPLICATION – SINGLE STAGE
- 3.5 SEALANT APPLICATION – TWO STAGE

PART 1 - GENERAL

1.1 SUMMARY OF WORK

- A. This Section includes all labor, materials, and equipment necessary to perform the following Work:
 - 1. Removal of all existing caulking/sealant to be replaced.
 - 2. Preparation of all surfaces to receive new sealant work.
 - 3. Application of the joint waterproofing sealant.
 - 4. Clean up.

1.2 QUALITY CONTROL

- A. The Manufacturer of the sealant system shall have a minimum of five (5) years experience in the manufacture of waterproof coatings and sealants.

1.3 SUBMITTALS

- A. Manufacturer's Literature: Submit three (3) complete sets of Manufacturer's literature and technical data for the sealant system.
- B. Contractor's Certificate: Submit copies of "Licensed Applicator's Certificate" issued by the Manufacturer.
- C. A total of three (3) copies of each submittal is required, unless noted otherwise.

1.4 MATERIAL HANDLING

- A. Delivery and Storage of Materials
 - 1. Deliver all materials in their original unopened containers with all markings intact.
 - 2. All materials must be stored in a dry place or otherwise protected from water or extreme humidity.
 - 3. Stack material on pallets at least 4" above the ground and cover with a breathable covering, such as canvas.
 - 4. Store sealants in the manner and temperature range recommended by the Manufacturer.
- B. Handling Materials
 - 1. Do not store or transport materials on the roof in a manner that may exceed the live load capacity of the deck system or the structure. The Architect, during routine inspections, may make recommendations as to loading.
 - 2. Do not transport materials over or store materials on a finished section without prior approval of Architect.

1 **1.5 WARRANTIES**

- 2 A. The sealant Manufacturer and the Contractor shall warrant the performance of the sealant system
3 for a period of five (5) years starting from the date of acceptance by the Architect. Such warranty
4 shall include material as well as labor for application. Damage and/or failure due to acts of God
5 and vandalism, may be excluded from such warranty.
6

7 **PART 2 - PRODUCTS**

8
9 **2.1 MANUFACTURERS**

- 10 A. Provide materials from the following Manufacturers:
11 1. EMSEAL Joint Systems, Ltd.
12 2. SIKA Corp.
13 3. BASF Corp.
14 4. Tremco, Inc.
15 5. Soudal
16 B. Materials shall meet all specified standards.
17 C. All materials shall be new unless noted otherwise.
18 D. New materials shall not contain asbestos.
19

20 **2.2 MATERIALS**

- 21 A. Non-sag Sealants: A hybrid multi-component chemically curing polyurethane joint sealant meeting
22 the requirements of ASTM C920 Type M or S, Grade NS. Sealant material shall be polyurethane
23 elastomer based, meeting or exceeding minimum physical properties as listed in Section 2.3, and
24 capable of producing a seamless waterproof joint seal. Color shall be chosen to most closely
25 match that of the adjacent limestone/masonry, or, non-staining and no-tack, soft type with high
26 elongation properties and shall be so designated on the label by the Manufacturer such as "Sikaflex
27 1a" by SIKA Corp., "Sikaflex - 2c NS" (Class 25) by SIKA Corp., "MasterSeal NP1" (Class 35) by
28 BASF Corp., "DynaTrol II" (Class 50) by Pecora Corp., "Dymonic" (Class 25) by Tremco, Inc. or
29 "SoudaSeal AP" (Class 35) by Soudal. Follow all Manufacturers' previously submitted
30 recommendations for type required at joints. Use non-sag at all joints. All sealants must take latex
31 and oil base paint.
32 B. Expandable Acrylic Foam Sealant such as BACKERSEAL, as manufactured by EMSEAL Joint
33 Systems Ltd, and as indicated on drawings for waterproof wall assembly locations.
34 1. Preformed sealant shall be preformed, pre-compressed, self-expanding, sealant system.
35 Expanding foam to be cellular foam impregnated with a water-based, non-drying, polymer-
36 modified 100% acrylic dispersion.
37 2. Material shall be capable of movement of +25%, -25% (50% total) of nominal material
38 size.
39 3. Expandable Acrylic Foam Sealant to be installed recessed from the substrate faces as
40 shown on the drawings to receive a primary field-applied coating of low-modulus liquid
41 sealant.
42 4. Expandable Acrylic Foam Sealant to be installed at depth sufficient to allow installation of
43 properly sized backer rod and liquid sealant, with appropriate air space, in front of
44 material.
45 5. Consult the architect to determine the sealant system model appropriate to the movement
46 and design requirements at each joint location.
47 6. Fabrication: Expandable Acrylic Foam Sealant must be supplied pre-compressed to less
48 than the joint size, packaged in reels or shrink-wrapped lengths (sticks) with a mounting
49 adhesive on one face.
50 C. Self-leveling (Pourable) Sealant: A hybrid multi-component chemically curing polyurethane joint
51 sealant meeting the requirements of ASTM C920 Type M, Grade P, Class 25 Standards for pitch
52 pan applications. Sealant material shall be polyurethane elastomer based, meeting or exceeding
53 minimum physical properties as listed in Section 2.3, and capable of producing a seamless
54 waterproof joint seal. Color shall be chosen to most closely match that of the adjacent
55 limestone/masonry, or, non-staining and no-tack, soft type with high elongation properties and shall
56 be so designated on the label by the Manufacturer such as "Sikaflex - 2c SL" by SIKA Corp., or
57 approved equal.
58 D. Joint Cleaning Compound: As recommended by the sealant Manufacturer for the joint surfaces to
59 be cleaned.
60 E. Joint Primer/Sealer: As recommended by the sealant Manufacturer for the joint surface to be
61 primed or sealed. All surfaces to which sealant is intended to bond shall be primed.

- 1 F. Bond Breaker Tape: Polyethylene tape or other plastic tape as recommended by the sealant
2 Manufacturer to be applied to sealant-contact surfaces where bond to the substrate or joint filler
3 must be avoided for proper performance of sealant. Provide self-adhesive tape where applicable.
4 G. Sealant Backer Rod: Compressible rod stock polyethylene foam, polyethylene jacketed and
5 polyurethane foam or other flexible, permanent, durable non-absorptive material as recommended
6 for the compatibility with sealant by the sealant Manufacturer; which will control the joint depth for
7 sealant placement, break bond of sealant at bottom of joint, form optimum shape of sealant bead
8 on back side, and provide a highly compressible backer to minimize the possibility of sealant
9 extrusion when the joint is compressed. Backer rod shall be at least larger than the width of the
10 joint. Refer to manufacturer recommendations for backer rod size. Coordinate with Architect.
11

12 **2.3 TYPICAL PERFORMANCE CHARACTERISTICS**

- A. T-S-00227E and 19-GP-24 test method:
- | | |
|--------------------------------|---|
| Adhesion-In-Peel | Mortar 6.3 kg (14 lbs)
Anodized aluminum 8.2 kg (18 lbs)
Granite 7.3 kg (16 lbs)
Minimum requirement 2.26 kg (5 lbs) |
| Durability (Bond and Cohesion) | Passed (on mortar, granite and anodized aluminum at ± 25% movement) |
| Sagging | None up to 50°C (122°F) |
| Hardness | 25 (Shore A) after 7 days at 24°C (75°F), plus 21 days at 70°C (158°F) |
| Percent Solids | 96% after 7 days at 24°C (75°F), plus 21 days at 70°C (158°F) |
| Pot Life | Up to 7 hours at 24°C (75°F) |
| Tack-Free Time | Less than 72 hours at 24°C (75°F) |
| Low Temperature Flexibility | -54°C (-65°F) |
| Staining | None |
- B. Other Test Methods:
- | | |
|--|--|
| Hardness
ASTM D2240 | Average 35 (Shore A) after 5 years |
| Extension and Compression and
Cycle
TRC-ST/450 | 1/2" X 1/2" (12 mm X 12 mm) at 24°C (75°F) will withstand 100
cycles of 40% extension and 25% compression |
| Ultra-Violet Resistance
TRC-ST/448 | No adverse effects after 5 weeks' exposure to 14-25 E-Viton of UV
energy at 70°C (158°F) |
| Accelerated Aging
ASTM E42, Method E | No adhesive or cohesive failure, nor significant changes at 8,000
hours |

13
14 **PART 3 - EXECUTION**

15
16 **3.1 EXAMINATION**

- 17 A. The Contractor shall have the sole responsibility for the accuracy of all measurements and for the
18 estimate of material quantities required and necessary to satisfy the requirements of these
19 Specifications.
20

21 **3.2 SEQUENCING/SCHEDULING**

- 22 A. Remove only as much sealant work as can be restored to a weathertight condition each day and
23 before showers commence.
24 B. All sealant work shall be completed each day on the section being worked on.
25 C. The Contractor shall not proceed with the sealant work until all unsatisfactory conditions
26 detrimental to the proper and timely completion of the sealant work have been corrected.
27

28 **3.3 SUBSTRATE PREPARATION**

- 29 A. Remove all debris from working surfaces. Remove all loose materials.
30 B. Thoroughly clean all surface areas involved to remove dirt, oils, grease, heavy laitance, for release
31 agent, curing compound, and other contaminants, which would interfere with the application and
32 performance of the sealant, in accordance with the Manufacturer's recommendations.
33 C. Remove all foreign projections in the joint by grinding or other suitable methods.
34 D. Prime all surfaces requiring adhesion of sealant.

- 1 E. Install the sealant material under conditions where rain is not anticipated within eight hours of
2 application and substrate surface temperatures are above 40°F and below 110°F.
3
- 4 **3.4 SEALANT APPLICATION**
- 5 A. All material shall be applied in strict accordance with the Manufacturer's recommendations.
6 B. All surfaces to receive the sealant system shall be air-dried a minimum of 24 hours immediately
7 prior to performing Work.
8 C. Where Manufacturer's specifications are more stringent or require more material than specified
9 herein, follow the Manufacturer's specifications.
10 D. Primer
11 1. Apply the concrete primer at the rate of 225 square feet per gallon. Evenly apply two
12 consecutive coats to the joint interface to produce a continuous film.
13 2. Allow the primer to dry for 45 minutes or until tack-free.
14 3. Do not apply more primer than can be coated over within 8 hours.
15 4. Do not apply primer to adjacent surfaces not scheduled for sealant to prevent staining.
16 E. Joint Backing
17 1. Joint backing shall be used to control the depth of joint to the recommended dimension.
18 2. Select a size, to allow for 25% minimum compression of the backing when inserted into
19 the joint.
20 3. Where depth of joint will not permit use of joint backing, a bond-breaker tape must be
21 installed to prevent three-sided adhesion.
22 F. Sealant
23 1. Mix according to Manufacturer's detailed instructions.
24 2. Minimum mixing time: 6 minutes.
25 3. Apply with conventional sealant equipment, filling joint completely.
26 G. Tooling
27 1. Immediately after application, tooling shall be employed to insure firm, full contact with the
28 inner faces of the joint.
29 2. Dry tooling is preferred. Tooling agents can be used.
30 H. Cleaning
31 1. Remove immediately all excess sealant adjacent to the joint with "Xylol" or "Toluol" as
32 work progresses.
33 2. Avoid staining of adjacent areas.
34 3. At the conclusion of the sealant Work, remove all tools, scaffolding, equipment,
35 construction materials and construction debris from the site.
36
37

END OF SECTION

SECTION 08 14 16
FLUSH WOOD DOORS

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- PART 1 – GENERAL
 - 1.1 SECTION INCLUDES
 - 1.2 RELATED REQUIREMENTS
 - 1.3 REFERENCE STANDARDS
 - 1.4 SUBMITTALS
 - 1.5 QUALITY ASSURANCE
 - 1.6 DELIVERY, STORAGE, AND HANDLING
 - 1.7 PROJECT CONDITIONS
 - 1.8 WARRANTY
- PART 2 – PRODUCTS
 - 2.1 MANUFACTURERS
 - 2.2 DOORS
 - 2.3 DOOR AND PANEL CORES
 - 2.4 DOOR FACINGS
 - 2.5 DOOR CONSTRUCTION
 - 2.6 FACTORY FINISHING – WOOD VENEER DOORS
 - 2.7 ACCESSORIES
- PART 3 – EXECUTION
 - 3.1 EXAMINATION
 - 3.2 INSTALLATION
 - 3.3 TOLERANCES

PART 1 – GENERAL

1.1 SECTION INCLUDES

- A. Flush wood doors; flush and flush glazed configuration; non-rated.

1.2 RELATED SECTIONS

- A. Section 08 12 14 - Hollow Metal Doors and Frames
- B. Section 08 71 00 - Door Hardware

1.3 REFERENCE STANDARDS

- A. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass; 2012.
- B. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards; 2014.
- C. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards, U.S. Version 3.0; 2016.
- D. UL (DIR) - Online Certifications Directory; current listings at database.ul.com.

1.4 SUBMITTALS

- A. Product Data: Indicate door core materials and construction; veneer species, type, and characteristics.
- B. Shop Drawings: Show doors and frames, elevations, sizes, types, swings, undercuts, beveling, blocking for hardware, factory machining, factory finishing, cutouts for glazing, and other details.
- C. Specimen warranty.
- D. Samples: Submit two samples of door veneer, 6x6 inch in size illustrating wood grain, stain color, and sheen.
- E. Warranty executed in Owner's name.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section, with not less than three years of documented experience.
- B. Provide product EPD (Environmental Product Declaration)

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Package, deliver and store doors in accordance with specified quality standard.
- B. Accept doors on site in manufacturer's packaging. Inspect for damage.

- 1 C. Protect doors with resilient packaging sealed with heat shrunk plastic. Do not store in damp or wet
2 areas; or in areas where sunlight might bleach veneer. Seal top and bottom edges with tinted
3 sealer if stored more than one week. Break seal on site to permit ventilation.
4

5 **1.7 PROJECT CONDITIONS**

- 6 A. Coordinate the work with door opening construction, door frame and door hardware installation.
7

8 **1.8 WARRANTY**

- 9 A. Interior Doors: Provide manufacturer's warranty for the life of the installation.
10 B. Provide warranty for the following term:
11 1. Interior Doors: Life of installation.
12 C. Include coverage for delamination of veneer, warping beyond specified installation tolerances,
13 defective materials, and telegraphing core construction.
14

15 **PART 2 – PRODUCTS**

16
17 **2.1 MANUFACTURERS**

- 18 A. Wood Veneer Faced Doors:
19 1. Graham Wood Doors: www.grahamdoors.com.
20 2. Eggers Industries: www.eggersindustries.com.
21 3. Algoma Hardwoods, Inc.: www.algomahardwoods.com.
22 4. OregonDoor, www.oregondoor.com
23 5. Substitutions: requested substitutions may be considered.
24

25 **2.2 DOORS**

- 26 A. Doors: Refer to drawings for locations and additional requirements.
27 1. Quality Standard: Custom Grade, Heavy Duty performance, in accordance with
28 AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless noted otherwise.
29 2. Wood Veneer Faced Doors: 5-ply unless otherwise indicated.
30 B. Interior Doors: 1-3/4 inches thick unless otherwise indicated; flush construction.
31 1. Provide solid core doors at each location.
32 2. Wood: Match existing wood species and finish (field verify species and confirm finish with
33 Architect/Owner) unless noted otherwise: factory transparent finish.
34

35 **2.3 DOOR AND PANEL CORES**

- 36 A. Non-Rated Solid Core and 20 Minute Rated Doors: Type particleboard core (PC), plies and faces
37 as indicated.
38

39 **2.4 DOOR FACINGS**

- 40 A. Veneer Facing for Transparent Finish: Match existing library finishes, veneer grade in accordance
41 with quality standard indicated, plain sliced (flat cut), with book match between leaves of veneer,
42 running match of spliced veneer leaves assembled on door or panel face.
43 1. Vertical Edges: Any option allowed by quality standard for grade.
44 2. "Pair Match" each pair of doors; "Set Match" pairs of doors within 3 feet of each other
45 when doors are closed.
46 B. Facing Adhesive: Type I - waterproof.
47

48 **2.5 DOOR CONSTRUCTION**

- 49 A. Fabricate doors in accordance with door quality standard specified.
50 B. Provide solid blocks at lock edge for hardware reinforcement.
51 C. Provide solid blocking for other through-bolted hardware.
52 D. Fit door edge trim to edge of stiles after applying veneer facing.
53 E. Factory machine doors for hardware other than surface-mounted hardware, in accordance with
54 hardware requirements and dimensions.
55 F. Factory fit doors for frame opening dimensions identified on shop drawings, with edge clearances
56 in accordance with specified quality standard.
57 G. Provide edge clearances in accordance with the quality standard specified.

58 **2.6 FACTORY FINISHING – WOOD VENEER DOORS**

- 59 A. Finish work in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), Section 5 -
60 Finishing for grade specified and as follows:
61 1. Transparent:

- 1 a. System - low or no VOC UV cured polyurethane.
- 2 b. Sheen: Match existing door sheen
- 3 B. Seal door top edge with color sealer to match door facing.
- 4

5 **2.7 ACCESSORIES**

- 6 A. Hollow Metal Door Frames: As specified in Section 08 12 14.
- 7 B. Glazed Openings:
 - 8 1. Heat-Strengthened and Fully Tempered Glass: ASTM C1048.
 - 9 2. Tint: Clear.
- 10 C. Glazing Stops: Wood, of same species as door facing, butted corners; prepared for countersink
- 11 style tamper proof screws.
- 12 D. Door Hardware: As specified in Section 08 71 00.
- 13

14 **PART 3 – EXECUTION**

15

16 **3.1 EXAMINATION**

- 17 A. Verify existing conditions before starting work.
- 18 B. Verify that opening sizes and tolerances are acceptable.
- 19 C. Do not install doors in frame openings that are not plumb or are out-of-tolerance for size or
- 20 alignment.
- 21

22 **3.2 INSTALLATION**

- 23 A. Install doors in accordance with manufacturer's instructions and specified quality standard.
- 24 B. Factory-Finished Doors: Do not field cut or trim; if fit or clearance is not correct, replace door.
- 25 C. Trim door height by cutting bottom edges to a maximum of 3/4 inch (19 mm)
- 26 D. Use machine tools to cut or drill for hardware.
- 27 E. Coordinate installation of doors with installation of frames and hardware.
- 28 F. Coordinate installation of glazing.
- 29

30 **3.3 TOLERANCES**

- 31 A. Conform to specified quality standard for fit and clearance tolerances.
- 32 B. Conform to specified quality standard for telegraphing, warp, and squareness.
- 33 C. Adjust doors for smooth and balanced door movement.
- 34 D. Adjust closers for full closure.
- 35

36 **END OF SECTION**

SECTION 08 56 80
ALUMINUM PASS-THRU SLIDING SERVICE WINDOWS

PART 1 – GENERAL

- 1.1 SUMMARY
- 1.2 SUBMITTALS
- 1.3 DELIVERY, STORAGE, AND HANDLING
- 1.4 PROJECT CONDITIONS
- 1.5 WARRANTY

PART 2 – PRODUCTS

- 2.1 ACCEPTABLE MANUFACTURERS
- 2.2 MATERIALS

PART 3 – EXECUTION

- 3.1 INSTALLATION
- 3.2 CLEANING
- 3.3 PROTECTION

PART 1 – GENERAL

1.1 SUMMARY

- A. This section includes:
 - 1. Aluminum, medium-duty commercial sliding service windows as indicated in drawings and in sections.

1.2 SUBMITTALS

- A. Product Data: Submit Manufacturer's technical product data substantiating that products comply.
- B. Shop drawings: Submit for fabrication and installation of windows. Include details, elevations and installation requirement of finish hardware and cleaning.
- C. Certification: Provide printed data in sufficient detail to indicate compliance with the contract documents.

1.3 DELIVERY, STORAGE, AND HANDLING

- A. Deliver windows crated to provide protection during transit and job storage.
- B. Inspect windows upon delivery for damage. Unless minor defects can be made to meet the Architect's specifications and satisfaction, damaged parts should be removed and replaced.
- C. Store windows at building site under cover in dry location.

1.4 PROJECT CONDITIONS

- A. Field measurements: Check opening by accurate field measurement before fabrication. Show recorded measurements on shop drawings. Coordinate fabrication schedule with construction progress to avoid delay of work.

1.5 WARRANTY

- A. All material and workmanship shall be warranted against defects for a period of one (1) year from the original date of purchase.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Basis of design: Design is based aluminum, interior sliding service window manufactured by:
C.R. Laurence Co., Inc. (CRL)
(800) 421-6144
www.crlaurence.com

2.2 MATERIALS

- A. CR Lawrence two-panel manual sliding XX service window. Two sliding service windows that both slide, latch mechanism in closed position with locking.
 - 1. Frames: 4" Aluminum frame modules shall be constructed of 6063-T5 extruded aluminum. Window rolls on top-hung ball bearing rollers. Catch locks included with all interior

- 1 windows. Overall frame sizes are to be in accordance with the contract drawings.
2
3 2. Finish: All aluminum to be clear anodized.
4 3. Glazing: 1/4" thickness clear laminated glass. Glass to be supplied by others.
5 4. Options: keyed lock, full bottom track.
6 5. Model: Daisy (XX)
7 B. CR Lawrence DW series, three-panel manual deluxe sliding OXO service window. One sliding
8 service windows and two fixed. Latch mechanism in closed position with locking. Without screens.
9 6. Frames: 4" Aluminum frame modules shall be constructed of 6063-T5 extruded aluminum.
10 Window rolls on top-hung ball bearing rollers. Catch locks included with all interior
11 windows. Overall frame sizes are to be in accordance with the contract drawings.
12 7. Finish: All aluminum to be clear anodized.
13 8. Glazing: 1/4" thickness clear laminated glass. Glass to be supplied by others.
14 9. Options: keyed lock, stainless steel shelf, full bottom track.
15 10. Model: Barbara (OXO)

16 **PART 3 – EXECUTION**

17
18 **3.1 INSTALLATION**

- 19 A. Install window in accordance with manufacturer's printed instructions and recommendations.
20 Repair damaged units as directed (if approved by the manufacturer and the architect) or replace
21 with new units.
22

23 **3.2 CLEANING**

- 24 A. Handle and store product according to manufacturers' recommendations.
25 B. Clean glazing channels and other framing members receiving glass immediately before glazing
26 remove coatings not firmly bonded to substrates.
27

28 **3.3 PROTECTION**

- 29 A. Institute protective measures required throughout the remainder of the construction period to
30 ensure that all the windows do not incur any damage or deterioration, other than normal
31 weathering, at the time of acceptance.
32

33 **END OF SECTION**

SECTION 08 71 00
DOOR HARDWARE

PART 1 – GENERAL

- 1.1 SUMMARY
- 1.2 QUALITY ASSURANCE
- 1.3 DELIVERY, STORAGE, AND HANDLING
- 1.4 WARRANTY

PART 2 – PRODUCTS

- 2.1 SCHEDULED DOOR HARDWARE
- 2.2 HINGES
- 2.3 MECHANICAL LOCKS AND LATCHES
- 2.4 MANUAL FLUSH BOLTS
- 2.5 EXIT DEVICES AND AUXILIARY ITEMS
- 2.6 LOCK CYLINDERS
- 2.7 KEYING
- 2.8 OPERATING TRIM
- 2.9 ACCESSORIES FOR PAIRS OF DOORS
- 2.10 SURFACE CLOSERS
- 2.11 MECHANICAL STOPS AND HOLDERS
- 2.12 OVERHEAD STOPS AND HOLDERS
- 2.13 DOOR GASKETING
- 2.14 THRESHOLDS
- 2.15 METAL PROTECTIVE TRIM UNITS
- 2.16 AUXILIARY DOOR HARDWARE
- 2.17 FABRICATION
- 2.18 FINISHES

PART 3 – EXECUTION

- 3.1 INSTALLATION
- 3.2 DOOR HARDWARE SCHEDULE

PART 1 – GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Mechanical door hardware for the following:
 - a. Swinging doors.
 - 2. Cylinders for door hardware specified in other Sections.
 - 3. Electrified door hardware.
- B. Product Data: For each type of product indicated.
- C. Shop Drawings: Details of electrified door hardware.
- D. Other Action Submittals:
 - 1. Door Hardware Schedule: Prepared by or under the supervision of Installer, detailing fabrication, and assembly of door hardware, as well as installation procedures and diagrams. Coordinate final door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.
 - a. Format: Use same scheduling sequence and format and use same door numbers as in the Contract Documents.
 - b. Content: Include the following information:
 - i. Identification number, location, hand, fire rating, size, and material of each door and frame.
 - ii. Locations of each door hardware set, cross-referenced to Drawings on floor plans and to door and frame schedule.
 - iii. Complete designations, including name and manufacturer, type, style, function, size, quantity, function, and finish of each door hardware product.
 - iv. Retain first subparagraph below for electrified door hardware.
 - v. Description of electrified door hardware sequences of operation and interfaces with other building control systems.
 - 2. Keying Schedule: Prepared by or under the supervision of Installer, detailing Owner's final

keying instructions for locks.

- E. Schedules shall be kept current with all changes to the project. If changes occur, project hardware schedules shall be maintained to reflect the changes as they are approved. Omitted items shall be deleted from openings, added, and replaced items shall be included. Installation submittals shall be kept current as changes occur. Upon request, a complete updated hardware schedule shall be provided to the contractor. Supplemental submittals that include only the changed openings will not be acceptable.
- F. Prior to final payment, provide a record copy of hardware schedules, including all revisions and updates. All openings shall be listed to reflect final installed configuration only.

1.2 QUALITY ASSURANCE

- A. Supplier Qualifications: The hardware supplier shall be a corporate member in good standing of The Door and Hardware Institute (DHI), employing at least one Architectural Hardware Consultant (AHC) who is currently participating in DHI's continuing education program (CEP).
- B. Source Limitations: Provide electrified door hardware from same manufacturer as mechanical door hardware, unless otherwise indicated.
- C. Items of hardware not definitely specified herein but necessary for completion of the work shall be provided. Such items shall be of type and quality suitable to the service required and comparable to the adjacent hardware. Where size and shape of members is such as to prevent the use of types specified, hardware shall be furnished of suitable types having as nearly as practicable the same operation and quality as the type specified. Sizes shall be adequate for the service required.
- D. Include such nuances as strike type, strike lip length, raised barrel hinges, mounting brackets, blade stop spacers, special templates, fasteners, shims, and coordination between conflicting products. All doors shall be provided with a stop.
- E. Fire-Rated Door Assemblies: Where fire-rated door assemblies are indicated, provide door hardware rated for use in assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C, unless otherwise indicated. Provide positive latching and self-closing, regardless if specified in sets.
- F. Smoke- and Draft-Control Door Assemblies: Where smoke- and draft-control door assemblies are required, provide door hardware that meet requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105.
 - 1. Air Leakage Rate: Maximum air leakage of 0.3 cfm/sq. ft. (3 cu. m per minute/sq. m) at the tested pressure differential of 0.3-inch wg (75 Pa) of water.
- G. Electrified Door Hardware: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction.
- H. Means of Egress Doors: Latches do not require more than 15 lbf (67 N) to release the latch. Locks do not require use of a key, tool, or special knowledge for operation.
- I. Accessibility Requirements: For door hardware on doors in an accessible route, comply with ICC/ANSI A117.1.
 - 1. Provide operating devices that do not require tight grasping, pinching, or twisting of the wrist and that operate with a force of not more than 5 lbf (22.2 N).
 - 2. Comply with the following maximum opening-force requirements:
 - i. Interior, Non-Fire-Rated Hinged Doors: 5 lbf (22.2 N) applied perpendicular to door.
 - ii. Fire Doors: Minimum opening force allowable by authorities having jurisdiction.
- J. Bevel raised thresholds with a slope of not more than 1:2. Provide thresholds not more than 1/2 inch (13 mm) high.
- K. Adjust door closer sweep periods so that, from an open position of 90 degrees, the door will take at least 5 seconds to move to a point 12 degrees from the latch, measured to the leading edge of the door.
- L. Keying Conference: Conduct conference at Project site to comply with requirements in Section 013100 "Project Management and Coordination."

1.3 DELIVERY, STORAGE AND HANDLING

- A. Deliver keys to Owner by registered mail or overnight package service.

1.4 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Manufacturers' standard warranty period.

PART 2 – PRODUCTS

2.1 SCHEDULED DOOR HARDWARE

- A. Provide door hardware for each door as scheduled in Part 3 "Door Hardware Schedule" Article to comply with requirements in this Section.
1. Door Hardware Sets: Provide quantity, item, size, finish or color indicated, and named manufacturers' products.
 2. Sequence of Operation: Provide electrified door hardware function, sequence of operation, and interface with other building control systems indicated.

2.2 HINGES

- A. Hinges: BHMA A156.1. Provide template-produced hinges for hinges installed on hollow-metal doors and hollow-metal frames.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Hager Companies.
 2. IVES Hardware; an Allegion company.
 3. Stanley Commercial Hardware; Div. of The Stanley Works.
- C. Interior Door Hinges: Steel, 0.134 inch minimum thickness except as noted. Provide heavyweight 0.180 inch minimum thickness on doors wider than 3'0".
- D. Exterior Door Hinges: Stainless steel, provide heavyweight 0.180 inch minimum thickness unless noted otherwise.
- E. Hinge Size: 4-1/2" x 4-1/2" unless noted otherwise.
- F. Hinge Options:
1. Nonremovable Pins: Provide set screw in hinge barrel that when tightened into a groove in hinge pin, prevents removal of pin while door is closed; for outswinging exterior doors, outswinging lockable corridor doors and doors with access control components.
 2. Corners: Square.
- G. Provide quantity as follows unless otherwise indicated.
- H. For doors up to 60 inches in height, provide 1 pair hinges; for doors 60 inches to 90 inches in height, provide 1-1/2 pairs of hinges; for doors over 90 inches and up to 120 inches in height, provide 1 additional hinge for each 30 inches of height.

2.3 MECHANICAL LOCKS AND LATCHES

- A. Strikes: Provide manufacturer's standard strike for each lock bolt or latchbolt complying with requirements indicated for applicable lock or latch and with strike box and curved lip extended to protect frame; finished to match lock or latch.
- B. Bored Locks: BHMA A156.2;
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 2. Corbin Russwin.

2.4 MANUAL FLUSH BOLTS

- A. Manual Flush Bolts: BHMA A156.16; minimum 3/4-inch (19-mm) throw; designed for mortising into door edge.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Hager Companies.
 2. IVES Hardware.
 3. Rockwood Manufacturing Company.
 4. Trimco.

2.5 EXIT DEVICES AND AUXILIARY ITEMS

- A. Exit Devices and Auxiliary Items: BHMA A156.3.
- B. Manufacturers: Subject to compliance with requirements, provide products by the following:
1. Corbin Russwin.

2.6 LOCK CYLINDERS

- A. Lock Cylinders: Tumbler type, constructed from brass or bronze, stainless steel, or nickel silver.
- B. Manufacturer: Same manufacturer as for locking devices.

1
2 **2.7 KEYING**

- 3 A. Keying System: Factory registered, complying with guidelines in BHMA A156.28, Appendix A.
4 Incorporate decisions made in keying conference.
5 1. Existing System:
6 a. Master key or grand master key locks to Owner's existing system.
7 B. Keys: Brass.
8 1. Stamping: Permanently inscribe each key with a visual key control number and include
9 the following notation:
10 a. Notation: Information to be furnished by Owner.
11 C. Quantity: In addition to one extra key blank for each lock, provide the following:
12 1. Cylinder Change Keys: Three.
13 2. Master Keys: Five.
14 3. Grand Master Keys: Five.
15

16 **2.8 OPERATING TRIM**

- 17 A. Operating Trim: BHMA A156.6; stainless steel, unless otherwise indicated.
18 B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
19 1. Corbin Russwin.
20 2. Hager Companies.
21 3. IVES Hardware; an Allegion company.
22 4. Rockwood Manufacturing Company.
23 5. Trimco.
24

25 **2.9 ACCESSORIES FOR PAIRS OF DOORS**

- 26 A. Astragals: BHMA A156.22.
27

28 **2.10 SURFACE CLOSERS**

- 29 A. Surface Closers: BHMA A156.4; rack-and-pinion hydraulic type with adjustable sweep and latch
30 speeds controlled by key-operated valves and forged-steel main arm. Comply with manufacturer's
31 written recommendations for size of door closers depending on size of door, exposure to weather,
32 and anticipated frequency of use. Provide factory-sized closers, adjustable to meet field conditions
33 and requirements for opening force.
34 B. Manufacturers: Subject to compliance with requirements, provide products by the following:
35 1. LCN.
36

37 **2.11 MECHANICAL STOPS AND HOLDERS**

- 38 A. Wall- and Floor-Mounted Stops: BHMA A156.16; polished cast brass base metal.
39 B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
40 1. Hager Companies.
41 2. IVES Hardware; an Allegion company.
42 3. Rockwood Manufacturing Company.
43 4. Trimco.
44

45 **2.12 OVERHEAD STOPS AND HOLDERS**

- 46 A. Overhead Stops and Holders: BHMA A156.8.
47 B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
48 1. Corbin Russwin.
49 2. Glynn-Johnson; an Allegion company.
50 3. Rixson Specialty Door Controls.
51 4. SARGENT Manufacturing Company; an ASSA ABLOY Group company.
52

53 **2.13 DOOR GASKETING**

- 54 A. Door Gasketing: BHMA A156.22; air leakage not to exceed 0.50 cfm per foot (0.000774 cu. m/s
55 per m) of crack length for gasketing other than for smoke control, as tested according to
56 ASTM E 283; with resilient or flexible seal strips that are easily replaceable and readily available
57 from stocks maintained by manufacturer.
58 B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
59 1. Hager Companies.
60 2. National Guard Products.
61 3. Reese Enterprises, Inc.

- 1 4. Zero International.
2

3 **2.14 THRESHOLDS**

- 4 A. Thresholds: BHMA A156.21; fabricated to full width of opening indicated.
5 B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
6 1. Hager Companies.
7 2. National Guard Products.
8 3. Reese Enterprises, Inc.
9 4. Zero International.

10
11 **2.15 METAL PROTECTIVE TRIM UNITS**

- 12 A. Metal Protective Trim Units: BHMA A156.6; fabricated from 0.050-inch- (1.3-mm-) thick stainless
13 steel; four sides beveled, with manufacturer's standard machine or self-tapping screw countersunk
14 fasteners.
15 B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
16 1. Hager.
17 2. IVES.
18 3. Rockwood.
19 4. Trimco.

20
21 **2.16 AUXILIARY DOOR HARDWARE**

- 22 A. Auxiliary Hardware: BHMA A156.16.
23 B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
24 1. Hager Companies.
25 2. IVES Hardware; an Allegion company.
26 3. Rockwood Manufacturing Company.
27 4. Trimco.

28
29 **2.17 FABRICATION**

- 30 A. Fasteners: Provide door hardware manufactured to comply with published templates prepared for
31 machine, wood, and sheet metal screws. Provide screws that comply with commercially
32 recognized industry standards for application intended, except aluminum fasteners are not
33 permitted. Provide Phillips flat-head screws with finished heads to match surface of door hardware,
34 unless otherwise indicated.
35 1. Concealed Fasteners: For door hardware units that are exposed when door is closed,
36 except for units already specified with concealed fasteners. Do not use through bolts for
37 installation where bolt head or nut on opposite face is exposed unless it is the only means
38 of securely attaching the door hardware. Where through bolts are used on hollow door
39 and frame construction, provide sleeves for each through bolt.
40 2. Fire-Rated Applications:
41 a. Wood or Machine Screws: For the following:
42 i. Hinges mortised to doors or frames; use threaded-to-the-head wood
43 screws for wood doors and frames.
44 ii. Strike plates to frames.
45 iii. Closers to doors and frames.
46 b. Steel Through Bolts: For the following unless door blocking is provided:
47 i. Surface hinges to doors.
48 ii. Closers to doors and frames.
49 iii. Surface-mounted exit devices.
50 3. Spacers or Sex Bolts: For through bolting of hollow-metal doors.
51 4. Fasteners for Wood Doors: Comply with requirements in DHI WDHS.2, "Recommended
52 Fasteners for Wood Doors."
53 5. Gasketing Fasteners: Provide noncorrosive fasteners for exterior applications and
54 elsewhere as indicated.
55

56 **2.18 FINISHES**

- 57 A. Provide finishes complying with BHMA A156.18 as indicated in door hardware schedule.
58 B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary
59 protective covering before shipping.
60
61

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Wood Doors: Comply with DHI WDHS.5 "Recommended Hardware Reinforcement Locations for Mineral Core Wood Flush Doors."
- B. Mounting Heights: Mount door hardware units at heights to comply with the following unless otherwise indicated or required to comply with governing regulations.
 - 1. Standard Steel Doors and Frames: ANSI/SDI A250.8.
 - 2. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."
- C. Install each door hardware item to comply with manufacturer's written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work. Do not install surface-mounted items until finishes have been completed on substrates involved.
 - 1. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.
 - 2. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.
- D. Boxed Power Supplies: Locate power supplies as indicated or, if not indicated, above accessible ceilings. Verify location with Architect.
 - 1. Configuration: Provide least number of power supplies required to adequately serve doors with electrified door hardware.
- E. Thresholds: Set thresholds for exterior doors and other doors indicated in full bed of sealant complying with requirements specified in Section 079200 "Joint Sealants."
- F. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they will impede traffic.
- G. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.
- H. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.
- I. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed.
- J. Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

3.2 DOOR HARDWARE SCHEDULE

HARDWARE SET 1

3	EA	HINGES	4 1/2 , STD WT	652	HAG
1	EA	OFFICE	CL3500	625	CRN
1	EA	WALL STOP	403	626	ROC
3	EA	SILENCERS	608-RKW	GRAY	ROC

HARDWARE SET 2

3	EA	HINGE	4 1/2 STD WT	652	HAG
1	EA	ELECTRIC STRIKE	5000C	630	HES
1	EA	STOREROOM	CL3500	625	CRN
1	EA	CLOSER	4050 SCUSH	689	LCN
1	EA	WALL STOP	403	626	ROC
1	EA	CARD READER	BY SECURITY CONTRACTOR		

HARDWARE SET 3

3	EA	HINGES	4 1/2 , STD WT	652	HAG
1	EA	PASSAGE	CL3500	625	CRN
3	EA	SILENCERS	608-RKW	GRAY	ROC

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1			<u>HARDWARE SET 4</u>			
2	3	EA	HINGES	4 1/2 , STD WT	652	HAG
3	1	EA	PUSH PLATE	70F 8 x 16	630	ROC
4	1	EA	PULL PLATE	BF11 x 70C 4 x 16	630	ROC
5	1	EA	CLOSER	4050 X 18TJ	689	LCN
6	1	EA	WALL STOP	403	626	ROC
7	1	EA	KICK PLATE	12 x 2 LDW	630	ROC
8						
9						
10						

END OF SECTION

SECTION 08 80 00
GLASS AND GLAZING

PART 1 – GENERAL

- 1.1 SUMMARY
- 1.2 DEFINITIONS
- 1.3 DESIGN REQUIREMENTS
- 1.4 SUBMITTALS
- 1.5 QUALITY ASSURANCE
- 1.6 DELIVERY, STORAGE, AND HANDLING
- 1.7 PROJECT CONDITIONS
- 1.8 WARRANTY

PART 2 – PRODUCTS

- 2.1 PRODUCTS AND MANUFACTURERS
- 2.2 GLASS PRODUCTS
- 2.3 INSULATED GLASS PRODUCTS
- 2.4 MISCELLANEOUS GLAZING MATERIALS

PART 3 – EXECUTION

- 3.1 EXAMINATION
- 3.2 PREPARATION
- 3.3 INSTALLATION
- 3.4 CLEANING

PART 1 – GENERAL

1.1 SUMMARY

- A. This Section includes glazing for the following products and applications, including those specified in other Sections where glazing requirements are specified by reference to this Section:
 - 1. Glass
 - 2. Glazing materials
- B. Related Items
 - 1. Section 07 90 00 - Sealants
 - 2. Section 08 43 13 - Aluminum-Framed Storefronts

1.2 DEFINITIONS

- A. Manufacturer: A firm that produces primary glass or fabricated glass as defined in referenced glazing publications
- B. Interspace: Space between lites of any insulating glass unit that contains dehydrated air or a specified gas.
- C. Deterioration of Coated Glass: Defects developed from normal use that are attributed to the manufacturing process and not to causes other than glass breakage and practices for maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking and other indications of deterioration in metallic coating.
- D. Deterioration of Insulating Glass: Failure of the hermetic seal under normal use that is attributed to the manufacturing process and not to causes other than glass breakage and practices for maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.

1.3 DESIGN REQUIREMENTS

- A. General: Provide glazing systems capable of withstanding normal thermal movements, wind, and impact loads without failure, including loss or glass breakage due to defective manufacture, fabrication, and installation, deterioration of glazing materials and other defects in construction.
- B. Glass Design: Provide glass lites in the thickness and strengths (annealed or heat-treated) to meet or exceed the following criteria based on analysis of Project loads and in-service conditions.
 - 1. Minimum glass thickness of lites composed of annealed or heat-treated glass are selected so the worst-case probability of failure does not exceed the following:
 - a. Eight (8) lites per 1000 for lites set vertically or not over 15 degrees off vertical and under wind action.
 - b. One (1) lite per 1000 for lites set over 15 degrees off vertical and under action of wind or snow.

- c. Specified Design Wind Loads: As determined by manufacturer.
 - d. Specified Design Snow Loads: As determined by manufacturer.
 - e. Minimum Glass Thickness for Exterior Lites: Not less than 6mm
 - f. Thickness of Tinted and Heat-Absorbing glass: Provide the same thickness of each tint color indicated throughout Project.
2. Thermal and Optical Performance Properties: Provide glass with performance properties specified based on manufacturer's published test data, as determined according to procedures indicated below:
- a. Center-of-glass U-values: NFRC 100 methodology using LBL-35298 WINDOW 5.2 computer program, expressed as BTU/sq ft x h x deg F (W/sq. m x K).
 - b. Center-of-glass solar heat gain coefficient: NFRC 200 methodology using LBL-35298 WINDOW 5.2 computer program
 - c. Solar Optical Properties: NFRC 300.

1.4 SUBMITTALS

- A. Submit 12-inch square samples of each type of glass indicated except for clear monolithic glass products, and 12-inch long samples of each color required (except black) for each type of sealant or gasket exposed to view.
- B. Glazing contractor to obtain compatibility and adhesion test reports from sealant manufacturer indicating that glazing materials were tested for compatibility and adhesion with glazing sealants and other glazing materials.
- C. Product Certificates: Obtain Certificate of Compliance for all glass products.

1.5 QUALITY ASSURANCE

- A. Comply with published recommendations of glass product manufacturers and organizations below, except where more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this section or in referenced standards.
 - 1. GANA Publications
 - a. GANA Glazing Manual
 - b. Tempering Division – Engineering Standards Manual
 - 2. LSGA Publications
- B. Safety glass products are to comply with ANSI Z97.1 and testing requirements of 16 CFR Part 1201 for Category II materials.
 - 1. Subject to compliance with requirements, provide safety glass permanently marked with certification label of Safety Glazing Certification Council (SGCC) or other certification agency acceptable to authorities having jurisdiction.
- C. Single Source fabrication responsibility: Fabrication processes, including Low E and reflective coatings, insulating, laminating, silkscreen, and tempering, shall be fabricated by a single Fabricator.
- D. Glass fabricator to have 10 years of experience and meet ANSI / ASQC Q9002 1994.
- E. Mockups: Before glazing, build mockups for each glass product indicated below to verify selections made under sample Submittals and to demonstrate aesthetic effects and qualities of materials and execution. Build mockups using materials indicated for the completed work.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect glazing materials according to manufacturer's written instructions and as needed to prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun or other causes.

1.7 PROJECT CONDITIONS

- B. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by the glazing material manufacturers and when glazing channel substrates are wet from rain, frost condensation, or other causes.
 - 1. Do not install liquid glazing sealants when ambient and substrate temperature conditions are outside limits permitted by glazing sealant manufacturer or below 40 deg F (4.4 deg C).

1.8 WARRANTY

- A. Provide a written 10-year warranty (vertical application). Warranty covers deterioration due to normal conditions of use and not to handling, installing, protecting, and maintaining practices contrary to glass manufacturer's published instructions.

1
2 **PART 2 – PRODUCTS**
3

4 **2.1 PRODUCTS AND MANUFACTURERS**

- 5 A. Products: Subject to compliance with requirements, provide products specified from the following
6 approved Manufacturers:
7 1. OldCastle BuildingEnvelope, Inc.
8 2. Pilkington Glass, Ltd.
9 3. Viracon
10 4. Vitro Architectural Glass
11

12 **2.2 GLASS PRODUCTS**

- 13 A. Float Glass: Provide float glass-based glazing unless noted otherwise.
14 1. Heat-Strengthened and Fully Tempered Types: ASTM C1048, Kind HS and FT.
15 2. Fully Tempered Safety Glass: Complies with ANSI Z97.1 and 16 CFR 1201 criteria.
16 3. Tinted Type: ASTM C1036, Class 2 - Tinted, Quality-Q3, color and performance
17 4. characteristics To match appearance of adjacent existing glass.
18 5. Thicknesses: 1/4"
19

20 **2.3 MISCELLANEOUS GLAZING MATERIALS**

- 21 A. Select glazing sealants, tapes, gaskets and other glazing materials of proven compatibility with
22 other materials they will contact, including glass products, seals of insulating glass units and
23 glazing channel substrates, under conditions of installation and service, as demonstrated by testing
24 and field experience.
25

26 **PART 3 – EXECUTION**
27

28 **3.1 EXAMINATION**

- 29 A. Verify prepared openings for glazing are correctly sized and within tolerance.
30 B. Verify that a functioning weep system is present.
31 C. Verify that the minimum required face and edge clearances are being followed.
32 D. Do not proceed with glazing until unsatisfactory conditions have been corrected.
33

34 **3.2 PREPARATION**

- 35 A. Handle and store product according to manufacturers' recommendations.
36 B. Clean glazing channels and other framing members receiving glass immediately before glazing
37 remove coatings not firmly bonded to substrates.
38
39

40 **3.3 INSTALLATION**

- 41 A. Install products using the recommendations of manufacturers of glass, sealants, gaskets, and other
42 glazing materials except where more stringent requirements are indicated, including those in
43 "GANA Glazing Manual".
44 B. Install glass in prepared glazing channels and other framing members.
45 C. Install setting blocks in rabbets as recommended by referenced glazing standards in GANA Glazing
46 Manual and IGMA Glazing Guidelines.
47 D. Provide bite on glass, minimum edge and face clearances and glazing material tolerances
48 recommended by GANA Glazing Manual.
49 E. Provide weep system as recommended by GANA Glazing Manual.
50 F. Set glass lites in each series with uniform pattern, draw, bow and similar characteristics.
51 G. Distribute the weight of the glass unit along the edge rather than at the corner.
52 H. Comply with manufacturer's and referenced industry recommendations on expansion joints and
53 anchors, accommodating thermal movement, glass openings, use of setting blocks, edge, face and
54 bite clearances, use of glass spacers, edge blocks and installation of weep systems.
55 I. Prevent glass from contact with contaminating substances that result from construction operations,
56 such as weld spatter, fireproofing or plaster.
57 J. Protect glass from edge damage during the handing and installation.
58 K. Protect glass from contact with contaminating substances resulting from construction operations
59 including weld splatter.
60 L. Remove and replace glass that is broken, chipped, cracked or damaged in any way.
61

- 1 **3.4 CLEANING**
2 A. Clean excess sealant or compound from glass and framing members immediately after application,
3 using solvents or cleaners recommended by manufacturers.
4 B. Glass to be cleaned according to:
5 1. GANA Glass Informational Bulletin GANA 01-0300 - Proper Procedures for Cleaning
6 Architectural Glass Products.
7 2. GANA Glass Information Bulletin GANA TD-02-0402 – Heat-Treated Glass Surfaces Are
8 Different.
9 C. Do not use scrapers or other metal tools to clean glass.

10 **END OF SECTION**
11

SECTION 08 90 00
LOUVERS AND VENTS

PART 1 – GENERAL

- 1.1 DESCRIPTION OF WORK
- 1.2 RELATED DOCUMENTS
- 1.3 QUALITY ASSURANCE
- 1.4 SUBMITTALS

PART 2 – PRODUCTS

- 2.1 MATERIALS
- 2.2 FABRICATION, GENERAL
- 2.3 STATIONARY EXTRUDED ALUMINUM WALL LOUVERS
- 2.4 LOUVER SCREENS
- 2.5 METAL FINISHES

PART 3 – EXECUTION

- 3.1 PREPARATION
- 3.2 INSTALLATION

PART 1 – GENERAL

1.1 DESCRIPTION OF WORK

- A. The extent of louvers and vents is shown on the drawing, including indications of sizes and locations.
- B. Types of louvers and vents include the following:
 - 1. Extruded aluminum louvers
 - 2. Interior grilles and diffusers

1.2 RELATED DOCUMENTS

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

1.3 REFERENCE STANDARDS

- A. Performance Requirements
 - 1. Where louvers are indicated to comply with specific performance requirements, provide units whose performance ratings have been determined in compliance with AMCA Standard 500.
 - 2. AMCA Certification: Where indicated, provide louvers with AMCA Certified Ratings Seal evidencing that product complies with above requirement.
- B. Comply with SMACNA "Architectural Sheet Metal Manual" recommendations for fabrication, construction details and installation procedures, except as otherwise indicated.
- C. Field Measurements: Verify size, location and placement of louver units prior to fabrication, wherever possible.
- D. Shop Assembly: Coordinate field measurements and shop drawings with fabrication and shop assembly to minimize field adjustments, splicing, mechanical joints and field assembly of units. Preassemble units in shop to greatest extent possible and disassemble only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's specifications; certified test data, where applicable; and installation instructions for required products, including finishes.
- B. Shop Drawings: Submit shop drawings for fabrication and erection of louver units and accessories. Include plans, elevation and details of sections and connections to adjoining work. Indicate materials, finishes, fasteners, joinery and other information to determine compliance with specified requirements.
- C. Samples: Submit 3 samples, 6" square, of each required aluminum finish. Prepare samples on metal of the same gage and alloy to be used in work. Where normal color and texture variations are to be expected, include 2 or more units in each sample showing the limits of such variations.

1 **PART 2 – PRODUCTS**

2
3 **2.1 MATERIALS**

- 4 A. Aluminum Sheet: ASTM B 209, Alloy 3003 or 5005 with temper as required for forming, or as
5 otherwise recommended by the metal producer to provide the required finish.
6 B. Aluminum Extrusions: ASTM B 221, Alloy 6063-T52.
7 C. Fastenings: Use same material as items fastened, unless otherwise indicated. Fasteners for
8 exterior application may be stainless steel or aluminum. Provide types, gages and lengths to suit
9 unit installation conditions. Use Phillips flat-head machine screws for exposed fasteners, unless
10 otherwise indicated.
11 D. Anchors and Inserts: Use non-ferrous metal anchors and inserts for exterior installations and
12 elsewhere as required for corrosion resistance. Use steel or lead expansion bolt devices for drilled-
13 in-place anchors. Furnish inserts, as required, to be set into concrete or masonry work.
14

15 **2.2 FABRICATION, GENERAL**

- 16 A. Provide louvers and accessories of design, materials, sizes, depth, arrangement, and metal
17 thicknesses indicated, or if not indicated, as required for optimum performance with respect to
18 airflow; water penetration; strength; durability; and uniform appearance, as suited to applications
19 shown and intended use.
20 B. Fabricate frames including integral sills to suit adjacent construction with adequate tolerances for
21 installation including application of sealants in joints between louvers and adjoining work, where
22 applicable.
23 C. Include supports, anchorages, and accessories required to achieve a complete assembly, properly
24 installed.
25 D. Provide vertical mullions of type and at spacings indicated but not further apart than recommended
26 by manufacturer of 72" whichever is less.
27 E. Provide sill extensions and loose sills made of same material as louvers, where indicated, or
28 required for drainage to exterior and to prevent water penetrating to interior.
29 F. Join frame members to one another and to stationary lover blades by welding, except where
30 indicated otherwise or where field bolted connections between frame members are made
31 necessary by size of louvers. Maintain equal blade spacing including separation between blades
32 and frames at head and sill to produce a uniform appearance.
33

34 **2.3 STATIONARY EXTRUDED ALUMINUM WALL LOUVERS**

- 35 A. Horizontal Drainable Blade Louvers. Units designed to collect and drain water to exterior at sill by
36 means of gutters in front edges of blades, and channels in jambs and mullions. Furnish units with
37 extrusions not less than 0.080" thick, of depth, and sizes indicated, complying with the following
38 performance requirements:
39 1. Free area: Not less than 50% for a 48" x 48" size.
40 2. Static Pressure Loss: Not more than 0.15" of water gage at an airflow of 900 fpm free area
41 velocity in the intake direction.
42 3. Water Penetration: Not more than 0.02 oz. per sq ft. of free area at an airflow of 1000 fpm
43 free area velocity.
44 4. AMCA Certification: Furnish units bearing AMCA Certified Ratings Seal.
45 5. Blade Depth: 6 inches.
46 6. Continuous Horizontal Blades: Conceal supporting framework from vision on outside face
47 of louver by placing braces, mullions and brackets on inside face: with close fitting, field-
48 made splice joints in blades designed to permit expansion and contraction without
49 deforming blades or framework.
50

51 **2.4 LOUVER SCREENS**

- 52 A. Provide removable screens for all exterior louvers.
53 B. Fabricate screen frames of the same metal and finish as the louver units to which secured. Provide
54 rewirable frames consisting of formed or extruded metal with a driven spline or insert for securing
55 screen mesh.
56 C. Use bird screens of the following: 1/2" sq. mesh 0.063 anodized aluminum wire.
57 D. Locate screens on inside face of louvers. Secure screens to louver frames with machine screws,
58 spaced at each corner and at 12" o.c. between.
59
60
61

2.5 METAL FINISHES

- A. General:
 - 1. Comply with NAAMM "Metal Finishes Manual" for finish designations and application recommendations, except as otherwise indicated. Apply finishes in factory after products are assembled. Protect finishes on exposed surfaces with protective covering, prior to shipment. Remove all scratches and blemishes from exposed surfaces which will be visible after completing finishing process.
- B. Aluminum Finishes:
 - 1. Type I: Class I, Clear Anodic Finish: AA-M12C22A41 (Mechanical Finish: nonspecular as fabricated; Chemical Finish; etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 607.1.
 - 2. Type II: Shop Painted (Color TBD).
 - a. For louvers scheduled to be painted (see drawings) Unless Otherwise Indicated: Including shop primed steel, galvanized steel, and Aluminum Substrates.
 - b. Two top coats and one coat primer.
 - c. Surface Preparation and Primer Coat per Section 09 91 00

PART 3 – EXECUTION

3.1 PREPARATION

- A. Coordinate setting drawings, diagrams, templates, instructions and directions for the installation of anchorages which are to be embedded in masonry construction. Coordinate the delivery of such items to the project site.

3.2 INSTALLATION

- A. Locate and place louver units plumb, level and in proper alignment with adjacent work.
- B. Use concealed anchorages wherever possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weathertight connection.
- C. Form tight joints with exposed connections accurately fitted together. Provide reveals and openings for sealants and joint fillers, as indicated.
- D. Repair finishes damaged by cutting, welding, soldering and grinding operations required for fitting and jointing. Restore finishes so that there is no evidence of corrective work. Return items which cannot be refinished in the field to the shop, make the required alterations, and refinish the entire unit, or provide new units, at Contractor's option.
- E. Protect non-ferrous metal surfaces from corrosion or galvanic action by application of a heavy coating of bituminous paint on surfaces which will be in contact with concrete, masonry or dissimilar metals.
- F. Provide concealed gaskets, flashings, joint fillers, and insulations, and install as the work progresses to make the installations weathertight.
- G. Refer to Division 7 sections for sealants in connection with installations of louvers.

END OF SECTION

SECTION 09 21 16
GYPSUM BOARD ASSEMBLIES

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PART 1 – GENERAL

- 1.1 SECTION INCLUDES
- 1.2 RELATED REQUIREMENTS
- 1.3 REFERENCE STANDARDS
- 1.4 SUBMITTALS

PART 2 – PRODUCTS

- 2.1 GYPSUM BOARD ASSEMBLIES
- 2.2 METAL FRAMING MATERIALS
- 2.3 BOARD MATERIALS
- 2.4 LOUVER SCREENS
- 2.5 ACCESSORIES

PART 3 – EXECUTION

- 3.1 EXAMINATION
- 3.2 FRAMING INSTALLATION
- 3.3 ACOUSTIC ACCESSORIES INSTALLATION
- 3.4 BOARD INSTALLATION
- 3.5 INSTALLATION OF TRIM AND ACCESSORIES
- 3.6 JOINT TREATMENT
- 3.7 TOLERANCES

PART 1 – GENERAL

1.1 SECTION INCLUDES

- A. Metal stud wall framing.
- B. Metal channel ceiling framing.
- C. Acoustic insulation.
- D. Gypsum sheathing.
- E. Gypsum wallboard.
- F. Joint treatment and accessories.

1.2 RELATED REQUIREMENTS

- A. Section 05 40 00 - Cold-Formed Metal Framing
- B. Section 06 10 00 - Rough Carpentry

1.3 REFERENCE STANDARDS

- A. ASTM C475/C475M - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board; 2015.
- B. ASTM C645 - Standard Specification for Nonstructural Steel Framing Members; 2014.
- C. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2012.
- D. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products; 2015.
- E. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board; 2013.
- F. ASTM C954 - Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs From 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness; 2015.
- G. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs; 2014.
- H. ASTM C1047 - Standard Specification for Accessories For Gypsum Wallboard and Gypsum Veneer Base; 2014a.
- I. ASTM C1177/C1177M - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing; 2013.
- J. ASTM C1396/C1396M - Standard Specification for Gypsum Board; 2014a.
- K. ASTM C1629/C1629M - Standard Classification for Abuse-Resistant Nondecorated Interior Gypsum Panel Products and Fiber-Reinforced Cement Panels; 2015.
- L. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber; 2016.

1 M. GA-216 - Application and Finishing of Gypsum Board; 2013.

2
3 **1.4 SUBMITTALS**

- 4 A. Product Data: Provide data on metal framing, gypsum board, accessories, and joint finishing
5 system.
6 B. Product Data: Provide manufacturer's data on partition head to structure connectors, showing
7 compliance with requirements.
8

9 **PART 2 – PRODUCTS**

10
11 **2.1 GYPSUM BOARD ASSEMBLIES**

- 12 A. Provide completed assemblies complying with ASTM C840 and GA-216.
13

14 **2.2 METAL FRAMING MATERIALS**

- 15 A. Non-Loadbearing Framing System Components: ASTM C645; galvanized sheet steel, of size and
16 properties necessary to comply with ASTM C754 for the spacing indicated, with maximum
17 deflection of wall framing of L/120 at 5 psf.
18 1. Studs: "C" shaped with flat or formed webs with knurled faces.
19 2. Runners: U shaped, sized to match studs.
20 3. Ceiling Channels: C-shaped.
21 4. Furring: Hat-shaped sections, minimum depth of 7/8 inch.
22 B. Loadbearing Studs for Application of Gypsum Board: As specified in Section 05 4000.
23 C. Ceiling Hangers: Type and size as specified in ASTM C754 for spacing required.
24 1. 650 Grid System; Chicago Metallic.
25 D. Partition Head To Structure Connections: Provide track fastened to structure with legs of sufficient
26 length to accommodate deflection, for friction fit of studs cut short and fastened as indicated on
27 drawings.
28

29 **2.3 BOARD MATERIALS**

- 30 A. Gypsum Wallboard (GYP): Paper-faced gypsum panels as defined in ASTM C1396/C1396M; sizes
31 to minimize joints in place; ends square cut.
32 1. Application: Use for vertical surfaces and ceilings, unless otherwise indicated.
33 2. At Assemblies Indicated with Fire-Rating: Use type required by indicated tested assembly;
34 if no tested assembly is indicated, use Type X board, UL or WH listed.
35 3. Thickness:
36 a. Vertical Surfaces: 5/8 inch.
37 b. Ceilings: 5/8 inch.
38 B. Impact Resistant Wallboard:
39 1. Application: Bottom 4 feet of all walls, unless noted otherwise.
40 2. Paper-Faced Type: Gypsum wallboard as defined in ASTM C1396/C1396M.
41 3. Type: Fire resistance rated Type X, UL or WH listed.
42 4. Thickness: 5/8 inch.
43 5. Edges: Tapered.
44 C. Backing Board For Non-Wet Areas: Water-resistant gypsum backing board as defined in ASTM
45 C1396/C1396M; sizes to minimum joints in place; ends square cut.
46 1. Application: Toilet Rooms.
47 2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
48 3. Type: Regular, in locations indicated.
49 4. Regular Board Thickness: 5/8 inch.
50 5. Edges: Tapered.
51

52 **2.4 ACCESSORIES**

- 53 A. Acoustic Insulation: ASTM C665; preformed glass fiber, friction fit type, unfaced. Thickness: 3-1/2
54 inch.
55 B. Beads, Joint Accessories, and Other Trim: ASTM C1047, galvanized steel or rolled zinc, unless
56 noted otherwise.
57 1. Rigid Corner Beads: Low profile, for 90 degree outside corners.
58 2. Expansion Joints: W-flex profile with factory-installed protective tape.
59 C. Joint Materials: ASTM C475/C475M and as recommended by gypsum board manufacturer for
60 project conditions.
61 1. Tape: 2 inch wide, coated glass fiber tape for joints and corners, except as otherwise

- 1 indicated.
2 2. Tape: 2 inch wide, creased paper tape for joints and corners, except as otherwise
3 indicated.
4 3. Powder-type vinyl-based joint compound.
5 4. Chemical hardening type compound.
6 D. Screws for Fastening of Gypsum Panel Products to Cold-Formed Steel Studs Less than 0.033 inch
7 in Thickness and Wood Members: ASTM C1002; self-piercing tapping screws, corrosion resistant.
8 E. Screws for Fastening of Gypsum Panel Products to Steel Members from 0.033 to 0.112 inch in
9 Thickness: ASTM C954; steel drill screws, corrosion resistant.

10
11 **PART 3 – EXECUTION**

12
13 **3.1 EXAMINATION**

- 14 A. Verify that project conditions are appropriate for work of this section to commence.

15
16 **3.2 FRAMING INSTALLATION**

- 17 A. Metal Framing: Install in accordance with ASTM C754 and manufacturer's instructions.
18 B. Suspended Ceilings and Soffits: Space framing and furring members at 16 inches on center.
19 1. Level ceiling system to a tolerance of 1/1200.
20 2. Laterally brace entire suspension system.
21 C. Studs: Space studs at 16 inches on center.
22 1. Extend partition framing to structure and to 6 inches above finished ceiling where noted.
23 2. Partitions Terminating at Structure: Attach extended leg top runner to structure, maintain
24 clearance between top of studs and structure, and brace both flanges of studs with
25 continuous bridging.
26 D. Openings: Reinforce openings as required for weight of doors, using not less than double studs at
27 jambs.
28 E. Blocking: Install wood blocking for support of:
29 1. Wall mounted cabinets.
30 2. Plumbing fixtures.
31 3. Toilet accessories.
32 4. Wall mounted door hardware.

33
34 **3.3 ACOUSTIC ACCESSORIES INSTALLATION**

- 35 A. Acoustic Insulation: Place tightly within spaces, around cut openings, behind and around electrical
36 and mechanical items within partitions, and tight to items passing through partitions.

37
38 **3.4 BOARD INSTALLATION**

- 39 A. Comply with ASTM C840, GA-216, and manufacturer's instructions. Install to minimize butt end
40 joints, especially in highly visible locations.
41 B. Single-Layer Non-Rated: Install gypsum board perpendicular to framing, with ends and edges
42 occurring over firm bearing.
43 C. Exterior Sheathing: Comply with ASTM C1280. Install sheathing vertically, with edges butted tight
44 and ends occurring over firm bearing.
45 1. Seal joints, cut edges, and holes with water-resistant sealant.
46 D. Installation on Metal Framing: Use screws for attachment of gypsum board except face layer of
47 non-rated double-layer assemblies, which may be installed by means of adhesive lamination.

48
49
50 **3.5 INSTALLATION OF TRIM AND ACCESSORIES**

- 51 A. Control Joints: Place control joints consistent with lines of building spaces and as indicated.
52 1. Not more than 30 feet apart on walls and ceilings over 50 feet long.
53 B. Corner Beads: Install at external corners, using longest practical lengths.
54 C. Edge Trim: Install at locations where gypsum board abuts dissimilar materials.

55
56 **3.6 JOINT TREATMENT**

- 57 A. Glass Mat Faced Gypsum Board and Exterior Glass Mat Faced Sheathing: Use fiberglass joint
58 tape, bedded and finished with chemical hardening type joint compound.
59 B. Finish gypsum board in accordance with levels defined in ASTM C840, as follows:
60 1. Level 4: Walls and ceilings to receive paint finish or wall coverings, unless otherwise
61 indicated.

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- 2. Level 2: In utility areas, behind cabinetry, and on backing board to receive tile finish.
 - 3. Level 1: Fire rated wall areas above finished ceilings, whether or not accessible in the completed construction.
 - C. Finish all gypsum board in accordance with ASTM C 840 Level 4.
 - D. Tape, fill, and sand exposed joints, edges, and corners to produce smooth surface ready to receive finishes.
 - 1. Feather coats of joint compound so that camber is maximum 1/32 inch.
 - 2. Taping, filling, and sanding is not required at surfaces behind adhesive applied ceramic tile and fixed cabinetry.

3.7 TOLERANCES

- A. Maximum Variation of Finished Gypsum Board Surface from True Flatness: 1/8 inch in 10 feet in any direction.

END OF SECTION

SECTION 09 30 00

TILING

PART 1 – GENERAL

- 1.1 SECTION INCLUDES
- 1.2 RELATED REQUIREMENTS
- 1.3 REFERENCE STANDARDS
- 1.4 ADMINISTRATIVE REQUIREMENTS
- 1.5 SUBMITTALS
- 1.6 QUALITY ASSURANCE
- 1.7 MOCK-UP

PART 2 – PRODUCTS

- 2.1 TILE
- 2.2 TRIM AND ACCESSORIES
- 2.3 SETTING MATERIALS
- 2.4 GROUTS
- 2.5 ACCESSORY ACCESSORIES

PART 3 – EXECUTION

- 3.1 EXAMINATION
- 3.2 PREPARATION
- 3.3 INSTALLATION - GENERAL
- 3.4 INSTALLATION – FLOORS – MORTAR BED METHODS
- 3.5 INSTALLATION – WALL TILE
- 3.6 CLEANING
- 3.7 PROTECTION

PART 1 – GENERAL

1.1 SECTION INCLUDES

- A. Tile for floor applications.
- B. Tile for wall applications.
- C. Ceramic trim.
- D. Non-ceramic trim.

1.2 RELATED REQUIREMENTS

- A. Section 07 90 00 - Sealants
- B. Section 09 21 16 - Gypsum Board Assemblies

1.3 REFERENCE STANDARDS

- A. ANSI A108/A118/A136.1 - American National Standard Specifications for the Installation of Ceramic Tile (Compendium); 2013.1.
- B. ANSI A108.1a - American National Standard Specifications for Installation of Ceramic Tile in the Wet-Set Method, with Portland Cement Mortar; 2014.
- C. ANSI A108.1b - American National Standard Specifications for Installation of Ceramic Tile on a Cured Portland Cement Mortar Setting Bed with Dry-Set or Latex-Portland Cement Mortar; 1999 (Reaffirmed 2010).
- D. ANSI A108.1c - Specifications for Contractors Option: Installation of Ceramic Tile in the Wet-Set Method with Portland Cement Mortar or Installation of Ceramic Tile on a Cured Portland Cement Mortar Bed with Dry-Set or Latex-Portland Cement; 1999 (Reaffirmed 2010).
- E. ANSI A108.4 - American National Standard Specifications for Installation of Ceramic Tile with Organic Adhesives or Water Cleanable Tile-Setting Epoxy Adhesive; 2009 (Revised).
- F. ANSI A108.5 - American National Standard Specifications for Installation of Ceramic Tile with Dry-Set Portland Cement Mortar or Latex-Portland Cement Mortar; 1999 (Reaffirmed 2010).
- G. ANSI A108.6 - American National Standard Specifications for Installation of Ceramic Tile with Chemical Resistant, Water Cleanable Tile-Setting and -Grouting Epoxy; 1999 (Reaffirmed 2010).
- H. ANSI A108.8 - American National Standard Specifications for Installation of Ceramic Tile with Chemical Resistant Furan Resin Mortar and Grout; 1999 (Reaffirmed 2010).
- I. ANSI A108.9 - American National Standard Specifications for Installation of Ceramic Tile with Modified Epoxy Emulsion Mortar/Grout; 1999 (Reaffirmed 2010).
- J. ANSI A108.10 - American National Standard Specifications for Installation of Grout in Tilework;

- 1 1999 (Reaffirmed 2010).
- 2 K. ANSI A108.11 - American National Standard for Interior Installation of Cementitious Backer Units;
- 3 2010 (Revised).
- 4 L. ANSI A108.12 - American National Standard for Installation of Ceramic Tile with EGP (Exterior
- 5 Glue Plywood) Latex-Portland Cement Mortar; 1999 (Reaffirmed 2010).
- 6 M. ANSI A108.13 - American National Standard for Installation of Load Bearing, Bonded, Waterproof
- 7 Membranes for Thin-Set Ceramic Tile and Dimension Stone; 2005 (Reaffirmed 2010).
- 8 N. ANSI A118.4 - American National Standard Specifications for Modified Dry-Set Cement Mortar;
- 9 2012 (Revised).
- 10 O. ANSI A118.7 - American National Standard Specifications for High Performance Cement Grouts for
- 11 Tile Installation; 2010 (Revised).
- 12 P. ANSI A118.12 - American National Standard Specifications for Crack Isolation Membranes for
- 13 Thin-Set Ceramic Tile and Dimension Stone Installation; 2014.
- 14 Q. ANSI A118.15 - American National Standard Specifications for Improved Modified Dry-Set Cement
- 15 Mortar; 2012.
- 16 R. ANSI A137.1 - American National Standard Specifications for Ceramic Tile; 2013.1.
- 17 S. ASTM C373 - Standard Test Method for Water Absorption, Bulk Density, Apparent Porosity, and
- 18 Apparent Specific Gravity of Fired Whiteware Products, Ceramic Tiles, and Glass Tiles; 2014a.
- 19 T. TCNA (HB) - Handbook for Ceramic, Glass, and Stone Tile Installation; 2016.

20 21 **1.4 ADMINISTRATIVE REQUIREMENTS**

- 22 A. Preinstallation Meeting: Convene a preinstallation meeting one week before starting work of this
- 23 section; require attendance by all affected installers.

24 25 **1.5 SUBMITTALS**

- 26 A. Product Data: Provide manufacturers' data sheets on tile, mortar, grout, and accessories. Include
- 27 instructions for using grouts and adhesives.
 - 28 1. Manufacturer's name, product name and/or catalog number, and general product
 - 29 category.
 - 30 2. MPI product number
 - 31 3. Cross-reference to specified tile systems product is to be used in; include description of
 - 32 each system.
 - 33 4. If proposal of substitutions is allowed under submittal procedures, explanation of
 - 34 substitutions proposed.
- 35 B. Shop Drawings: Indicate tile layout, patterns, color arrangement, perimeter conditions, junctions
- 36 with dissimilar materials, control and expansion joints, thresholds, ceramic accessories, and setting
- 37 details.
- 38 C. Maintenance Data: Include recommended cleaning methods, cleaning materials, and stain removal
- 39 methods.
- 40 D. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 41 1. Extra Tile: 10 square feet of each size, color, and surface finish combination.

42 43 **1.6 QUALITY ASSURANCE**

- 44 A. Maintain one copy of and ANSI A108/A118/A136.1 and TCNA (HB) on site.
- 45 B. Installer Qualifications: Company specializing in performing tile installation, with minimum of five
- 46 years of documented experience.

47 48 **1.7 MOCK-UP**

- 49 A. Construct tile mock-up in one toilet room, incorporating all components specified for the location.
 - 50 1. Minimum size of mock-up shall be 4 ft. x 4 ft.
 - 51 2. Approved mock-up may remain as part of the Work.

52 **PART 2 – PRODUCTS**

53 54 **2.1 TILE**

- 55 A. Manufacturers:
 - 56 1. Crossville: www.crossvilleinc.com.
 - 57 2. Atlas Concorde USA: www.atlasconcordeusa.com.
 - 58 3. Dal-Tile Corporation
 - 59 4. American Marazzi Tile, Inc.
 - 60 5. American Olean Corporation
- 61 B. Porcelain Tile, Type: See finish matrix on drawings.

- 1 1. Moisture Absorption: 0 to 0.5 percent as tested in accordance with ASTM C373.
- 2 2. Size: See finish matrix on drawings.
- 3 3. Thickness: 3/8 inch.
- 4 4. Edges: Square.
- 5 5. Surface Finish: See finish matrix on drawings.
- 6 6. Dynamic Coefficient of Friction: Not less than 0.42.
- 7 7. Colors: See finish matrix on drawings
- 8 a. Trim Units: Matching shapes with sizes indicated.
- 9 b. Products: See finish matrix on drawings

10
11 **2.2 TRIM AND ACCESSORIES**

- 12 A. Ceramic Trim: Matching cove base ceramic shapes in sizes coordinated with field tile.
 - 13 1. Applications:
 - 14 a. Open Edges: Metal trim
 - 15 b. Inside Corners: Jointed.
 - 16 c. Floor to Wall Joints: Cove base.
 - 17 2. Manufacturers: Same as for tile.
- 18 B. Non-Ceramic Floor Transition:
 - 19 1. Applications:
 - 20 a. Floor Transitions of floor tile: Product to be selected as needed from Schluter
 - 21 stainless steel transition range that meets ADA code requirements.
 - 22 2. Manufacturers:
 - 23 a. Schluter-Systems: www.schluter.com.
 - 24 b. Substitutions: See Section 01 60 00 - Product Requirements.
- 25 C. Edge Protection:
 - 26 1. Application: As needed
 - 27 2. Size: height as required to coordinate with tile selection and setting system selected.
 - 28 3. Material: Stainless Steel 304
- 29 D. Floor Transitions:
 - 30 1. Applications: Edges of floor tile only where needed for transitions to different levels
 - 31 2. Size: height as required to coordinate with tile selection and setting system selected.
 - 32 3. Material: Stainless Steel

33
34 **2.3 SETTING MATERIALS**

- 35 A. Use manufacturer's recommended setting material for each tile type and size and existing
- 36 conditions. Depending on the application and conditions present, the use of a liquid-latex fortified
- 37 sanded cement mortar, Polymer modified sanded cement, medium bed, or epoxy mortar is
- 38 recommended.

39
40 **2.4 GROUTS**

- 41 A. Bostik TruColor RapidCure premium, pre-mixed, urethane grout with HXD Polymer Technology.
 - 42 1. Applications: Use this type of grout at all floor tiles & tile wall base. Use where indicated
 - 43 and where no other type of grout is indicated.
 - 44 2. Color(s): As selected by Architect from manufacturer's full line.
 - 45 3. Samples for Verification: Not less than 12 inches square, mounted on rigid panel, with
 - 46 grouted joints, for each type of tile or stone and for each grout color.
 - 47 4. Provide a copy of manufacturer's warranty.
 - 48 5. Execution
 - 49 a. Examination: Examine substrates, areas, and conditions where materials will be
 - 50 installed, with installer present, for compliance with requirements for installation
 - 51 tolerances and other conditions affecting performance of the Work. Proceed with
 - 52 installation only after unsatisfactory conditions have been corrected.
 - 53 b. Preparation: Comply with manufacturer's written instructions, including product
 - 54 technical bulletins and product package instructions.
 - 55 c. Installation: Comply with ANSI A108 and manufacturer's written instructions,
 - 56 including product technical bulletins and product package instructions.
 - 57 d. Protection: Limit foot traffic over installation according to manufacturer's written
 - 58 instructions so they are free of foreign matter.

59
60 **2.5 ACCESSORY MATERIALS**

- 61 A. Concrete Floor Slab Crack Isolation Membrane: Material complying with ANSI A118.12; not

- intended as waterproofing.
1. Thickness: 20 mils, maximum.
 2. Crack Resistance: No failure at 1/16 inch gap, minimum.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Verify that sub-floor surfaces are smooth and flat within the tolerances specified for that type of work and are ready to receive tile.
- B. Verify that sub-floor surfaces are dust-free and free of substances that could impair bonding of setting materials to sub-floor surfaces.
- C. Verify that concrete sub-floor surfaces are ready for tile installation by testing for moisture emission rate and alkalinity; obtain instructions if test results are not within limits recommended by tile manufacturer and setting materials manufacturer.
- D. Verify that required floor-mounted utilities are in correct location.

3.2 PREPARATION

- A. Protect surrounding work from damage.
- B. Vacuum clean surfaces and damp clean.
- C. Seal substrate surface cracks with filler. Level existing substrate surfaces to acceptable flatness tolerances.
- D. Install backer board in accordance with ANSI A108.11 and board manufacturer's instructions. Tape joints and corners, cover with skim coat of setting material to a feather edge.
- E. Prepare substrate surfaces for adhesive installation in accordance with adhesive manufacturer's instructions.

3.3 INSTALLATION - GENERAL

- A. Install tile, thresholds, and stair treads and grout in accordance with applicable requirements of ANSI A108.1a through ANSI A108.13, manufacturer's instructions, and TCNA (HB) recommendations.
- B. Lay tile to pattern indicated. Do not interrupt tile pattern through openings.
- C. Cut and fit tile to penetrations through tile, leaving sealant joint space. Form corners and bases neatly. Align floor joints.
- D. Place tile joints uniform in width, subject to variance in tolerance allowed in tile size. Make grout joints without voids, cracks, excess mortar or excess grout, or too little grout.
- E. Form internal angles square and external angles bullnosed.
- F. Install non-ceramic trim in accordance with manufacturer's instructions.
- G. Sound tile after setting. Replace hollow sounding units.
- H. Keep control and expansion joints free of mortar, grout, and adhesive.
- I. Prior to grouting, allow installation to completely cure; minimum of 48 hours.
- J. Grout tile joints unless otherwise indicated. Use grout indicated in specification unless otherwise indicated.
- K. At changes in plane and tile-to-tile control joints, use tile sealant instead of grout, with either bond breaker tape or backer rod as appropriate to prevent three-sided bonding.

3.4 INSTALLATION – FLOORS – MORTAR BED METHODS

- A. Over interior concrete substrates, install in accordance with TCNA (HB) Method F111, with cleavage membrane, unless otherwise indicated.
- B. Mortar Bed Thickness: 5/8 inch, unless otherwise indicated.

3.5 INSTALLATION – WALL TILE

- A. Over gypsum wallboard on wood or metal studs install in accordance with TCNA (HB) Method W243, thin-set with dry-set or latex-Portland cement bond coat, unless otherwise indicated.

3.6 CLEANING

- A. Clean tile and grout surfaces.

3.7 PROTECTION

- A. Do not permit traffic over finished floor surface for 4 days after installation.

END OF SECTION

SECTION 09 51 00
SUSPENDED ACOUSTICAL CEILINGS

PART 1 – GENERAL

- 1.1 SECTION INCLUDES
- 1.2 REFERENCE STANDARDS
- 1.3 SUBMITTALS
- 1.4 DELIVERY, STORAGE AND HANDLING
- 1.5 PROJECT CONDITIONS
- 1.6 WARRANTY
- 1.7 MAINTENANCE

PART 2 – PRODUCTS

- 2.1 MANUFACTURERS
- 2.2 ACOUSTICAL UNITS
- 2.3 SUSPENSION SYSTEM(S)
- 2.4 ACCESSORIES

PART 3 – EXECUTION

- 3.1 INSTALLATION – SUSPENSION SYSTEM
- 3.2 INSTALLATION – ACOUSTICAL UNITS
- 3.3 TOLERANCES
- 3.4 ADJUSTING AND CLEANING

PART 1 – GENERAL

1.1 SECTION INCLUDES

- A. Suspended metal grid ceiling system.
- B. Acoustical units.

1.2 REFERENCE STANDARDS

- A. ASTM C635/C635M - Standard Specification for the Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings; 2013a.
- B. ASTM E1264 - Standard Classification for Acoustical Ceiling Products; 2014.
- C. NFPA 286 - Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth; 2015.

1.3 SUBMITTALS

- A. Shop Drawings: Indicate grid layout and related dimensioning.
- B. Product Data: Provide data on suspension system components.
- C. Samples: Submit two samples 6 by 6 inch in size illustrating material and finish of acoustical units.
- D. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. Extra Acoustical Units: 40 sq ft of each type and size.

1.4 DELIVERY, STORAGE AND HANDLING

- A. Deliver acoustical ceiling units to project site in original, unopened packages and store them in a fully enclosed space where they will be protected against damage from moisture, direct sunlight, surface contamination, and other causes.
- B. Before installing acoustical ceiling units, permit them to reach room temperature and a stabilized moisture content.
- C. Handle acoustical ceiling units carefully to avoid chipping edges or damaging units in any way.

1.5 PROJECT CONDITIONS

- A. Space enclosure: Standard ceilings: Do not install interior ceilings until space is enclosed and weatherproof; wet work in place is completed and nominally dry; work above ceilings is complete; and ambient conditions of temperature and humidity are continuously maintained at values near those intended for final occupancy. Building areas to receive ceilings shall be free of construction dust and debris.

1.6 WARRANTY

- A. Acoustical Panel: Submit a written warranty executed by the manufacturer, agreeing to repair or

replace panels that fail within the warranty period. Failures include, but are not limited to, the following:

1. Acoustical Panels: sagging and warping
 2. Grid System: Rusting and manufacturer's defects
- B. Warranty Period:
1. Acoustical Panels: Ten (10) years from date of substantial completion
 2. Suspension: Ten (10) years from date of substantial completion
 3. Ceiling System: Fifteen (15) years from date of substantial completion
- C. The Warranty shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and will be in addition to and run concurrent with other warranties made by the Contractor under the requirements of the Contract Documents.

1.7 MAINTENANCE

- A. Extra Materials: Deliver extra materials to Owner. Furnish extra materials described below that match products installed. Packaged with protective covering for storage and identified with appropriate labels.
1. Acoustical Ceiling Unites: Furnish quality of full-size units equal to 5.0 percent of amount installed.
 2. Exposed suspension system components: Furnish quantity of each exposed suspension component equal to 2.0 percent of amount installed.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Acoustic Tiles/Panels:
1. CertainTeed, www.certainteed.com 800-233-8990
 2. Armstrong World Industries, Inc: www.armstrong.com.
 3. USG Acoustical Ceiling Products (ACP): www.acpideas.com.
- B. Substitution Requests: Submitted requests will be considered with Prior Approval: Unless otherwise provided for in the Contract documents. Acceptability of a proposed substitution is contingent upon the Architect's review of the proposal for acceptability and approved products will be set forth by the Addenda. If included in a Bid are substitute products that have not been approved by Addenda, the specified products shall be provided without additional compensation.
1. Submittals that do not provide adequate data for the product evaluation will not be considered. The proposed substitution must meet all requirements of this section, including but not necessarily limited to, the following: Single source materials suppliers (if specified in Section 1.5); Underwriters' Laboratories Classified Acoustical performance; Panel design, size, composition, color, and finish; Suspension system component profiles and sizes; Compliance with the referenced standards.

2.2 ACOUSTICAL UNITS

- A. Acoustical Units - General: ASTM E1264, Class A.
- B. Acoustical Panels: Mineral Fiber, ASTM E1264 Type III, with the following characteristics:
1. Size: 24 by 24 inches.
 2. Thickness: 15/16 inches.
 3. Light Reflectance: 82-83 percent, determined in accordance with ASTM E1264.
 4. NRC: 0.70 or higher, determined in accordance with ASTM E1264.
 5. Edge: Reveal
 6. Surface Color: White
 7. Surface Texture: Fine
 8. Suspension System: Reuse existing unless noted otherwise. Match existing adjacent grids where new grids are necessary.
 9. Products:
 - a. Cashmere CM-454NRCP
 - b. OPTIMA Lay-in and Tegular, 3152
 - c. USG Halcyon Acoustical Panels

2.3 SUSPENSION SYSTEM(S)

- A. Suspension Systems - General: Complying with ASTM C635/C635M; die cut and interlocking components, with stabilizer bars, clips, splices, perimeter moldings, and hold down clips as

- 1 required.
2 B. Exposed Steel Suspension System: Formed steel, commercial quality cold rolled; heavy-duty.
3 1. Profile: Reveal
4 2. Construction: Match existing
5 3. Finish: Match existing
6

7 **2.4 ACCESSORIES**

- 8 A. Support Channels and Hangers: Galvanized steel; size and type to suit application, seismic
9 requirements, and ceiling system flatness requirement specified.
10 B. Perimeter Moldings: Same material and finish as grid.
11 1. At Exposed Grid: Provide L-shaped molding for mounting at same elevation as face of
12 grid.
13 C. 6 inch Suspension Trim Fascia:
14 1. Use where noted
15

16 **PART 3 – EXECUTION**

17
18 **3.1 INSTALLATION – SUSPENSION SYSTEM**

- 19 A. Rigidly secure system, including integral mechanical and electrical components, for maximum
20 deflection of 1:360.
21 B. Locate system on room axis according to reflected plan.
22 C. Install after major above-ceiling work is complete. Coordinate the location of hangers with other
23 work.
24 D. Hang suspension system independent of walls, columns, ducts, pipes and conduit. Where carrying
25 members are spliced, avoid visible displacement of face plane of adjacent members.
26 E. Where ducts or other equipment prevent the regular spacing of hangers, reinforce the nearest
27 affected hangers and related carrying channels to span the extra distance.
28 F. Do not support components on main runners or cross runners if weight causes total dead load to
29 exceed deflection capability.
30 G. Support fixture loads using supplementary hangers located within 6 inches of each corner, or
31 support components independently.
32 H. Do not eccentrically load system or induce rotation of runners.
33 I. Perimeter Molding: Install at intersection of ceiling and vertical surfaces and at junctions with other
34 interruptions.
35 1. Use longest practical lengths.
36 2. Overlap and rivet corners.
37

38 **3.2 INSTALLATION – ACOUSTICAL UNITS**

- 39 A. Install acoustical units in accordance with manufacturer's instructions.
40 B. Fit acoustical units in place, free from damaged edges or other defects detrimental to appearance
41 and function.
42 C. Suspend main beam from overhead construction with hanger wires spaced 4-0 on center along the
43 length of the main runner. Install hanger wires plumb and straight.
44 D. Fit border trim neatly against abutting surfaces.
45 E. Install units after above-ceiling work is complete.
46 F. Install wall moldings at intersection of suspended ceiling and vertical surfaces. Miter corners where
47 wall moldings intersect or install corner caps.
48 G. Install acoustical units level, in uniform plane, and free from twist, warp, and dents.
49 H. Cutting Acoustical Units:
50 1. Make field cut edges of same profile as factory edges.
51 I. Install hold-down clips on each panel to retain panels tight to grid system; comply with fire rating
52 requirements.
53 J. Install hold-down clips on panels within 20 ft of an exterior door.
54 K. Install hold-down clips where indicated on drawings.
55

56 **3.3 TOLERANCES**

- 57 A. Maximum Variation from Flat and Level Surface: 1/8 inch in 10 feet.
58 B. Maximum Variation from Plumb of Grid Members Caused by Eccentric Loads: 2 degrees.

59 **3.4 ADJUSTING AND CLEANING**

- 60 A. Replace damaged and broken panels.
61 B. Clean exposed surfaces of acoustical ceilings, including trim, edge moldings, and suspension

1 members. Comply with manufacturer's instructions for cleaning and touch up of minor finish
2 damage. Remove any ceiling products that cannot be successfully cleaned and or repaired.
3 Replace with attic stock or new product to eliminate evidence of damage.
4 C. Before disposing of ceilings, contact the Armstrong Recycling Center at 877-276-7876 select option
5 #1 then #8 to review with a consultant the condition and location of building where the ceilings will
6 be removed. The consultant will verify the condition of the material and that it meets the Armstrong
7 requirements for recycling. The Armstrong consultant will provide assistance to facilitate the
8 recycling of the ceiling.
9

10 **END OF SECTION**

SECTION 09 65 00
RESILIENT FLOORING

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PART 1 – GENERAL

- 1.1 SECTION INCLUDES
- 1.2 REFERENCE STANDARDS
- 1.3 SUBMITTALS
- 1.4 QUALITY ASSURANCE
- 1.5 DELIVERY, STORAGE AND HANDLING
- 1.6 FIELD CONDITIONS
- 1.7 ATTIC STOCK

PART 2 – PRODUCTS

- 2.1 RUBBER SHEET FLOORING
- 2.2 LUXURY VINYL TILE FLOORING
- 2.3 RESILIENT BASE
- 2.4 ACCESSORIES

PART 3 – EXECUTION

- 3.1 EXAMINATION
- 3.2 PREPARATION
- 3.3 INSTALLATION
- 3.4 TILE FLOORING
- 3.5 RESILIENT BASE
- 3.6 STAIR COVERINGS
- 3.7 CLEANING
- 3.8 PROTECTION

PART 1 – GENERAL

1.1 SECTION INCLUDES

- A. Luxury vinyl tile flooring.
- B. Resilient base.
- C. Installation accessories.

1.2 REFERENCE STANDARDS

- A. American Society for Testing and Materials International
 - a. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring; 2011.
 - b. ASTM F1066 - Standard Specification for Vinyl Composition Floor Tile; 2004 (Reapproved 2014).
 - c. ASTM F1303 - Standard Specification for Sheet Vinyl Floor Covering with Backing; 2004 (Reapproved 2014).
 - d. ASTM F1913 - Standard Specification for Vinyl Sheet Floor Covering Without Backing; 2004 (Reapproved 2014).
 - e. ASTM C518 Standard Test Method for Steady State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
 - f. ASTM D412 Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers – Tension.
 - g. ASTM D2047 Standard Test Method for Static Coefficient of Friction of Polish-Coated Floor Surfaces as Measured by the James Machine.
 - h. ASTM D2240 Standard Test Method for Rubber Property – Durometer Hardness
 - i. ASTM D3389 Standard Test Method for Coated Fabrics Abrasion Resistance (Rotary Platform, Double Head Abrader).
 - j. ASTM D6499 Standard Test Method for The Immunological Measurement of Antigenic Protein in Natural Rubber and its Products.
 - k. ASTM E90 Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
 - l. ASTM E648 Standard Test Method for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source.
 - m. ASTM E662 Standard Test Method for Specific Optical Density of Smoke Generated by Solid Materials.

- n. ASTM E1745 Standard Specification for Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs.
 - o. ASTM E2179 Standard Test Method for Laboratory Measurement of the Effectiveness of Floor Coverings in Reducing Impact Sound Transmission Through Concrete Floors.
 - p. ASTM E2180 Standard Test Method for Determining the Activity of Incorporated Antimicrobial Agent(s) in Polymeric or Hydrophobic Materials.
 - q. ASTM F386 Standard Test Method for Thickness of Resilient Flooring Materials Having Flat Surfaces
 - r. ASTM F925 Standard Test Method for Resistance to Chemicals of Resilient Flooring
 - s. ASTM F970 Standard Test Method for Static Load Limit
 - t. ASTM F1482 Standard Practice for Installation and Preparation of Panel Type Underlayments to Receive Resilient Flooring.
 - u. ASTM F1514 Standard Test Method for Measuring Heat Stability of Resilient Flooring by Color
 - v. ASTM F1859 Standard Specification for Rubber Sheet Floor Covering Without Backing
 - w. ASTM F1861 Standard Specification for Resilient Wall Base
 - x. ASTM F2169 Standard Specification for Resilient Stair Treads
 - y. ASTM F2199 Standard Test Method for Determining Dimensional Stability of Resilient Floor Tile after Exposure to Heat.
 - z. ASTM G21 Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi
- B. International Organization for Standardization
- a. ISO 140 Measurement of sound insulation in buildings and of building elements
- C. National Fire Protection Association
- a. NFPA 253 Test Method for Critical Radiant Flux of Floor Covering Systems Using a Radiant Energy Source
 - b. NFPA 258 Test Method for Specific Density of Smoke Generated by Solid Materials

1.3 SUBMITTALS

- A. See Section 01 33 23 – Submittals
- B. Product Data: Provide data on specified products, describing physical and performance characteristics; including sizes, patterns and colors available; and installation instructions.
- C. Verification Samples: Submit two samples, 12 by 12 inch in size illustrating color and pattern for each resilient flooring product specified.
- D. Certification: Prior to installation of flooring, submit written certification by flooring manufacturer and adhesive manufacturer that condition of sub-floor is acceptable.
- E. Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning, stripping, and re-waxing.
- F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. Extra Flooring Material: 10 square feet of each type and color.
 - 2. Extra Wall Base: 40 linear feet of each type and color.
 - 3. Extra Stair Materials: Quantity equivalent to 5 percent of each type and color.

1.4 QUALITY ASSURANCE

- A. Manufacturer: Provide resilient flooring manufactured by a firm with a minimum of 10 years' experience flooring of type's equivalent to those specified. Manufacturers proposed for use, which are not named in this section, should submit evidence of ability to meet performance requirements specified not less than 10 days prior to bid date.
 - 1. The manufacturer should have the Quality Management System approved by Lloyd Register Quality Assurance to the Quality Management System Standard ISO 9001:2000.
 - 2. Color Matching: Provide resilient flooring products, including wall base, accessories, and subfloor preparation products from one manufacturer to ensure color matching and compatibility.
 - 3. Manufacturer must be capable of providing technical training and technical field service representation.
- B. Installer Qualifications: Installer should be approved for the requirements of each product.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials in labeled packages. Store and handle in strict compliance with manufacturer's recommendations. Protect from damage due to weather, excessive temperatures, and construction operations.

- B. Upon receipt, immediately remove any shrink-wrap and check materials for damage and the correct style, color, quantity and run numbers.
- C. Store all materials off the floor in an acclimatized, weather-tight space.
- D. Maintain temperature in storage area between 55 degrees F and 90 degrees F.
- E. Do not double stack pallets.

1.6 FIELD CONDITIONS

- A. Store materials for not less than 48 hours prior to installation in area of installation at a temperature of 70 degrees F to achieve temperature stability. Thereafter, maintain conditions above 55 degrees F.

1.7 ATTIC STOCK

- A. Deliver to owner 1% attic stock of resilient tile flooring when project is complete. All packaging to contain manufacturer's name and marks, identification number, and related information.
- B. Deliver to owner 5% attic stock resilient sheet flooring and resilient stair accessories when project is complete. All packaging to contain manufacturer's name and marks, identification number, and related information.

PART 2 – PRODUCTS

2.1 LUXURY VINYL TILE FLOORING

- A. LVT – Types FLR-1: High performance, heterogenous luxury vinyl tile Product A007
 - 1. Manufacturers:
 - a. Tarkett, Inc.
 - b. Mannington Commercial
 - c. Interface
 - 2. Product Specifications:
 - a. Class / ASTM F1700
 - b. Wear Layer Thickness: 22 ml or better
 - c. Backing Class: Commercial grade
 - d. Color: Chosen from full range
 - 3. Performance Specifications
 - a. IIC Sound Rating: ASTM E492-09: 64 IIC
 - b. Slip Resistance: (ASTM D2047) >0.55 wet/dry, ADA Compliant
 - c. Static Load Limit: (ASTM F970) 1500 psi
 - d. Flexibility: (ASTM F137) Passes
 - e. Resistance to Heat: (ASTM F1514) Passes
 - f. Resistance to Light: (ASTM F1515) Passes
 - g. Radiant Flux: (ASTM E648) Class I
 - h. Smoke Density: (ASTM E 662) ≤ 450
 - i. Size & Squareness: (ASTM F2055) Passes, +/- 0.016 in. per linear foot
 - j. Thickness: (ASTM F386) Passes
 - k. Dimensional Stability: (ASTM F2199) Passes
 - l. Residual Indentation: (ASTM F1914) Passes
 - m. Resistance to Chemicals: (ASTM F925) Passes
 - 4. Environmental Specifications
 - a. Material Composition: Free of Ortho Phthalates, Added Formaldehyde and Heavy Metal Stabilizers
 - b. Environmental Product Declaration available
 - c. Health Product Declaration available

2.2 RESILIENT BASE

- A. Resilient Base: ASTM F1861, Type TS rubber, vulcanized thermoset; top set Style B, Cove.
 - 1. Height: 4 inch.
 - 2. Thickness: 0.125 inch thick.
 - 3. Finish: Satin.
 - 4. Length: Roll.
 - 5. Color: See finish matrix.
 - 6. Accessories: Pre-molded external corners.

2.3 ACCESSORIES

- 1 A. Primers, Adhesives, and Seam Sealer: Waterproof; types recommended by flooring manufacturer.
- 2 B. Moldings, Transition and Edge Strips: Rubber.
- 3 1. Provide at all new floor material transitions.
- 4 2. Profile to suit thickness of abutting materials.

5
6 **PART 3 – EXECUTION**

7
8 **3.1 EXAMINATION**

- 9 A. Verify that surfaces are flat to tolerances acceptable to flooring manufacturer, free of cracks that
- 10 might telegraph through flooring, clean, dry, and free of curing compounds, surface hardeners, and
- 11 other chemicals that might interfere with bonding of flooring to substrate.
- 12 B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work,
- 13 are dust-free, and are ready to receive resilient base.
- 14 C. Cementitious Sub-floor Surfaces: Verify that substrates are dry enough and ready for resilient
- 15 flooring installation by testing for moisture and pH.
- 16 1. Test in accordance with ASTM F710.
- 17 2. Obtain instructions if test results are not within limits recommended by resilient flooring
- 18 manufacturer and adhesive materials manufacturer.
- 19 D. Verify that required floor-mounted utilities are in correct location.

20
21 **3.2 PREPARATION**

- 22 A. Prepare floor substrates as recommended by flooring and adhesive manufacturers.
- 23 B. Remove sub-floor ridges and bumps. Fill minor low spots, cracks, joints, holes, and other defects
- 24 with sub-floor filler to achieve smooth, flat, hard surface.
- 25 C. Prohibit traffic until filler is fully cured.
- 26 D. Clean substrate.

27
28
29 **3.3 INSTALLATION**

- 30 A. Starting installation constitutes acceptance of sub-floor conditions.
- 31 B. Install in accordance with manufacturer's written instructions.
- 32 C. Spread only enough adhesive to permit installation of materials before initial set.
- 33 D. Fit joints and butt seams tightly.
- 34 E. Set flooring in place, press with heavy roller to attain full adhesion.
- 35 F. Where type of floor finish, pattern, or color are different on opposite sides of door, terminate flooring
- 36 under centerline of door.
- 37 G. Install edge strips at unprotected or exposed edges, where flooring terminates, and where
- 38 indicated.
- 39 1. Resilient Strips: Attach to substrate using adhesive.
- 40 H. Scribe flooring to walls, columns, cabinets, floor outlets, and other appurtenances to produce tight
- 41 joints.

42
43 **3.4 TILE FLOORING**

- 44 A. Mix tile from container to ensure shade variations are consistent when tile is placed, unless
- 45 otherwise indicated in manufacturer's installation instructions.
- 46 B. Lay flooring with joints and seams parallel to building lines to produce symmetrical tile pattern.
- 47 C. Install in pattern indicated on drawings.

48
49 **3.5 RESILIENT BASE**

- 50 A. Fit joints tightly and make vertical. Maintain minimum dimension of 48 inches between joints.
- 51 B. Miter internal corners. At external corners, use premolded units. At exposed ends, use premolded
- 52 units.
- 53 C. Install base on solid backing. Bond tightly to wall and floor surfaces.

54
55 **3.6 STAIR COVERINGS**

- 56 A. Install stair coverings in one piece for full width and depth of tread.
- 57 B. Adhere over entire surface. Fit accurately and securely.

58
59 **3.7 CLEANING**

- 60 A. Remove excess adhesive from floor, base, and wall surfaces without damage.
- 61 B. Clean in accordance with manufacturer's written instructions.

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30 NOVEMBER 2022

1 C. Clean, seal, and wax resilient flooring products in accordance with manufacturer's instructions.
2

3 **3.8 PROTECTION**

4 A. Prohibit traffic on resilient flooring for 48 hours after installation.
5

6

END OF SECTION

SECTION 09 68 13

CARPET

PART 1 – GENERAL

- 1.1 SECTION INCLUDES
- 1.2 RELATED DOCUMENTS
- 1.3 RELATED SECTIONS
- 1.4 QUALITY ASSURANCE AND REGULATORY REQUIREMENTS
- 1.5 SUBMITTALS
- 1.6 WARRANTY
- 1.7 ATTIC STOCK

PART 2 – PRODUCTS

- 2.1 MANUFACTURERS
- 2.2 MODULAR CARPET TILE PERFORMANCE STANDARDS
- 2.3 PRODUCT SPECIFICATION
- 2.4 MINIMUM CONSTRUCTION STANDARDS IN ADDITION TO PRODUCT SPECIFICATIONS
- 2.5 RELATED CARPET MATERIALS

PART 3 – EXECUTION

- 3.1 PRE-INSTALLATION REQUIREMENTS
- 3.2 INSTALLATION
- 3.2 PREPARATION
- 3.3 CLEANING AND PROTECTION
- 3.4 INSPECTION
- 3.5 ENVIRONMENTAL IMPACT AND MEASUREMENTS

PART 1 – GENERAL

1.1 SECTION INCLUDES

- A. Specification standards for modular carpet. It includes construction, submittals, installation, and warranty information regarding modular carpets.

1.2 RELATED DOCUMENTS

- A. Drawings and General Provisions of the Contract (Including General and Supplementary Conditions and Division 1 Sections) apply to the work in this section only.

1.3 RELATED SECTIONS

- A. Other Division 9 sections for floor finishes related to this section but not the work of this section.

1.4 QUALITY ASSURANCE AND REGULATORY REQUIREMENTS

- A. Installation Provider
 - 1. The installation provider must be directly responsible for the quality of the completed floorcovering installation, including both the quality of the materials and labor used in the installation. The installation provider must directly warrant to owner that all products, materials, and services related to the floorcovering installation (including any floorcovering(s), adhesives(s), and/or other products or materials used in the installation) will meet specification set forth herein. The product warranty required herein must be provided directly by the carpet manufacturer.
 - 2. The installation provider must have successful carpet installation experience similar to the work of the Section.

1.5 SUBMITTALS

- A. Submit each of the following in accordance with Section 01 33 00 Submittal Procedures with your bid (unless otherwise noted):
- B. Manufacturer's Data – Two copies of carpet manufacturer's specifications and installation instructions for carpet and related items specified.
- B. All applicable product warranties must be issued by the manufacturer as standard published warranties on all types of carpets within this document. Second source warranties that involve parties other than carpet manufacturer are unacceptable. If the product fails to perform as warranted when installed according to the Interface, Inc. installation instructions and maintained according to Interface, Inc. maintenance instructions, the affected area will be repaired or replaced

- 1 at the expense of the manufacturer.
2 C. Installation provider's proof of insurance, copy of contractor's license and worker's compensation
3 certificate.
4 D. Samples – Standard size carpet samples of each type of carpet, in each specified pattern, color,
5 and construction.
6 E. Maintenance Instructions – Two copies of the manufacturer's carpet maintenance instructions.
7 F. Green house Gas Status of Product – The average quantity of green house gas emissions
8 associated with the life cycle of the product, a description of the green house offsets used to make
9 the product green house gas neutral (climate neutral), and the name for the 3rd party organization
10 certifying such offsets.
11

1.6 WARRANTY

- 12 A. Provide the following written warranties by carpet manufacturer for a period of no less than 15
13 years:
14 1. Lifetime product performance. Will not delaminate along seams or lose more than five
15 percent by weight of fiber during its useful life.
16 2. Lifetime static propensity, meaning built-in protection below 3.0 Kv as tested under
17 AATCC-134.
18 3. Lifetime Colorfastness (Light and Crocking).
19 4. No dimensional instability (i.e., shrinkage, curling, and doming) which adversely affect the
20 ability of the tile to lay flat.
21 5. Merge ability – carpet that is of the same style/color, but from different dye lots and/or
22 manufacturing dates, may be merged and used interchangeably, both at initial installation
23 and at later selective replacement, to create a continuous carpeted surface with no tile
24 appearing out of place.
25 B. Submit manufacturer's NVLAP certified test results to show that carpet meets or exceeds product
26 performance specification criteria for carpet testing requirement under Section 2.1 hereof.
27 C. Installation provider shall warrant all installation services will be free from defects in workmanship
28 for a period of at least one year following their completion, and that in the even of defective
29 services, the installation provider will re-perform the affected services and, as necessary, supply
30 new products of the same or similar grad sufficient to repair or replace products.
31

1.7 ATTIC STOCK

- 32 A. Deliver to owner 5% attic stock when project is complete. All packaging to contain manufacturer's
33 name and marks, identification number, shipping and handling instructions, and related information.
34
35
36

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- 37 A. Acceptable Manufacturer: Tarkett, Mannington Commercial, Interface or equal.
38

2.2 MODULAR CARPET TILE PERFORMANCE STANDARDS:

- 39 A. Pill Test / DOC-FF-1-70 (ASTM D-2589) - Requirement: Pass
40 B. Flooring Radiant Panel / ASTM E-648 - Requirement: Class I (Above .45 w/cm)
41 C. CRI VOC Chamber Test/Indoor Air Quality test (CRI-IAQ) Green Label Plus™ Test.
42 D. Lightfastness: Rating of not less than 5 on International Grey Scale after 40 SFU's when tested in
43 accordance with AATCC Test Method 16E.
44 E. Crockfastness: Minimum stain rating on International Grey Scale of not less than 5 wet or dry when
45 tested in accordance with AATCC Test Method 165.
46 F. Atmospheric Fading: Burned Gas shall not be less than 5 on International Grey Scale after two
47 cycles on each test as per AATCC Test Method 129 Ozone and AATCC Test Method 23.
48 G. Noise Reduction Coefficient (ASTM C 423-02): NRC Rating of 0.30
49 H. Impact Insulation Classification (ASTM E 492-09): IIC Rating of 64
50 I. Slip Resistance (ASTM 1028-96): Complies with ADA Guidelines for level surface
51
52 J. **PRODUCT SPECIFICATION:**
53 K. Product: See finish matrix.
54 L. Color: See finish matrix.
55 M. Backing: 100% synthetic
56 N. Dye Method: Solution Dyed
57 O. Density: normal = 7,128; weight density = 142,574
58
59
60
61

- 1 P. Pattern Repeat: N/A
- 2 Q. Standard Size: 24 x 24 or similar
- 3 R. Warranties: Lifetime Product Performance, Colorfastness to Light & Crocking, Stain Removal,
4 Static Protection, Protection from Edge Ravel and Delamination Failure; Lifetime Dimensional
5 Stability.
- 6 S. Testing Specifications - Flooring Radiant Panel: Class 1 direct glue
- 7 T. Testing Specifications – pill test (ASTM D-2859) - pass
- 8 U. Testing Specifications - Smoke Density: Less than 450 flaming (ASTM E 662)
- 9 V. Testing Specifications - Static Test: Less than 3.0kv (AATCC-134)

11
12 **2.3 RELATED CARPET MATERIALS**

- 13 A. Leveling compound – As recommended by carpet manufacturer. Must be compatible with the
14 carpet adhesive and curing/sealing compound on concrete.
- 15 B. Manufacturer’s recommended adhesive
- 16 C. Installation connectors – Compounded acrylic adhesive, applied to PET polyester backing with PET
17 polyester release liner (clear 3” x 3” polyester squares with small quantity of a pressure sensitive
18 adhesive applied on one side of the polyester film). The squares connect the carpet modules
19 together to form a stable surface over almost any hard surface. The connectors shall contain no
20 liquid components and shall have “zero” calculated VOC’s.
- 21 A. Carpet edge guard – Provide ADA compliant finished floor transitions at all abutting flooring
22 materials.
 - 23 1. non-metallic – Extruded or molded heavy-duty vinyl or rubber carpet edge guard of size
24 and profile indicated, and with minimum two inch wide anchorage flange; colors selected
25 by architect/designer from among standard colors available within the industry.
 - 26 2. Metallic – as indicated on Drawings.
- 27 D. Miscellaneous materials – As recommended by manufacturer of carpet. Other carpeting products to
28 be selected by installation provider to meet project requirements.

29
30 **PART 3 – EXECUTION**

31
32 **3.1 PRE-INSTALLATION REQUIREMENTS**

- 33 A. Examine and verify that sub-floor surfaces are smooth and flat within tolerances specified for that
34 type of work and are ready to receive installation of modules.
- 35 B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work,
36 are dust-free, and are ready to receive installation of modules.
- 37 C. Verify that sub-floor surfaces are dust-free and free of substances that could impair bonding of
38 adhesive materials to sub-floor surfaces.
- 39 D. Verify that concrete sub-floor surfaces are dry enough and ready for flooring installation by testing
40 for moisture emission rate and alkalinity in accordance with ASTM F 710; obtain instructions if test
41 results are not within limits recommended by manufacturer.
- 42 E. Verify that required floor-mounted utilities are in correct location.

43
44 **3.2 INSTALLATION**

- 45 F. General
 - 46 1. Comply with manufacturer’s instructions and recommendations. In the event that a
47 releasable glue method of installation is required, the adhesive must be water-based and
48 allow for removal of carpet tile at any time without damage to carpet or substrate.
49 Adhesive must contain antimicrobial preservative and have “zero” calculated VOC’s.
 - 50 2. Install carpet under open-bottom obstructions and under removable flanges and
51 furnishings, and into alcoves and closets of each space.
 - 52 3. Provide cut outs where required. Conceal cut edges with protective edge guards or
53 overlapping flanges.
 - 54 4. Run carpet under open bottom items such as heating convectors and install tight against
55 walls, columns and cabinets so that the entire floor area is covered with carpet. Cover
56 over all floor type door closures.
 - 57 5. Install edging guard at all openings and doors wherever carpet terminates, unless
58 indicated otherwise.
 - 59 6. Cutting shall be done in accordance with recommendation, using the tools designed for
60 the carpet being installed.
 - 61 7. Use leveling compound where necessary. Any floor filling or leveling shall have a

1 minimum of 4'-0" of feather.

2 8. Expansion joints – Do not bridge building expansion joints with continuous carpeting.

3 G. Installation

4 1. Install carpet according to carpet manufacturer's printed instructions and in accordance
5 with the Carpet and rug Institute's Installation Standard.

6 2. "Chair Pads" shall not be recommended or required within installation instructions.

7
8 **3.3 CLEANING AND PROTECTION**

9 A. On completion of the installation in each area, all dirt, carpet scraps, etc. must be removed from the
10 surface of the carpet.

11 B. Surface Preparation - Dust, dirt, debris and non-compatible adhesive must be removed before the
12 installation begins. Surfaces must be smooth and level with all holes and cracks filled with Portland
13 cement-based patch reinforced with polymers. Adhesive cannot be applied to any substrate where
14 chemical or solvent-based cleaners have been used.

15 C. Construction manager shall protect carpeting against damage during construction.

16 D. At the completion of the work and when directed by the construction manager, vacuum carpet
17 using commercial dual motor vacuum of type recommended by carpet manufacturer. Remove
18 spots and replace carpet where spots cannot be removed. Remove rejected carpeting and replace
19 with new carpeting. Remove any protruding yarns with shears or sharp scissors.

20
21 **3.4 INSPECTION**

22 A. Upon completion of the installation, verify that work is complete, properly installed and acceptable.

23 B. Preliminary Acceptance – Upon completion of the carpet installation of each floor, it shall be
24 inspected by owner, the construction manager, and installation provider.

25
26 **3.5 ENVIRONMENTAL IMPACT AND MEASUREMENTS**

27 A. Follow CRI Installation standards – in addition to the specific floor preparation and installation
28 instructions detailed, the Carpet and Rug Institute's Carpet Installation Standard must be followed.

29
30 **END OF SECTION**

SECTION 09 91 00

PAINTING

PART 1 – GENERAL

- 1.1 SECTION INCLUDES
- 1.2 RELATED REQUIREMENTS
- 1.3 DEFINITIONS
- 1.4 REFERENCE STANDARDS
- 1.5 SUBMITTALS
- 1.6 QUALITY ASSURANCE
- 1.7 MOCK-UP
- 1.8 DELIVERY, STORAGE, AND HANDLING
- 1.9 FIELD CONDITIONS

PART 2 – PRODUCTS

- 2.1 MANUFACTURERS
- 2.2 PAINTS AND FINISHES - GENERAL
- 2.3 PAINT SYSTEMS - INTERIOR
- 2.4 PAINT SYSTEMS – EXTERIOR
- 2.5 ACCESSORY MATERIALS

PART 3 – EXECUTION

- 3.1 EXAMINATION
- 3.2 PREPARATION
- 3.3 APPLICATION
- 3.4 CLEANING
- 3.5 PROTECTION

PART 1 – GENERAL

1.1 SECTION INCLUDES

- A. Surface preparation.
- B. Field application of paints.
- C. Scope: See interior Finish Plans for areas in painting scope: including gypsum board, concrete, concrete masonry units, plaster, shop primed steel, and galvanized steel.
 - 1. Mechanical and Electrical:
 - a. In finished areas, paint insulated and exposed pipes, conduit, boxes, insulated and exposed ducts, hangers, brackets, collars and supports, mechanical equipment, and electrical equipment, unless otherwise indicated.
 - b. In finished areas, paint shop-primed items.
- D. Scope: Finish exterior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated.
 - 1. Non-Architectural structural steel
 - 2. Architectural structural steel
 - 3. Metal trim touch-up
 - 4. Existing storefront framing and trim
- E. Do Not Paint or Finish the Following Items:
 - 1. Items factory-finished unless otherwise indicated; materials and products having factory-applied primers are not considered factory finished.
 - 2. Items indicated to receive other finishes.
 - 3. Items indicated to remain unfinished.
 - 4. Fire rating labels, equipment serial number and capacity labels, bar code labels, and operating parts of equipment.
 - 5. Marble, granite, slate, and other natural stones.
 - 6. Floors, unless specifically indicated.
 - 7. Ceramic and other tiles.
 - 8. Brick, architectural concrete, cast stone, integrally colored plaster and stucco.
 - 9. Glass.
 - 10. Concrete masonry units in utility, mechanical, and electrical spaces.
 - 11. Concealed pipes, ducts, and conduits.

1 **1.2 RELATED REQUIREMENTS**

- 2 A. Section 05 50 00 - Metal Fabrications
3 B. Section 09 91 10 - Electrostatically Applied Coating
4

5 **1.3 DEFINITIONS**

- 6 A. Conform to ASTM D16 for interpretation of terms used in this section.
7

8 **1.4 REFERENCE STANDARDS**

- 9 A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural
10 Coatings; U.S. Environmental Protection Agency; current edition.
11 B. ASTM D16 - Standard Terminology for Paint, Related Coatings, Materials, and Applications; 2016.
12 C. ASTM D4442 - Standard Test Methods for Direct Moisture Content Measurement of Wood and
13 Wood-Based Materials; 2015.
14 D. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual; Current Edition,
15 www.paintinfo.com.
16 E. SSPC-SP 1 - Solvent Cleaning; 2015.
17 F. SSPC-SP 2 - Hand Tool Cleaning; 1982 (Ed. 2004).
18 G. SSPC-SP 6 - Commercial Blast Cleaning; 2007.
19

20 **1.5 SUBMITTALS**

- 21 A. Product Data: Provide complete list of products to be used, with the following information for each:
22 1. Manufacturer's name, product name and/or catalog number, and general product category
23 (e.g. "alkyd enamel").
24 2. MPI product number (e.g. MPI #47).
25 3. Cross-reference to specified paint system(s) product is to be used in; include description
26 of each system.
27 4. If proposal of substitutions is allowed under submittal procedures, explanation of
28 substitutions proposed.
29 B. Maintenance Data: Submit data including finish schedule showing where each product/color/finish
30 was used, product technical data sheets, material safety data sheets (MSDS), care and cleaning
31 instructions, touch-up procedures, repair of painted and finished surfaces, and color samples of
32 each color and finish used.
33 C. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
34 1. Extra Paint and Finish Materials: 1 gallon of each color; from the same product run, store
35 where directed.
36 2. Label each container with color in addition to the manufacturer's label.
37

38 **1.6 QUALITY ASSURANCE**

- 39 A. Applicator Qualifications: Company specializing in performing the type of work specified with
40 minimum 3 years' experience.
41

42 **1.7 MOCK-UP**

- 43 A. Provide panel, 9 feet long by 9 feet wide, illustrating paint color, texture, and finish.
44 B. Locate where directed by Architect.
45 C. Mock-up may remain as part of the work.
46

47 **1.8 DELIVERY, STORAGE AND HANDLING**

- 48 A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.
49 B. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code,
50 coverage, surface preparation, drying time, cleanup requirements, color designation, and
51 instructions for mixing and reducing.
52 C. Paint Materials: Store at minimum ambient temperature of 45 degrees F and a maximum of 90
53 degrees F, in ventilated area, and as required by manufacturer's instructions.
54

55 **1.9 FIELD CONDITIONS**

- 56 A. Do not apply materials when surface and ambient temperatures are outside the temperature
57 ranges required by the paint product manufacturer.
58 B. Follow manufacturer's recommended procedures for producing best results, including testing of
59 substrates, moisture in substrates, and humidity and temperature limitations.
60 C. Provide lighting level of 80 ft candles measured mid-height at substrate surface.
61

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Provide paints and finishes from the same manufacturer to the greatest extent possible.
 - 1. In the event that a single manufacturer cannot provide specified products, minor exceptions will be permitted provided approval by Architect is obtained using the specified procedures for substitutions.
 - 2. Substitution of other products by the same manufacturer is preferred over substitution of products by a different manufacturer.
- B. Paints:
 - 1. Base Manufacturer: Sherwin Williams.
 - 2. Sherwin-Williams Company: www.sherwin-williams.com.
 - 3. Tnemec Inc.: www.tnemec.com
- C. Primer Sealers: Same manufacturer as top coats.
- D. Substitution Requests: Submitted requests will not be considered without consent of Architect.

2.2 PAINTS AND FINISHES - GENERAL

- A. Paints and Finishes: Ready mixed, unless intended to be a field-catalyzed paint.
 - 1. Provide paints and finishes of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
 - 2. Supply each paint material in quantity required to complete entire project's work from a single production run.
 - 3. Do not reduce, thin, or dilute paint or finishes or add materials unless such procedure is specifically described in manufacturer's product instructions.
- B. Volatile Organic Compound (VOC) Content:
 - 1. Provide paints and finishes that comply with the most stringent requirements specified in the following:
 - a. 40 CFR 59, Subpart D--National Volatile Organic Compound Emission Standards for Architectural Coatings.
 - 2. Determination of VOC Content: Testing and calculation in accordance with 40 CFR 59, Subpart D (EPA Method 24), exclusive of colorants added to a tint base and water added at project site; or other method acceptable to authorities having jurisdiction.
- C. Flammability: Comply with applicable code for surface burning characteristics.
- D. Sheens: Provide the sheens specified; where sheen is not specified, sheen will be selected later by Architect from the manufacturer's full line.
- E. Colors: As indicated on drawings.
 - 1. Allow for minimum of three colors for each system, unless otherwise indicated, without additional cost to Owner.
 - 2. Extend colors to surface edges; colors may change at any edge as directed by Architect.
 - 3. In finished areas, finish pipes, ducts, conduit, and equipment the same color as the wall/ceiling they are mounted on/under.

2.3 PAINT SYSTEMS - INTERIOR

- A. Paint I-OP - Interior Surfaces – See interior Finish Plans for areas in painting scope: including gypsum board, concrete, concrete masonry units, plaster, shop primed steel, and galvanized steel.
 - 1. Two top coats and one coat primer.
 - 2. Top Coat(s): Interior Latex; MPI #43, 44, 52, 53, 54, or 114.
 - a. Products:
 - i. Sherwin-Williams ProMar 200 Zero VOC Interior Latex.
 - ii. Substitution Requests: Submitted requests will not be considered without consent of Architect
 - 3. Top Coat Sheen: Match existing sheen in adjacent areas.
 - a. (See Finish Matrix on Drawings)
 - 4. Primer: As recommended by top coat manufacturer for specific substrate.
- B. Paint I-OP-MD-DT - Medium Duty Door/Trim: For surfaces subject to frequent contact by occupants, including metals and wood:
 - 1. Two top coats and one coat primer.
 - 2. Top Coat(s): Interior Epoxy-Modified Latex; MPI #115 or 215.
 - a. Products:
 - i. Sherwin-Williams Waterbased Catalyzed Epoxy, Semi-Gloss.

- 1 3. Top Coat Sheen:
2 a. Match existing sheen at existing door frames in building.
3 4. Primer: As recommended by top coat manufacturer for specific substrate.
4 C. Paint I-OP-DF - Dry Fall: Metals; exposed structure and overhead-mounted services in utilitarian
5 spaces, including shop primed steel deck, structural steel, metal fabrications, galvanized ducts,
6 galvanized conduit, and galvanized piping.
7 1. One top coat and one coat primer.
8 2. Top Coat: Latex Dry Fall; MPI #118, 155, or 226.
9 a. Products:
10 i. Sherwin-Williams Waterborne Acrylic Dryfall.
11 3. Top Coat Sheen:
12 a. Match existing sheen.
13 4. Primer: As recommended by top coat manufacturer for specific substrate.
14
15

2.4 ACCESSORY MATERIALS

- 17 A. Accessory Materials: Provide primers, sealers, cleaning agents, cleaning cloths, sanding materials,
18 and clean-up materials as required for final completion of painted surfaces.
19 B. Patching Material: Latex filler.
20 C. Fastener Head Cover Material: Latex filler.
21

PART 3 – EXECUTION

3.1 EXAMINATION

- 25 A. Verify that surfaces are ready to receive work as instructed by the product manufacturer.
26 B. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition
27 that may potentially affect proper application.
28 C. Test shop-applied primer for compatibility with subsequent cover materials.
29 D. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes
30 unless moisture content of surfaces are below the following maximums:
31 1. Gypsum Wallboard: 12 percent.
32 2. Plaster and Stucco: 12 percent.
33 3. Masonry, Concrete, and Concrete Masonry Units : 12 percent.
34 4. Interior Wood: 15 percent, measured in accordance with ASTM D4442.
35

3.2 PREPARATION

- 37 A. Clean surfaces thoroughly and correct defects prior to application.
38 B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best
39 result for the substrate under the project conditions.
40 C. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim,
41 escutcheons, and fittings, prior to preparing surfaces or finishing.
42 D. Seal surfaces that might cause bleed through or staining of topcoat.
43 E. Masonry:
44 1. Remove efflorescence and chalk. Do not coat surfaces if moisture content or alkalinity of
45 surfaces or if alkalinity of mortar joints exceed that permitted in manufacturer's written
46 instructions. Allow to dry.
47 2. Prepare surface as recommended by top coat manufacturer.
48 F. Gypsum Board: Fill minor defects with filler compound. Spot prime defects after repair.
49 G. Plaster: Fill hairline cracks, small holes, and imperfections with latex patching plaster. Make smooth
50 and flush with adjacent surfaces. Wash and neutralize high alkali surfaces.
51 H. Insulated Coverings: Remove dirt, grease, and oil from canvas and cotton.
52 I. Galvanized Surfaces:
53 1. Prepare surface according to SSPC-SP 2.
54 J. Ferrous Metal:
55 1. Solvent clean according to SSPC-SP 1.
56 2. Shop-Primed Surfaces: Sand and scrape to remove loose primer and rust. Feather edges
57 to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel
58 surfaces. Re-prime entire shop-primed item.
59 3. Remove rust, loose mill scale, and other foreign substances using using methods
60 recommended in writing by paint manufacturer and blast cleaning according to SSPC-SP
61 6 "Commercial Blast Cleaning". Protect from corrosion until coated.

- 1 K. Wood Surfaces to Receive Opaque Finish: Wipe off dust and grit prior to priming. Seal knots, pitch
- 2 streaks, and sappy sections with sealer. Fill nail holes and cracks after primer has dried; sand
- 3 between coats. Back prime concealed surfaces before installation.
- 4 L. Metal Doors to be Painted: Prime metal door top and bottom edge surfaces.

5
6 **3.3 APPLICATION**

- 7 A. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical
- 8 components and paint separately.
- 9 B. Apply products in accordance with manufacturer's written instructions and recommendations in
- 10 "MPI Architectural Painting Specification Manual".
- 11 C. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is
- 12 applied.
- 13 D. Apply each coat to uniform appearance in thicknesses specified by manufacturer.
- 14 E. Dark Colors and Deep Clear Colors: Regardless of number of coats specified, apply as many coats
- 15 as necessary for complete hide.
- 16 F. Sand wood and metal surfaces lightly between coats to achieve required finish.
- 17 G. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to
- 18 applying next coat.
- 19 H. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior
- 20 to finishing.

21
22 **3.4 CLEANING**

- 23 A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and
- 24 remove daily from site.

25
26 **3.5 PROTECTION**

- 27 A. Touch-up damaged finishes after Substantial Completion.

28
29 **END OF SECTION**

SECTION 10 14 23

PANEL SIGNAGE

PART 1 – GENERAL

- 1.1 SUMMARY
- 1.2 REFERENCES
- 1.3 SUBMITTALS
- 1.4 QUALITY ASSURANCE

PART 2 – PRODUCTS

- 2.1 MANUFACTURER
- 2.2 DESCRIPTION
- 2.3 MATERIALS

PART 3 – EXECUTION

- 3.1 EXAMINATION
- 3.2 INSTALLATION
- 3.3 CLEANING AND PROTECTION

PART 1 – GENERAL

1.1 SUMMARY

- A. Panel signage manufactured from material specified and utilized as either changeable or semi-permanent room identification and information signage.
- B. Panel Signage:
 - 1. Acrylic Panel
- C. Related Sections include:
 - 1. Section 10 14 67 Tactile Signage.

1.2 REFERENCES

- A. (ASTM) American Society for Testing & Materials; D638 Standard Test Method for Tensile Properties of Plastics, D790 Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials, D256 Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics, D785 Standard Test Method for Rockwell Hardness of Plastics and Electrical Insulating Materials.
- B. (UL) Underwriters Laboratories, Inc.; UL94 Tests for Flammability of Plastic Materials.
- C. (ARTC) Aircraft Research & Testing Committee; Modification of MIL-P-6997, Plastic; Working and Installation of Transparent Sheet, Craze Resistance.
- D. Department of Justice, 2010 ADA Standards for Accessible Design.
- E. ICC/ANSI A117.1-2009: Accessible and Usable Buildings and Facilities.

1.3 SUBMITTALS

- A. Product Data: Provide manufacturer's descriptive product literature for sign types specified, including components and accessories.
- B. Shop Drawings: Provide manufacturer's detail of construction relative to materials, dimensions of individual components, profiles and finishes:
 - 1. Show individual sign types, graphics, tpestyles, colors, sign dimensions and profiles. Show mounting methods, locations, accessories and installation guidelines.
 - 2. Provide message list for each sign required, including large-scale details of wording and lettering layout where signs contain more than one word or more than one number.
- C. Samples: Provide a single unit sample of each sign type to verify colors, dimensions, profiles, finishes, method of installation and quality.

1.4 QUALITY ASSURANCE

- A. Use a single manufacturing source to produce panel signage that is finished and ready for installation.
- B. Manufacturer Qualification: Use panel sign manufacturer with at least ten years experience in the fabrication of architectural and ADA signs.
- C. Installer Qualifications: Use a sign installation contractor that is specialized and experienced in work similar to the sign installation requirements for this project.

PART 2 – PRODUCTS

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2.1 MANUFACTURER

- A. Basis of Design Product: Existing Signage in the West Square Office Building.

2.2 DESCRIPTION

- A. Produce tactile signage to meet the following regulatory requirements:
 - 1. 2010 Standards for Title II and III Facilities, 2004 ADAAG.
 - 2. ICC/ANSI A117.1-2009.
 - 3. State building code provisions as adopted by regulatory authorities having jurisdiction.

2.3 MATERIALS

- A. General: Produce panel signage that complies with requirements indicated for material, thickness, colors, design, shapes, sizes and details of construction.
 - 1. Produce tactile signs utilizing material which complies with applicable provisions of ASTM D638, D790, D256, and D785 for tensile strength, flexural strength, impact strength and rockwell hardness, UL94 for flammability and ARTC guidelines for craze resistance.
 - 2. Produce panel signs to remain flat under installed conditions and within a tolerance of plus or minus 0.015 inches when measured diagonally.
- B. Acrylic panel signage is produced from the following list of applicable materials:
 - 1. Fabricate acrylic panel using clear acrylic with a non-glare surface texture and an overall thickness of 0.250 inches. Subsurface paint acrylic panel with an acrylic polyurethane paint finish.
 - a. Apply text, pictograms and symbols to acrylic panel using Subsurface Applied Adhesive Backed Vinyl or Screenprinting.
 - b. Install acrylic panel to wall using 3/4" inch diameter, satin clear stainless steel standoffs.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Examine wall surfaces, substrate areas and conditions with the Installer present, for compliance with the requirements for installation guidelines, tolerances and other conditions affecting the performance of work.
- B. Verify that items including anchor inserts and electrical power provided under other sections of work are sized and located to accommodate sign installation.
- C. Examine supporting members to ensure that surfaces are at elevations indicated or required to comply with the authorities having jurisdiction and are free from dirt and other deleterious matter.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Locate signs and accessories where indicated, using mounting methods of types described and in compliance with manufacturer's written instructions.
 - 1. Install signs level, plumb and at heights indicated, with sign surfaces free from distortion and other defects in appearance.
 - 2. Install signs in accordance with ADAAG and ICC/ANSI A117.1 – 2009, section 703.4, unless otherwise specified.
- B. Wall Mounted Panel Signs: Attach Panel Signage to wall surfaces using the methods indicated.
 - 1. Fasteners: Use Stainless Steel Standoff 3/4" inch in diameter with satin finish.

3.3 CLEANING AND PROTECTION

- A. After installation, clean soiled sign surfaces according to manufacturers' written instructions. Protect signs from damage until acceptance by Owner.

END OF SECTION

SECTION 10 14 67
TACTILE SIGNAGE

PART 1 – GENERAL

- 1.1 SUMMARY
- 1.2 REFERENCES
- 1.3 SUBMITTALS
- 1.4 QUALITY ASSURANCE

PART 2 – PRODUCTS

- 2.1 MANUFACTURER
- 2.2 DESCRIPTION
- 2.3 MATERIALS

PART 3 – EXECUTION

- 3.1 EXAMINATION
- 3.2 INSTALLATION
- 3.3 CLEANING AND PROTECTION

PART 1 – GENERAL

1.1 SUMMARY

- A. Tactile signage with raised text and Grade II Braille in accordance with the (ADAAG) Americans with Disabilities Act Accessibility Guidelines.
- B. Tactile Signage
 - 1. Injection Molded Plastic Braille
 - a. interior and exterior rated

1.2 REFERENCES

- A. Department of Justice, 2010 ADA Standards for Accessible Design.
 - 1. 2010 Standards for State and local governments, Title II regulations at 28 CFR 35.151 and the 2004 ADAAG at 36 CFR part 1191, appendices B and D.
 - 2. 2010 Standards for public accommodations and commercial facilities, Title III regulations at 28 CFR part 36, subpart D and the 2004 ADAAG at 36 CFR part 1191, appendices B and D.
- B. ICC/ANSI A117.1-2009: Accessible and Usable Buildings and Facilities.

1.3 SUBMITTALS

- A. Product Data: Provide manufacturer's descriptive product literature for sign types specified, including components and accessories.
- B. Shop Drawings: Provide manufacturer's detail of construction relative to materials, dimensions of individual components, profiles and finishes:
 - 1. Show individual sign types, graphics, typestyles, colors, sign dimensions and profiles. Show mounting methods, locations, accessories and installation guidelines.
 - 2. Provide message list for each sign required, including large-scale details of wording and lettering layout where signs contain more than one word or more than one number.
- C. Samples: Provide a single unit sample of each sign type to verify colors, dimensions, profiles, finishes, method of installation and quality.
- D. Sustainable Design Data: Provide material, process and disposition of waste data relating to the material used to manufacture tactile signage.
 - 1. Recycled Content: Indicate the percentage of post-industrial recyclable content in material used during the manufacturing of tactile signage.
 - 2. Low Emitting Materials: Indicate the (VOC) Volatile Organic Compound limits for paint finishes used during the manufacturing of tactile signage.
 - 3. Waste: Indicate the percentage of biodegradable waste and method of disposal of scrap material generated during the manufacturing of tactile signage.

1.4 QUALITY ASSURANCE

- A. Use a single manufacturing source to produce tactile signage that is finished and ready for installation.
- B. Manufacturer Qualification: Use a tactile sign manufacturer with at least ten years experience in the fabrication of architectural and ADA signs.

- 1 C. Installer Qualifications: Use a sign installation contractor that is specialized and experienced in
2 work similar to the sign installation requirements for this project.
3

4 **PART 2 – PRODUCTS**

5
6 **2.1 MANUFACTURER**

- 7 A. Basis of Design Product: Intersign Injection Molded Plastic Braille based tactile signage.
8

9 **2.2 DESCRIPTION**

- 10 A. Produce tactile signage to meet the following regulatory requirements:
11 1. 2010 Standards for Title II and III Facilities, 2004 ADAAG.
12 2. ICC/ANSI A117.1-2009.
13 3. State building code provisions as adopted by regulatory authorities having jurisdiction.
14

15 **2.3 MATERIALS**

- 16 A. General: Produce tactile signage that complies with requirements indicated for material, thickness,
17 colors, design, shapes, sizes and details of construction.
18 1. Produce tactile signs to comply with applicable provisions of the ADAAG and ICC/ANSI
19 A117.1 - 2009 standards including 0.031 inch raised pictograms, text and Grade II Braille
20 characters.
21 2. Produce panel signs to remain flat under installed conditions and within a tolerance of plus
22 or minus 0.015 inches when measured diagonally.
23 B. Sign Type: Produce tactile signage using one or more of the following materials and fabrication
24 processes.
25 1. Injection Molded Plastic Braille tactile signs are manufacturer's standard product as
26 follows:
27 a. Select tactile sign message from manufacturer's list of standard injection molded
28 colorized (HIPS) High Impact Polystyrene tactile signs, with an 8.00 inch x 8.00
29 inch tactile sign base, an overall thickness of 0.125 inches with 0.310 inch radius
30 corners and an eggshell finish of less than 15 degrees gloss. Select sign base
31 from manufacturer's list of standard colors. Text is separated from pictograms
32 and symbols with a 0.095 inch graphic line. Text, pictograms, symbols and
33 graphic line are raised and hotstamped white.
34 2. Specify text as Centered with corresponding Grade II Braille.
35 3. Produce tactile signs to conform to ADA Accessibility Guidelines and ICC/ANSI A117.1 –
36 2009, section 703.3 and 703.5, unless otherwise specified.
37

38 **PART 3 – EXECUTION**

39
40 **3.1 EXAMINATION**

- 41 A. Examine wall surfaces, substrate areas and conditions with the Installer present, for compliance
42 with the requirements for installation guidelines, tolerances and other conditions affecting the
43 performance of work.
44 B. Verify that items including anchor inserts and electrical power provided under other sections of
45 work are sized and located to accommodate sign installation.
46 C. Examine supporting members to ensure that surfaces are at elevations indicated or required to
47 comply with the authorities having jurisdiction and are free from dirt and other deleterious matter.
48 D. Proceed with installation only after unsatisfactory conditions have been corrected.
49

50 **3.2 INSTALLATION**

- 51 A. General: Locate signs and accessories where indicated, using mounting methods of types
52 described and in compliance with manufacturer's written instructions.
53 1. Install signs level, plumb and at heights indicated, with sign surfaces free from distortion
54 and other defects in appearance.
55 2. Install signs in accordance with ADAAG and ICC/ANSI A117.1 – 2009, section 703.4,
56 unless otherwise specified.
57 B. Wall Mounted Tactile Signs: Attach Tactile Signage to wall surfaces using the methods indicated.
58 1. Foam-Tape: Use double-sided foam tape to mount signs to smooth, non-porous surfaces.
59 2. Silicone Adhesive: Use liquid silicone to attach signs to irregular, porous or vinyl covered
60 surfaces. Use doubled-sided foam tape to hold sign in place while adhesive cures.

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3.3 CLEANING AND PROTECTION

- A. After installation, clean soiled sign surfaces according to manufacturers' written instructions. Protect signs from damage until acceptance by Owner.

END OF SECTION

SECTION 10 21 00
TOILET COMPARTMENTS

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PART 1 – GENERAL

- 1.1 SECTION INCLUDES
- 1.2 RELATED SECTIONS
- 1.3 REFERENCES
- 1.4 SUBMITTALS
- 1.5 DELIVERY, STORAGE, AND HANDLING
- 1.6 PROJECT CONDITIONS
- 1.7 WARRANTY
- 1.8 COORDINATION

PART 2 – PRODUCTS

- 2.1 MANUFACTURERS
- 2.2 COMPARTMENTS AND SCREENS
- 2.3 SOLID PHENOLIC / COLOR-THRU TOILET COMPARTMENTS

PART 3 – EXECUTION

- 3.1 EXAMINATION AND PREPARATION
- 3.2 INSTALLATION
- 3.3 ADJUSTING
- 3.4 PROTECTION

PART 1 – GENERAL

1.1 SECTION INCLUDES

- A. Solid plastic toilet compartments including the following: (Hiny Hiders)
 - 1. Floor mounted overhead-braced toilet compartments.
 - 2. Ceiling hung toilet compartments.
 - 3. Privacy screens.

1.2 RELATED SECTIONS

- A. Section 05 50 00 – Metal Fabrications: Concealed steel support members
- B. Section 06 10 00 – Rough Carpentry.
- C. Section 10 28 00 – Toilet Accessories.

1.3 REFERENCES

- A. ASTM International:
 - 4. ASTM E 84 – Standard Test Method for Surface Burning Characteristics of Building Materials.
 - 5. ASTM A 666 – Standard Specifications for Stainless and Het-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
 - 6. ASTM B 221 – Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
 - 7. National Fire Protection Association (NFPA) 286 – Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth.
 - 8. United States EPA (Environmental Protection Agency) Registration – Bactericidal Surfaces Registered with the U.S. EPA to Legally Make Claims that these Materials Kill Infectious Bacteria.

1.4 SUBMITTALS

- A. Submit under provisions of Section 01300.
- B. Manufacturer's data sheets on each product to be used, including:
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
 - 3. Installation methods.
- C. Shop Drawings:
 - 1. Dimensioned plans indicating layout of toilet compartments.
 - 2. Dimensioned elevations indicating heights of doors, pilasters, separation partitions, and other components; indicate locations and sizes of openings in compartment separation partitions for toilet and bath accessories to be installed in partitions; indicate floor and

- 1 ceiling clearances.
2 3. Details indicating anchoring components (bolt layouts) and methods for project conditions;
3 indicate components required for installation, but not supplied by toilet compartment
4 manufacturer.
5 D. Selection Samples: For each finish product specified, one complete set of color selection guides
6 representing manufacturer's full range of available colors, textures, and patterns.
7 E. Verification Samples: For each finish product specified, two samples representing actual product,
8 color, texture, and pattern.
9 F. Manufacturer's Certificates: Certify products meet or exceed specified requirements.

10
11 **1.5 DELIVERY, STORAGE, AND HANDLING**

- 12 A. Deliver, store, and handle materials and products in strict compliance with manufacturer's
13 instructions and recommendations and industry standards.
14 B. Store products indoors in manufacturer's or fabricator's original containers and packaging, with
15 labels clearly identifying product name and manufacturer. Protect from damage.
16 C. Lay cartons flat, with adequate support to ensure flatness and to prevent damage to pre-finished
17 surfaces.
18 D. Do not store where ambient temperature exceeds 120 degrees F (49 degrees C).

19
20 **1.6 PROJECT CONDITIONS**

- 21 A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits
22 recommended by manufacturer for optimum results. Do not install products under environmental
23 conditions outside manufacturer's absolute limits.
24 B. Do not deliver materials or begin installation until building is enclosed, with complete protection
25 from outside weather, and building temperature maintained at a minimum of 60 degrees F (15.6
26 degrees C).

27
28 **1.7 WARRANTY**

- 29 A. Manufacturer guarantees its plastic against breakage, corrosion, and delamination under normal
30 conditions for 25 years from the date of receipt by the customer. If materials are found to be
31 defective during that period for reasons listed above, the materials will be replaced free of charge.
32 Labor not included in warranty.

33
34 **1.8 COORDINATION**

- 35 A. Coordinate Work with placement of support framing and anchors in walls and ceilings.

36
37 **PART 2 – PRODUCTS**

38
39 **2.1 MANUFACTURERS**

- 40 A. Basis of Design: Scranton Products, which is located at: 801 E. Corey St.; Scranton, PA 18505;
41 ASD Toll Free Tel: 800-445-5148; Fax: 855-376-6161; Email: request info
42 (info@scrantonproducts.com); Web: <https://www.scrantonproducts.com>
43 1. Fabricator: Santana Toilet Partitions.
44 2. Fabricator: Comtec Toilet Partitions.
45 3. Fabricator: Capitol Toilet Partitions.
46 B. Requests for substitutions will be considered in accordance with provisions of Section 01 60 00.

47
48 **2.2 MATERIAL**

- 49 A. Plastic Panels: High density polyethylene (HDPE) suitable for exposed applications, waterproof,
50 non-absorbent, and graffiti-resistant textured surface.
51 1. Recycled Content; Pre Consumer: 70%
52 2. Recycled Content: Post Industrial: 100%
53 3. Recycled Content: Post Consumer: 100%

54
55 **2.3 SOLID PLASTIC COMPARTMENT AND SCREENS**

- 56 A. Basis of Design: Hiny Hiders Toilet Partitions as manufactured by and supplied by Scranton
57 Products.
58 1. Style: Floor mounted overhead-braced toilet compartments.
59 B. Doors, Panels, and Pilasters: 1 inch thick with all edges rounded to a radius. Mount doors and
60 dividing panels based on height of specified system.
61 2. Compartment Depth and Width: As scheduled and indicated on Drawings.

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- 3. Door Width: 24 inches.
 - 4. ADA Door Width: 36 inches.
 - 5. Door/Panel Height: 55 inches.
 - 6. Door Design: Traditional 2600.
 - 7. Panel Edge: Standard.
 - C. Panel Color: Traditional Series
 - 1. Color as selected by Architect from manufacturer's full line of current colors – Orange Peel.
 - D. Pilaster Shoes: 3 inches 20 gauge stainless steel. Secured to pilasters with a stainless steel tamper resistant Torx head sex bolt.
 - E. Head Rails: Hollow anodized aluminum, 1 by 1-1/2" size, with anti-grip profile and cast socket wall brackets.
 - F. Pilaster brackets: Natural anodized aluminum.
 - G. Wall Brackets: Continuous type, natural anodized aluminum.
 - H. Attachments, Screws and Bolts: Stainless steel, tamper proof type.
 - I. Hardware: Polished stainless steel:
 - 1. Pivot hinges, gravity type, adjustable for door close positioning, continuous piano hinges – through bolted.
 - 2. Door Latch: Stainless Steel Slide Bolt latch and Housing: Heavy-duty stainless steel type 304. The latch and housing to have a bright finish.
 - 3. Door Strike and Keeper with rubber bumper, mounted on pilaster in alignment with door latch.
 - 4. Doors supplied with one coat hook/bumper and door pull made of chrome plated Zamak.
 - 5. Equip outswing handicapped doors with second door pull and door stop.
 - J. Privacy and Urinal Screens: Wall hung.
 - 1. Provide plastic privacy screens in urinal and entry toilet room applications as indicated or scheduled.
 - 2. Panels and pilasters, if required, 1 inch thick with edges rounded to a radius. Screens to be mounted at 14 inches above the finished floor. Color as selected by Architect from manufacturer's full line of current colors.

PART 3 – EXECUTION

3.1 EXAMINATION AND PREPARATION

- A. Inspect and prepare substrates using the methods recommended by the manufacturer for achieving best result for the substrates under project conditions. Clean surfaces thoroughly prior to installation.
- B. Do not proceed with installation until substrates have been prepared using the methods recommended by the manufacturer and deviations from manufacturer's recommended tolerances are corrected. Commencement of installation constitutes acceptance of conditions.
- C. If preparation is the responsibility of another installer, notify Architect in writing of deviations from manufacturer's recommended installation tolerances and conditions.
 - 1. Verify dimensions of areas to receive compartments.
 - 2. Verify locations of built-in framing, anchorage, bracing, and plumbing fixtures.

3.2 INSTALLATION

- A. Install accessories in accordance with manufacturers' instructions in locations indicated on the drawings.
- B. Install in accordance with approved shop drawings and manufacturer's instructions.
- C. Fasten components to adjacent materials and to other components using purpose-designed fastening devices.
- D. Adjust pilaster anchors for substrate variations; conceal anchors with pilaster shoes.
- E. Install door strike keeper on pilasters in alignment with door latch.

3.3 ADJUSTING

- A. Adjust and align hardware to uniform clearance at vertical edge of doors.
- B. Adjust adjacent components for consistency of line or plane.

3.4 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair, or replace damaged products before Substantial Completion.

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30 NOVEMBER 2022

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END OF SECTION

SECTION 10 28 00
TOILET ACCESSORIES

PART 1 – GENERAL

- 1.1 SECTION INCLUDES
- 1.2 REFERENCE STANDARDS
- 1.3 ADMINISTRATIVE REQUIREMENTS
- 1.4 SUBMITTALS

PART 2 – PRODUCTS

- 2.1 MANUFACTURERS
- 2.2 MATERIALS
- 2.3 FINISHES
- 2.4 TOILET ROOM ACCESSORIES

PART 3 – EXECUTION

- 3.1 EXAMINATION
- 3.2 PREPARATION
- 3.3 INSTALLATION
- 3.4 PROTECTION

PART 1 – GENERAL

1.1 SECTION INCLUDES

- A. Accessories for toilet rooms.
- B. Grab bars.

1.2 REFERENCE STANDARDS

- A. ASTM A269/A269M - Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service; 2015a.
- B. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2015.
- C. ASTM C1036 - Standard Specification for Flat Glass; 2011.
- D. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass; 2012.
- E. ASTM C1503 - Standard Specification for Silvered Flat Glass Mirror; 2008 (Reapproved 2013).

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate the work with the placement of internal wall reinforcement, concealed ceiling supports, and reinforcement of toilet partitions to receive anchor attachments.

1.4 SUBMITTALS

- A. Product Data: Submit data on accessories describing size, finish, details of function, and attachment methods.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturers:
 - 1. AJW Architectural Products: www.ajw.com.
 - 2. ASI - American Specialties, Inc: www.americanspecialties.com.
 - 3. Bobrick Corporation
- B. All items of each type to be made by the same manufacturer.
- C. Refer to architectural drawings for accessories legend.

2.2 MATERIALS

- A. Accessories - General: Shop assembled, free of dents and scratches and packaged complete with anchors and fittings, steel anchor plates, adapters, and anchor components for installation.
- B. Stainless Steel Sheet: ASTM A666, Type 304.
- C. Stainless Steel Tubing: ASTM A269/A269M, Type 304 or 316.
- D. Mirror Glass: Annealed float glass, ASTM C1036 Type I, Class 1, Quality Q2, with silvering, protective and physical characteristics complying with ASTM C1503.

- 1 E. Mirror Glass: Tempered safety glass, ASTM C1048; and ASTM C1036 Type I, Class 1, Quality Q2,
2 with silvering as required.
- 3 F. Fasteners, Screws, and Bolts: Hot dip galvanized; tamper-proof; security type.
- 4 G. Expansion Shields: Fiber, lead, or rubber as recommended by accessory manufacturer for
5 component and substrate.
- 6

7 **2.3 FINISHES**

- 8 A. Stainless Steel: No. 4 Brushed finish, unless otherwise noted.
- 9

10 **2.4 TOILET ROOM ACCESSORIES**

- 11 A. Mirrors: Stainless steel framed, 1/4 inch thick annealed float glass; ASTM C1036.
 - 12 1. Size: varies, see drawings.
 - 13 2. Frame: 0.05 inch angle shapes, with mitered and welded and ground corners, and
14 tamperproof hanging system; No.4 finish.
- 15 B. Grab Bars: Stainless steel, nonslip grasping surface finish.
 - 16 1. Standard Duty Grab Bars:
 - 17 a. Push/Pull Point Load: 250 pound-force, minimum.
 - 18 b. Dimensions: 1-1/4 inch outside diameter, minimum 0.05 inch wall thickness,
19 exposed flange mounting, 1-1/2 inch clearance between wall and inside of grab
20 bar.
 - 21 c. Length and Configuration: As indicated on drawings.
 - 22

23 **PART 3 – EXECUTION**

24
25 **3.1 EXAMINATION**

- 26 A. Verify existing conditions before starting work.
- 27 B. Verify exact location of accessories for installation.
- 28 C. For electrically-operated accessories, verify that electrical power connections are ready and in the
29 correct locations.
- 30 D. Verify that field measurements are as indicated on drawings.
- 31

32 **3.2 PREPARATION**

- 33 A. Deliver inserts and rough-in frames to site for timely installation.
- 34 B. Provide templates and rough-in measurements as required.
- 35

36 **3.3 INSTALLATION**

- 37 A. Install accessories in accordance with manufacturers' instructions in locations indicated on the
38 drawings.
- 39 B. Install plumb and level, securely and rigidly anchored to substrate.
- 40 C. Mounting Heights: As required by accessibility regulations, unless otherwise indicated.
- 41 D. Mounting Heights and Locations: as indicated on drawings.
- 42

43 **3.4 PROTECTION**

- 44 A. Protect installed accessories from damage due to subsequent construction operations.
- 45
- 46

END OF SECTION

SECTION 21 05 00
COMMON WORK RESULTS FOR FIRE SUPPRESSION

PART 1 - GENERAL

SCOPE

This section includes information common to two or more technical fire protection specification sections or items that are of a general nature, not conveniently fitting into other technical sections.

The specifications and drawings are scope documents based on the Owner's requirements for the fire protection systems. It is the intent of the documents to detail and specify the minimum requirements and components. It is the responsibility of the Contractor to design and install a complete fire protection system in compliance with NFPA, State, and the Local Authority Having Jurisdiction codes and requirements. Pipe and equipment sizing shown in the documents is the minimum allowed. If larger size is required, it is to be included in the bid.

Included are the following topics:

PART 1 - GENERAL

- Reference
- Reference Standards
- Quality Assurance
- Continuity of Existing Services
- Protection of Finished Surfaces
- Codes
- Design Criteria
- Certificates and Inspections
- Submittals
- Operating and Maintenance Instructions
- Record Drawings

PART 2 - PRODUCTS

- Identification

PART 3 - EXECUTION

- Demolition
- Cutting and Patching
- Building Access
- Equipment Access
- Coordination
- Identification

REFERENCE

Applicable provisions of Division 1 govern work under this section.

REFERENCE STANDARDS

Abbreviations of standards organizations referenced in this, and other sections are as follows:

- AGA American Gas Association
- ANSI American National Standards Institute
- ASME American Society of Mechanical Engineers
- ASPE American society of Plumbing Engineers
- ASTM American Society for Testing and Materials
- AWWA American Water Works Association
- AWS American Welding Society
- CGA Compressed Gas Association
- CS Commercial Standards, Products Standards Sections, Office of Engineering Standards Service, NBS

1	EPA	Environmental Protection Agency
2	FM	FM Global
3	FS	Federal Specifications, Superintendent of Documents, U.S. Government Printing Office
4	IAPMO	International Association of Plumbing & Mechanical Officials
5	IEEE	Institute of Electrical and Electronics Engineers
6	ISA	Instrument Society of America
7	DSPS	State of Wisconsin Dept. of Safety and Professional Services
8	MSS	Manufacturer's Standardization Society of the Valve & Fitting Industry, Inc.
9	NBS	National Bureau of Standards
10	NEC	National Electric Code
11	NEMA	National Electrical Manufacturers Association
12	NFPA	National Fire Protection Association
13	STI	Steel Tank Institute
14	UL	Underwriters Laboratories Inc.

15

16 **QUALITY ASSURANCE**

17 Substitution of Materials: Refer to Section GC - General Conditions of the Contract, Equals and Substitutions.

18

19 All products and materials used are to be new, undamaged, clean and in good condition. Existing products and
20 materials are not to be reused unless specifically indicated.

21

22 Where equipment or accessories are used which differ in arrangement, configuration, dimensions, ratings, or
23 engineering parameters from those indicated on the contract documents, the contractor is responsible for all costs
24 involved in integrating the equipment or accessories into the system and for obtaining the intended performance from
25 the system into which these items are placed.

26

27 **CONTINUITY OF EXISTING SERVICES**

28 Do not interrupt or change existing services without prior written approval from the Owner's Project Representative.
29 When interruption is required, coordinate scheduling of down-time with the Owner to minimize disruption to his
30 activities. Unless specifically stated, all work involved in interrupting or changing existing services is to be done during
31 normal working hours.

32

33 **PROTECTION OF FINISHED SURFACES**

34 Refer to Division 1, General Requirements, Protection of Finished Surfaces.

35

36 **CODES**

37 Comply with requirements of Wisconsin Administrative Code, Dept. of Safety and Professional Services, NFPA
38 Standards and local Fire Chief or Fire Marshal (AHJ, Authority Having Jurisdiction) regarding design, materials and
39 installation.

40

41 **DESIGN CRITERIA**

42 Design fire protection systems in accordance with codes, standards and regulations noted above.

43

44 Hydraulically design system for the most remote area based on the following:

45

46 **CERTIFICATES AND INSPECTIONS**

47 Refer also to Division 1, General Conditions, Permits, Regulations, Utilities and Taxes.

48

49 Obtain and pay for all required State or local installation inspections except those provided by the Architect/Engineer.

50

51 **SUBMITTALS**

52 Refer to Section GC - General Conditions of the Contract, Submittals.

53 Shop drawing submittals are to be bound, labeled, contain the project manual cover page and a material index list
54 page showing item designation, manufacturer and additional items supplied with the installation. Submit for all

1 equipment and systems as indicated in the respective specification sections, marking each submittal with that
2 specification section number. Mark general catalog sheets and drawings to indicate specific items being submitted
3 and proper identification of equipment by name and/or number, as indicated in the contract documents. Include wiring
4 diagrams of electrically powered equipment.

5
6 Submittals shall be sent to the local Fire Chief or Fire Marshal for review prior to the Architect/Engineer. Include a
7 copy of all review/approval letters in submission to Architect/Engineer.

8
9 Submit plans indicating water supply location and size, piping layout and size, sprinkler locations and type, hanger
10 locations and type, equipment locations and type, valve locations and type, occupancy classes, hydraulic reference
11 points, design areas and discharge densities.

12
13 Submit hydraulic calculations for water supply and sprinkler and standpipe systems. Include summary sheet and
14 detailed work sheets. Describe characteristics of water supply and location of effective point used in calculations.
15 Include graph illustration of water supply, hose demand, sprinkler demand and in-rack sprinkler demand.

16
17 Submit sufficient quantities of data sheets and shop drawings to allow the following distribution:

- | | | |
|----|-------------------------------------|----------|
| 18 | • Operating and Maintenance Manuals | 2 copies |
| 19 | • Architect/Engineer | 1 copy |
| 20 | • Local Fire Chief or Marshal | 1 copy |

21
22 **OPERATING AND MAINTENANCE INSTRUCTIONS**

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

25
26 In addition to the general content specified under GENERAL REQUIREMENTS supply the following additional
27 documentation:

- 28 • Copies of all approved submittals along with approval letters.
- 29 • Manufacturer's wiring diagrams for electrically powered equipment.
- 30 • Records of tests performed to certify compliance with system requirements.
- 31 • Certificates of inspection by regulatory agencies.
- 32 • Parts lists for equipment and specialties.
- 33 • Manufacturers installation, operation and maintenance recommendations for equipment and specialties.
- 34 • Warranties
- 35 • Additional information as indicated in the technical specification sections

36
37 **RECORD DOCUMENTS**

38 Refer to Division 1, General Requirements, Record Documents.

39
40 In addition to the data indicated in the General Requirements, maintain fire protection layout record drawings and
41 hydraulic calculations on originals prepared by the installing contractor/subcontractor. Include copies of these record
42 drawings and calculations with the Operating and Maintenance manuals.

43
44 **PART 2 - PRODUCTS**

45
46 **IDENTIFICATION**

47 Stencils:

48 Not less than 1/2" high letters for pipe sizes 1" through 2-1/2" and 1 inch high letters/numbers for pipe sizes 3" and
49 above for marking pipe and equipment. Apply flow arrows to piping.

50
51 **ADHESIVE LABELS:**

52 Pressure-sensitive, adhesive backed, vinyl pipe markers with applicable labeling, 3/4" min. size for lettering and
53 surrounding tape on both ends. With flow arrows on piping. Conforming to ANSI, ANSI and NFPA standards. Seton
54 Opti-Code, MSI, Brady or approved equal. Clean piping before application.

1 **SNAP-AROUND MARKERS:**

2 One-piece, pre-formed, vinyl construction, snap-around or strap-around pipe markers with applicable labeling, 3/4" min.
3 size for lettering. Provide nylon ties on each end of pipe marker. Seton Setmark or approved equal.

4
5 **SIGNS:**

6 Metal construction, baked porcelain enamel finish signs, sizes conforming to NFPA no. 13 and 7-1.2, with holes and
7 s-hooks/chains for hanging or securing. With applicable labeling. MSI, Seton, W.H. Brady or equal.

8
9 **Engraved Name Plates:**

10 White letters on a black background, 1/16-inch-thick plastic laminate, beveled edges, screw mounting, Setonply Style
11 2060 by Seton Name Plate Company or Emedolite Style EIP by EMED Co., or equal by W. H. Brady.

12
13 **Valve Tags:**

14 Round brass tags with 1/2-inch numbers, 1/4 inch system identification abbreviation, 1-1/4 inch minimum diameter,
15 with brass jack chains with brass "S" hooks or one piece nylon ties around the valve stem, available from EMED Co.,
16 Seton Name Plate Company, MSI or W. H. Brady.

17
18 **PART 3 - EXECUTION**

19
20 **DEMOLITION**

21 Perform all demolition as indicated on the drawings to accomplish new work. Where demolition work is to be
22 performed adjacent to existing work that remains in an occupied area, construct temporary dust partition to minimize
23 the amount of contamination of the occupied space. Where pipe is removed and not reconnected with new work, cap
24 ends of existing services as if they were new work. Coordinate work with the User Agency to minimize disruption to
25 the existing building occupants.

26
27 All pipe, sprinklers, equipment, wiring, associated conduit and similar items demolished, abandoned, or deactivated
28 are to be removed from the site by the Contractor except as specifically noted otherwise. All designated equipment is
29 to be turned over to the User Agency/Owner for his use at a place and time he so designates. Maintain the condition
30 of material and/or equipment that is indicated to be reused equal to that existing before work began.

31
32 **CUTTING AND PATCHING**

33 Refer to Division 1, General Requirements, Cutting and Patching.

34
35 **BUILDING ACCESS**

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

39
40 **EQUIPMENT ACCESS**

41 Install all piping, conduit and accessories to permit access to equipment for maintenance and service. Coordinate the
42 exact location of wall and ceiling access panels and doors with the General Prime Contractor, making sure that access
43 is available for all equipment and specialties. Access doors in general construction are to be furnished by the Fire
44 Protection Contractor and installed by the General Prime Contractor.

45
46 Provide color coded thumb tacks or screws, depending on the surface, for use in accessible ceilings which do not
47 require access panels.

48
49 **COORDINATION**

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

52
53 Verify that all devices are compatible for the type of construction and surfaces on which they will be used.
54
55

1 **IDENTIFICATION**

2 Identify equipment in mechanical equipment rooms by stenciling equipment number and service with one coat of black
3 enamel against a light background or white enamel against a dark background. Use a primer where necessary for
4 proper paint adhesion.

5
6 Where stenciling is not appropriate for equipment identification, engraved name plates may be used.

7
8 Identify interior piping mains not less than once every 25 feet, not less than once in each room, adjacent to each
9 access door or panel, and on both sides of the partition where exposed piping passes through walls or floors. Place
10 flow directional arrows at each pipe identification location. Use one coat of black enamel against a light background
11 or white enamel against a dark background, or approved pipe marking label systems, or provide snap-around type
12 pipe markers as specified in Part 2 – Products.

13
14 Identify valves with signs per NFPA rulings.

15
16 Provide hydraulic design information sign of permanently marked weatherproof metal or engraved nameplate material.
17 Secure to alarm valve with brass chain. Information to include location of the design areas, discharge densities,
18 required flow and residual pressure at the base of riser, hose stream demand and sprinkler demand.

19
20 **END OF SECTION**

**SECTION 21 05 29
HANGERS AND SUPPORTS FOR FIRE SUPPRESSION PIPING AND EQUIPMENT**

PART 1 - GENERAL

SCOPE

This section includes specifications for support of all fire suppression equipment and materials as well as piping system anchors. Included are the following topics:

PART 1 - GENERAL

- Scope
- Reference
- Reference Standards
- Quality Assurance
- Description
- Shop Drawings
- Design Criteria

PART 2 - PRODUCTS

- Manufacturers
- Structural Supports
- Pipe Hangers and Supports
- Beam Clamps

PART 3 - EXECUTION

- Installation
- Hanger and Support Spacing

REFERENCE

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

REFERENCE STANDARDS

- MSS SP-58
- NFPA 13 Installation of Sprinkler Systems (Latest prevailing edition).
- NFPA 14 Installation of Standpipe and Hose Systems (Latest prevailing edition).
- NFPA 20 Installation of centrifugal fire pumps (Latest prevailing edition).
- UL Underwriters' Laboratories Listed.
- FM Factory Mutual Approved

QUALITY ASSURANCE

Substitution of Materials Refer to Section GC - General Conditions of the Contract, Equals and Substitutions.

DESCRIPTION

Provide all supporting devices as required for the installation of fire suppression equipment and materials. All supports and installation procedures are to conform to the latest requirements of the ANSI Code for building piping.

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

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

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

1 **SHOP DRAWINGS**

2 Schedule all hanger and support devices indicating attachment method and type of device for each pipe size and
3 type of service. Provide details on the working drawings submitted for approval with all pertinent information listed.

4
5 **DESIGN CRITERIA**

6 Materials and application of pipe hangers and supports shall be in accordance with MSS SP-58 Pipe Hangers and
7 Supports – Materials, Design, Manufacture, Selection, Application and Installation unless noted otherwise.

8 Materials and application of pipe hangers and supports shall be in accordance with NFPA rulings and be UL/FM
9 listed and approved.

10
11 **PART 2 - PRODUCTS**

12
13 **MANUFACTURERS**

14 B-Line, Anvil, Erico, Tolco, Afcon, Roof Products & Systems or approved equal.

15
16 **STRUCTURAL SUPPORTS**

17 Provide all supporting steel required for the installation of mechanical equipment and materials, including angles,
18 channels, beams, etc. to suspended or floor supported tanks and equipment. All of this steel may not be specifically
19 indicated on the drawings.

20
21 **PIPE HANGERS AND SUPPORTS**

22 HANGERS FOR PIPE SIZES 1/2" THROUGH 4":

23 Carbon steel, adjustable swivel ring with 3/8" min. UL/FM approved hanger rods. B-Line B3170NF, Anvil 69 or 70.

24 Carbon steel, adjustable clevis, standard, with UL/FM approved size hanger rods. B-Line B3100, Anvil 260.

25
26 **COPPER PIPE SUPPORTS:**

27 All supports, fasteners, clamps, etc. directly connected to copper piping shall be copper plated or polyvinylchloride
28 coated. Where steel channels are used, provide flexible elastomeric/thermoplastic isolation cushion material to
29 completely encircle the piping and avoid contact with the channel or clamp, equal to B-Line B1999 Vibra Cushion or
30 provide manufacturers clamp and cushion assemblies, B-Line BVT series, Grinnell PS 1400 series.

31
32 **PIPE HANGER RODS**

33 STEEL HANGER RODS:

34 Threaded both ends, threaded one end, or continuous threaded, complete with adjusting and lock nuts.

35
36 Size rods for individual hangers and trapeze support as indicated in the following schedule.

37

Pipe Size	Diam. Of Rod
Up to and Including 4"	3/8" or 9.5mm min.

38
39
40
41
42 **BEAM CLAMPS**

43 MSS SP-58 Types 19 & 23 malleable black iron clamp for attachment to beam flange to 0.62 inches thick with a
44 retaining ring and threaded rod of 3/8, 1/2-, and 5/8-inch diameter. Furnish with a hardened steel cup point set
45 screw. B-Line B3036L/B3034, Anvil 86/92.

46
47 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
48 sizes to 1-1/2-inch diameter. B-Line B3054, Anvil 228.

49
50
51 **PART 3 - EXECUTION**

52
53 **INSTALLATION**

54 Size, apply and install supports and anchors in compliance with manufacturers recommendations.

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

4
5 Coordinate hanger and support installation to properly group piping of all trades.

6
7 Where piping can be conveniently grouped to allow the use of trapeze type supports, use standard structural shapes
8 or continuous insert channels for the supporting steel. Where continuous insert channels are used, pipe supporting
9 devices made specifically for use with the channels may be substituted for the specified supporting devices provided
10 that similar types are used, and all data is submitted for prior approval.

11
12 Perform welding in accordance with standards of the American Welding Society.

13
14 **HANGER AND SUPPORT SPACING**

15
16 Use hangers with minimum vertical adjustment.

17
18 Where several pipes can be installed in parallel and at the same elevation, provide multiple or trapeze hangers.

19
20 Support riser piping independently of connected horizontal piping.

21
22 Adjust hangers to obtain the slope specified in the piping section of these specifications.

23
24 Space hangers for pipe as follows:

<u>Pipe Material</u>	<u>Pipe Size</u>	<u>Max. Horiz. Spacing</u>	<u>Max. Vert. Spacing</u>
Copper	3/4" through 1"	8'-0"	10'-0"
Copper	1-1/4" through 1-1/2"	10'-0"	10'-0"
Copper	2" through 3"	12'-0"	10'-0"
Steel	1" through 1-1/4"	12'-0"	15'-0"
Steel	1-1/2" through 8"	15'-0"	15'-0"
CPVC	1" through 1-1/4"	6'-0"	10'-0"
CPVC	1-1/2"	7'-0"	10'-0"
CPVC	2"	8'-0"	10'-0"
CPVC	2-1/2"	9'-0"	10'-0"
CPVC	3"	10'-0"	10'-0"

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35
36
37 Hangers, supports, and hanger spacing for CPVC plastic piping systems shall conform to the requirements of NFPA
38 13 and the manufacturer's requirements. Contractor shall provide details on the installation drawings for all
39 proposed means of support.

40 Restraint hangers shall be installed at all sprinkler head location within 1'-0" for a single restraint and within 5'-0" for
41 two points of restraint. The requirements for hanger restraint for systems in excess of 100 PSI pressure shall be
42 followed.

43
44 Hangers for CPVC systems shall not compress, distort, cut or abrade the piping and shall allow free movement of
45 the pipe to permit thermal expansion and contraction.

46
47 Unsupported length from the last hanger and an end sprinkler for steel piping systems shall be as follows:

48	1" piping	Not greater than 36"
49	1-1/4" piping	Not greater than 48"
50	1-1/2" piping	Not greater than 60"
51	or larger.	

52
53 **END OF SECTION**

SECTION 21 10 00
WATER BASED FIRE SUPPRESSION SYSTEMS

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PART 1 - GENERAL

SCOPE

This section contains specifications for fire suppression pipe and pipe fittings for this project. Included are the following topics:

PART 1 - GENERAL

- Scope
- Related Work
- Reference
- Reference Standards
- Shop Drawings
- Quality Assurance
- Delivery, Storage, and Handling
- Design Criteria
- Welder Qualifications

PART 2 - PRODUCTS

- Fire suppression Piping
- Unions and Flanges
- Mechanical Grooved Pipe Connections
- Sprinkler Heads
- Flexible Sprinkler Drop Fittings

PART 3 – EXECUTION

- General
- Preparation
- Erection
- Copper Pipe Joints
- Welded Pipe Joints
- Threaded Pipe Joints
- Mechanical Grooved Pipe Connections
- Unions and Flanges
- Piping System Leak Tests
- Installation
- Construction Verification Items

RELATED WORK

- Section 21 05 00 – Common Work Results for Fire Suppression
- Section 21 05 29 – Hangers and Supports for Fire Suppression Piping and Equipment

REFERENCE

Applicable provisions of Division 1 govern work under this section.

REFERENCE STANDARDS

- ANSI A21.4
- ANSI A21.11
- ANSI A21.51
- ANSI B16.1 Cast Iron Pipe Flanges and Flanged Fittings
- ANSI B16.3 Malleable and Ductile Iron Threaded Fittings
- ANSI B16.4 Cast Iron Threaded Fittings
- ANSI B16.5 Pipe Flanges and Flanged Fittings
- ANSI B16.9 Factory Made Wrought Steel Buttweld Fittings

1	ANSI B16.11	Forged Steel Fittings, Socket Welded and Threaded
2	ANSI B16.18	Cast Bronze Solder Joint Pressure Fittings
3	ANSI B16.22	Wrought Copper and Wrought Copper Alloy Solder Joint Pressure Fittings
4	ANSI B16.29	Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings - DWV
5	ASTM A53	Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless
6	ASTM A105	Forgings, Carbon Steel, for Piping Components
7	ASTM A126	Gray Cast Iron Castings for Valves, Flanges, and Pipe Fittings
8	ASTM A135	Electric Resistance Welded Steel Pipe
9	ASTM A181	Forgings, Carbon Steel for General Purpose Piping
10	ASTM A234	Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures
11	ASTM A536	Ductile Iron Castings
12	ASTM A795	Black and Hot Dipped Zinc Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use
13		
14	ASTM B88	Seamless Copper Water Tube
15	AWS A5.8	Brazing Filler Metal
16	AWS D10.9	Qualification of Welding Procedures and Welders for Piping and Tubing, Level AR3
17	NFPA 13	Installation of Sprinkler Systems. (Latest prevailing edition)
18	NFPA 14	Installation of Standpipe and Hose Systems. (Latest prevailing edition)
19	UL	Underwriters' Laboratories Listing
20	FM	Factory Mutual Approval

21

22 **SHOP DRAWINGS**

23 Schedule from the contractor indicating the ANSI/ASTM specification number of the pipe being proposed along with
24 its type and grade, if known at the time of submittal, and sufficient information to indicate the type and rating of
25 fittings for each service.

26

27 **QUALITY ASSURANCE**

28 Substitution of Materials: Refer to Section GC – General Conditions of the Contract, Equals and Substitutions.

29 Order steel pipe with each length marked with the name or trademark of the manufacturer and type of pipe; with
30 each shipping unit marked with the purchase order number, metal or alloy designation, temper, size, and name of
31 supplier.

32

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

35

36 **DELIVERY, STORAGE, AND HANDLING**

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

38

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

43

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

45

46 Storage and protection methods must allow inspection to verify products.

47

48 **DESIGN CRITERIA**

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

51

52 Construct all piping systems for the highest pressures and temperatures in the respective system but not less than
53 175 psig.

54

1 Where weld fittings are used, use only long radius elbows having a centerline radius of 1.5 pipe diameters.

2

3 Where mechanical grooved fittings are used, use only ASTM standard radius fittings, short radius grooved fittings
4 are not allowed.

5

6 Where ASTM A53 or A795 type F pipe is specified, grade A type E or S, or grade B type E or S may be substituted
7 at Contractor's option. Where ASTM A135 grade A pipe is specified, grade B pipe may be substituted at
8 Contractor's option. Where the grade or type is not specified, Contractor may choose from those commercially
9 available.

10

11 Where ASTM B88, type L H (drawn) temper copper tubing is specified, ASTM B88, type K H (drawn) temper copper
12 tubing may be substituted at Contractor's option.

13

14 **WELDER QUALIFICATIONS**

15 Welding procedures, welders, and welding operators for all building service piping to be in accordance with certified
16 welding procedures of the National Certified Pipe Welding Bureau and Section 927.5 of ASME B31.9 Building
17 Services Piping or AWS 10.9 Qualification of Welding Procedures and Welders for Piping and Tubing. Before any
18 metallic welding is performed, Contractor to submit his Standard Welding Procedure Specification together with the
19 Procedure Qualification Record as required by Section 927.6 of ASME B31.9 Building Services Piping.

20

21 The Architect or Engineer reserves the right to test the work of any welder employed on the project, at the Owner's
22 expense. If the work of the welder is found to be unsatisfactory, the welder shall be prevented from doing further
23 welding on the project and all defective welds replaced.

24

25

26 **PART 2 - PRODUCTS**

27

28 **FIRE SUPPRESSION PIPING**

29 **STEEL PIPE:**

30 Black steel pipe welded and seamless, Type F, Grade A, ASTM A53; black welded and seamless steel pipe for fire
31 protection use, Type F, ASTM A795; electric resistance welded steel pipe, Grade A, ASTM A135.

32

33 **Pipe wall Thickness:**

34 Threaded pipe shall have a minimum wall thickness of schedule 40.

35 All other pipe shall have a minimum wall thickness of schedule 10.

36 Piping 2" and under shall be minimum schedule 40 unless stated otherwise herein.

37

38 Fittings: Cast iron threaded fittings, Class 125 or 250, ASTM A126/ANSI B16.4. Malleable and ductile iron threaded
39 fittings, Class 150 or 300, ASTM A197/ANSI B16.3. Standard weight seamless carbon steel weld fittings, ASTM A234
40 grade, ANSI B16.9. Mechanical grooved fittings with EPDM gaskets, ASTM A536 ductile iron, ASTM A47 malleable
41 iron or ASTM A53 fabricated steel. For wet pipe systems mechanical tee fittings with full iron back equal to Grinnell
42 Figure 730 will be allowed only as needed for connection to existing systems. Outlets for drypipe and preaction
43 systems shall be mechanical tees. Mechanical tees with U-bolt back or other fastening means are not allowed.

44

45 Welding Materials: Comply with Section II, Part C, ASME Boiler and Pressure Vessel Code for welding materials.

46

47 Finish: Hot dipped zinc coated (galvanized) finish on piping and fittings shall be used in drypipe and pre-action
48 systems, piping exposed to weather and piping exposed to corrosive environments where indicated. Thread or
49 grooved hot dipped zinc coated pipe ends for fitting connections. Indoor dry standpipe systems supplied by a Fire
50 Dept. connection only may be black steel piping and fittings.

51

52 **CPVC PIPE:**

53 CPVC Sprinkler Pipe, ASTM F 442, SDR 13.5. 1" through 2" pipe size only.

1 CPVC Sprinkler Fittings, Schedule 40 and Schedule 80 dimensions for 1" through 1-1/4", Schedule 80 for 1-1/2"
2 through 2". Products to be UL Listed/FM Approved for a rated working pressure of 175 psi at 150°F for sprinkler
3 service. Spears FlameGuard or BlazeMaster.
4 No exposed CPVC piping material is allowed.
5

6 Plastic pipe and fittings will not be allowed for this project.
7

8 **PRESSURE SENSING LINE PIPE:**

9 Seamless Red Brass pipe, ASTM 43, regular weight (Schedule 40), with ASTM B584 threaded copper alloy
10 pressure fittings,
11

12 Type L copper water tube, H (drawn) temper, ASTM B88; with cast copper pressure fittings, ANSI B16.18; wrought
13 copper pressure fittings, lead free (<.2%) solder, ASTM B32; flux, ANSI B16.22; copper phosphorous brazing alloy,
14 AWS A5.8 BCuP.
15

16 **UNIONS AND FLANGES**

17 **2" AND SMALLER STEEL:**

18 ASTM A197/ANSI B16.3 malleable iron unions with brass seats. Use black malleable iron on black steel piping and
19 galvanized malleable iron on galvanized steel piping. Grooved couplings may be used in lieu of unions.
20

21 **2" AND SMALLER COPPER:**

22 ANSI B16.18 cast bronze union coupling or ANSI B15.24 Class 150 cast bronze flanges.
23

24 **2-1/2" AND LARGER:**

25 ASTM A181 or A105, Class 150, grade 1 hot forged steel flanges of threaded, welding neck, or slip-on pattern on
26 black steel and threaded only on galvanized steel. ANSI B16.1 or ANSI B16.5, Class 150 cast iron threaded flanges.
27 Use raised face flanges ANSI B16.5 for mating with other raised face flanges or equipment with flat ring or full face
28 gaskets. Use ANSI B16.1 flat face flanges with full face gaskets for mating with other flat face flanges on
29 equipment.
30

31 **2-1/2" AND LARGER COPPER:**

32 ANSI B16.24, Class 150 cast bronze flanges with raised face.
33

34 **MECHANICAL GROOVED PIPE CONNECTIONS**

35 Mechanical grooved pipe couplings and fittings, ASTM F1476, as manufactured by Victaulic, Anvil, or Grinnell may
36 be used with steel pipe. Mechanical grooved components and assemblies to be rated for minimum 175 psi working
37 pressure unless noted otherwise.
38

39 All mechanical grooved pipe material including gaskets, couplings, fittings and flange adapters shall be from the
40 same manufacturer.
41

42 Couplings and fittings to be malleable iron, ASTM A47, or ductile iron A536 with painted finish. Fittings used on
43 galvanized steel pipe to have galvanized finish, ASTM A153.
44

45 Gaskets to be EPDM, ASTM D2000. Gaskets for dry systems to be flush seal design. Heat treated carbon steel oval
46 neck track bolts and nuts, ASTM A-183, with zinc electroplated finish.
47

48 Flange adapters to be ductile iron, ASTM A536; except at lug type butterfly valves where standard threaded flanges
49 shall be used.
50

51 Credit for the inherent flexibility of mechanical grooved pipe connections when used for expansion joints or flexible
52 connectors may be allowed upon specific application by the Contractor. Three flexible couplings at first three
53 connection points both upstream and downstream of pumps may be used in lieu of flexible connectors. Request for
54 expansion joints shall be made in writing and shall include service, location, line size, proposed application and
55 supporting calculations for the intended service.

1 **SPRINKLER HEADS**

2 Manufacturer: Sprinkler head model numbers establish type and style of head. Products of the following
3 manufacturers determined to be equal by the Architect/Engineer will be accepted: Tyco, Reliable, Victaulic, Viking
4 and Globe.

5
6 Standard coverage sprinkler heads are to be the basis for design unless noted otherwise on the plans or within
7 these specifications.

8
9 Fusible link or glass bulb type, cast brass or bronze construction. Provide heads with nominal 1/2" or 17/32"
10 discharge orifice except where greater than normal density requires large orifice.

11
12 Select fusible link or glass bulb temperature rating to not exceed maximum ambient temperature rating allowed
13 under normal conditions at installed location. Provide ordinary temperature (155 to 165 degree) fusible link or glass
14 bulb type except at skylights, sealed display windows, unventilated attics and roof spaces, over cooking equipment,
15 adjacent to diffusers, unit heaters, uninsulated heating pipes or ducts, mechanical rooms, storage rooms, or where
16 otherwise indicated.

17
18 Provide quantity of spare heads as noted below and 1 wrench for each type of head and each temperature range
19 installed. Provide 6 spare heads per 300 or less installed heads, 12 per 1000 or less and 24 for more than 1000.
20 Provide steel cabinet for storage of heads and wrenches. Provide an equal number of concealed cover plates and/or
21 sprinkler escutcheons for each spare sprinkler head.

22
23 Quick Response Upright: Viking Microfast M (QR), brass finish.

24
25 Quick Response Pendant: Viking Microfast M, chrome plated finish and escutcheon.

26
27 Concealed sprinkler: Viking Mirage (Quick Response), with adjustable concealed cover plate. Cover plate finish to
28 be selected by the Architect/Engineer from the manufacturer's standard finish selections.

29
30 **FLEXIBLE SPRINKLER DROP FITTINGS**

31 Manufacturers: FlexHead Industries, Victaulic or Viking.

32
33 Corrugated Type 304 stainless steel hose with braided Type 304 stainless steel exterior cover, welded stainless
34 steel or zinc plated steel inlet and outlet threaded fittings with EPDM seals. 175 PSI pressure rating. 225 °F
35 temperature rating, 1" minimum internal hose diameter. 40" maximum hose length, straight or angle outlet
36 configuration. Galvanized steel ceiling support bar and brackets selected to match project ceiling support system
37 requirements. UL Listed and FM approved.

38
39 Flexible drops are only allowed for use above fully accessible ACT ceilings.

40
41
42 **PART 3 - EXECUTION**

43
44 **GENERAL**

45 Install pipe fittings, and other fire suppression system components in accordance with reference standards,
46 manufacturers recommendations and recognized industry practices.

47
48 **PREPARATION**

49 Cut pipe ends square. Ream ends of piping to remove burrs. Clean scale and dirt from interior and exterior of each
50 section of pipe and fitting prior to assembly.

51
52 **ERECTION**

53 Install all piping parallel to building walls and ceilings and at heights which do not obstruct any portion of a window,
54 doorway, stairway, or passageway. Where interferences develop in the field, offset or reroute piping as required to

1 clear such interferences. Coordinate locations of fire protection piping with piping, ductwork, conduit and equipment
2 of other trades to allow sufficient clearances. In all cases, consult drawings for exact location of pipe spaces, ceiling
3 heights, ceiling grid layout, light fixtures and grilles before installing piping.
4

5 Where copper or steel piping is embedded in masonry or concrete, provide protective sleeve covering of elastomeric
6 pipe insulation.
7

8 Provide 3/32" min. thickness steel nailing plates behind or on either side of piping where the possibility of
9 penetration from nails or drywall screws exists.
10

11 Maintain piping in clean condition internally during construction.
12

13 Provide clearance for access to valves and piping specialties.
14

15 Provide anchors, expansion joints, swing joints and/or expansion loops so that piping may expand and contract
16 without damage to itself, equipment, or building.
17

18 Install piping so that system can be drained. Where possible, slope to main drain valve. Slope dry pipe and pre-
19 action systems subject to freezing at minimum 1/4"/10' on mains and 1/2"/10' on branches. Where piping not
20 susceptible to freezing cannot be fully drained, install nipple and cap for drainage of less than 5 gallons or ball valve
21 with hose thread outlet and cap for drainage over 5 gallons. Pipe main drain valve to grade or to air gap sewer
22 receptor.
23

24 Mitered ells, notched tees, and orange peel reducers are not acceptable. On threaded piping, bushings are not
25 acceptable.
26

27 Do not route piping within exterior walls.
28

29 Do not route piping through transformer vaults or above transformers, panelboards, or switchboards, including the
30 required service space for this equipment, unless the piping is serving this equipment.
31

32 Install all valves and piping specialties, including items furnished by others, as specified and/or detailed. Provide
33 access to valves and specialties for maintenance. Make connections to all equipment, fixtures and systems installed
34 by others where same requires the piping services indicated in this section.
35

36 **COPPER PIPE JOINTS**

37 Remove all slivers and burrs remaining from the cutting operation by reaming and filing both pipe surfaces. Clean
38 fitting and tube with metal brush, emery cloth or sandpaper. Remove residue from the cleaning operation and
39 assemble joint to socket stop. Apply flame to fitting until brazing alloy melts when placed at joint. Wipe excess alloy
40 from joint.
41

42 **WELDED PIPE JOINTS**

43 Make all welded joints by fusion welding in accordance with ASME Codes, ANSI B31, and State Codes where
44 applicable. "Weldolets" and "Threadolets" may be used up to following sizes:

45	Maximum	
46	Weldolet/	Main
47	Threadolet	Pipe
48	<u>Diameter</u>	<u>Diameter</u>
49	3/4"	1 1/4"
50	1"	1 1/2"
51	1 1/4"	2"
52	1 1/2"	2 1/2"
53	2"	3"
54	3"	4"

1	4"	6"
2	6"	8"
3		

4 **THREADED PIPE JOINTS**

5 Use a thread lubricant or teflon tape when making joints; no hard setting pipe thread cement or caulking will be
6 allowed.

8 **MECHANICAL GROOVED PIPE CONNECTIONS**

9 Use pipe factory grooved in accordance with the coupling manufacturer's specifications or field grooved pipe in
10 accordance with the same specifications using specially designed tools available for the application. Lubricate pipe
11 and coupling gasket, align pipe, and secure joint in accordance with the coupling manufacturer's specifications.

13 **UNIONS AND FLANGES**

14 Install a union, flange or grooved coupling combination at each connection to each piece of equipment and at other
15 items which may require removal for maintenance, repair, or replacement. Where a valve is located at a piece of
16 equipment, locate the flange or union or grooved coupling combination connections on the equipment side of the
17 valve. Concealed unions, flanges or couplings are not acceptable.

19 **FLEXIBLE SPRINKLER DROP FITTINGS**

20 Install in accordance with manufacturer's installation instructions following minimum bend radii, maximum number of
21 bends and bend distance from end requirements.

23 **PIPING SYSTEM LEAK TESTS**

24 Conduct pressure test with test medium of water. If leaks are found, repair the area with new materials and repeat
25 the test; caulking will not be acceptable.

27 Test piping in sections or entire system as required by sequence of construction. Do not conceal pipe until it has
28 been successfully tested. If required for the additional pressure load under test, provide temporary restraints at
29 fittings or expansion joints. Entire test must be witnessed by the Division's representative.

31 Use clean water and remove air from the piping being tested where possible. Measure and record test pressure at
32 the high point in the system.

34 Test system at 200 psi for 2 hours showing no leakage. Where system design is in excess of 150 psig, test at a
35 pressure 50 psig above system design pressure.

37 All pressure tests are to be documented on NFPA Contractor's Material and Test Certificate forms.

39 **INSTALLATION**

40 Install fire protection system components in accordance with NFPA rulings, listings and manufacturers
41 recommendations. Locate where accessible for servicing and replacement.

43 Sprinkler Heads: Locate sprinkler heads as indicated on fire protection plan and reflected ceiling plan maintaining
44 minimum clearances from obstructions, ceilings and walls. Install sprinkler heads level in locations not subject to
45 spray pattern interference. Provide fire sprinkler head installations below ductwork, soffits, etc.

47 **END OF SECTION**

SECTION 22 05 00
COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

SCOPE

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

PART 1 - GENERAL

- Scope
- Related Work
- Reference
- Reference Standards
- Lead Free Requirements
- Quality Assurance
- Continuity of Existing Services
- Protection of Finished Surfaces
- Sleeves and Openings
- Sealing and Fire Stopping
- Submittals
- Off Site Storage
- Codes
- Certificates and Inspections
- Operating and Maintenance Data
- Record Drawings

PART 2 - PRODUCTS

- Identification
- Sealing and Fire Stopping

PART 3 - EXECUTION

- Demolition
- Surface Repair
- Concrete Work
- Cutting and Patching
- Building Access
- Equipment Access
- Coordination
- Identification
- Sleeves and Openings
- Sealing and Firestopping

RELATED WORK

Section 07 84 00 – Fire Stopping

REFERENCE

Applicable provisions of Division 1 govern work under this section.

This section applies to all Division 22 00 00 sections of plumbing.

REFERENCE STANDARDS

Abbreviations of standards organizations referenced in this, and other sections are as follows:

- ABMA American Boiler Manufacturers Association
- ACPA American Concrete Pipe Association

1	AGA	American Gas Association
2	AMCA	Air Movement and Control Association
3	ANSI	American National Standards Institute
4	ARI	Air Conditioning and Refrigeration Institute
5	ASME	American Society of Mechanical Engineers
6	ASPE	American society of Plumbing Engineers
7	ASSE	American Society of Sanitary Engineering
8	ASTM	American Society for Testing and Materials
9	AWWA	American Water Works Association
10	AWS	American Welding Society
11	CISPI	Cast Iron Soil Pipe Institute
12	CGA	Compressed Gas Association
13	CS	Commercial Standards, Products Standards Sections, Office of Eng. Standards Service, NBS
14	DSPS	State of Wisconsin Dept. of Safety and Professional Services, State Plumbing Code
15	EPA	Environmental Protection Agency
16	FS	Federal Specifications, Superintendent of Documents, U.S. Government Printing Office
17	GAMA	Gas Appliance Manufacturers Association
18	IAPMO	International Association of Plumbing & Mechanical Officials
19	IEEE	Institute of Electrical and Electronics Engineers
20	ISA	Instrument Society of America
21	MCA	Mechanical Contractors Association
22	MICA	Midwest Insulation Contractors Association
23	MSS	Manufacturer's Standardization Society of the Valve & Fitting Industry, Inc.
24	NBS	National Bureau of Standards
25	NEC	National Electric Code
26	NEMA	National Electrical Manufacturers Association
27	NFPA	National Fire Protection Association
28	NSF	National Sanitation Foundation
29	PDI	Plumbing and Drainage Institute
30	SMACNA	Sheet Metal and Air Conditioning Contractors' National Association. Inc.
31	STI	Steel Tank Institute
32	UL	Underwriters Laboratories Inc.

33

34 Standards referenced in this section:

35	ASTM E814	Standard Test Method for Fire Tests of Through-Penetration Fire Stops
36	ASTM E84	Standard Test Method for Surface Burning Characteristics of Building Materials
37	UL1479	Fire Tests of Through-Penetration Firestops
38	UL723	Surface Burning Characteristics of Building Materials

39

40 **LEAD FREE REQUIREMENTS**

41 All materials that contact potable water shall be lead free. Lead free refers to the wetted surface of pipe, fittings and
42 fixtures in potable water systems that have a weighted average lead content $\leq 0.25\%$
43 per the Federal Safe Drinking Water Act as amended January 4th, 2011, Section 1417.

44

45 This requirement applies to all of the subsequent Plumbing Specification Sections and Plumbing Drawings and
46 supersedes any part or model number that may conflict with this requirement.

47

48 **QUALITY ASSURANCE**

49 Substitution of Materials: Refer to Section GC - General Conditions of the Contract, Equals and Substitutions.

50

51 All products and materials used are to be new, undamaged, clean and in good condition. Existing products and
52 materials are not to be reused unless specifically indicated.

53

1 Where equipment or accessories are used which differ in arrangement, configuration, dimensions, ratings, or
2 engineering parameters from those indicated on the contract documents, the contractor is responsible for all costs
3 involved in integrating the equipment or accessories into the system and for obtaining the intended performance from
4 the system into which these items are placed.

5
6 **CONTINUITY OF EXISTING SERVICES**

7 Do not interrupt or change existing services without prior written approval from the Owner's Project Representative.
8 When interruption is required, coordinate scheduling of down-time with the Owner to minimize disruption to his activities.
9 Unless specifically stated, all work involved in interrupting or changing existing services is to be done during normal
10 working hours.

11
12 **PROTECTION OF FINISHED SURFACES**

13 Refer to Division 1, General Requirements, Protection of Finished Surfaces.

14
15 **SLEEVES AND OPENINGS**

16 Refer to Division 1, General Requirements, Sleeves and Openings.

17
18 **SEALING AND FIRESTOPPING**

19 Sealing and firestopping of sleeves/openings between piping, etc. and the sleeve or structural opening shall be the
20 responsibility of the contractor whose work penetrates the opening. The contractor responsible shall hire individuals
21 skilled in such work to do the sealing and fireproofing. Provide all fire stopping of fire rated penetrations and sealing
22 of smoke rated penetrations in compliance with section 07 84 00 Fire Stopping.

23
24 **OFF SITE STORAGE**

25 Generally, sleeves, pipe/pipe fittings and similar rough-in material will not be accepted for off-site storage. No material
26 will be accepted for off-site storage unless shop drawings for the material have been approved.

27
28 **CODES**

29 Comply with requirements of Wisconsin Administrative Code.

30
31 **CERTIFICATES AND INSPECTIONS**

32 Refer also to Division 1, General Conditions, Permits, Regulations, Utilities and Taxes.

33
34 Obtain and pay for all required State installation inspections except those provided by the Architect/Engineer. Deliver
35 the originals of inspection certificates and test records to the Owner's Project Representative. Include copies of the
36 certificates and test records in the Operating and Maintenance Instructions.

37
38 **SUBMITTALS**

39 Refer to Division 1, General Conditions, Submittals.

40
41 Shop drawing submittals are to be bound, labeled, contain the project manual cover page and a material index list page
42 showing item designation, manufacturer and additional items supplied with the installation. Submit for all equipment
43 and systems as indicated in the respective specification sections, marking each submittal with that specification section
44 number. Mark general catalog sheets and drawings to indicate specific items being submitted and proper identification
45 of equipment by name and/or number, as indicated in the contract documents. Include wiring diagrams of electrically
46 powered equipment.

47
48 Submit sufficient quantities of data sheets and shop drawings to allow the following distribution:

- 49 • Operating and Maintenance Manuals 2 copies
50 • Architect/Engineer 1 copy

51
52 **OPERATION AND MAINTENANCE DATA**

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

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

- 3 1. Records of tests performed a to certify compliance with system requirements
- 4 2. Manufacturer's wiring diagrams for electrically powered equipment
- 5 3. Certificates of inspection by regulatory agencies
- 6 4. Valve schedules
- 7 5. Parts lists for fixtures, equipment, valves and specialties.
- 8 6. Manufacturers installation, operation and maintenance recommendations for fixtures, equipment, valves and
9 specialties.
- 10 7. Additional information as indicated in the technical specification sections

11 12 **RECORD DRAWINGS**

13 Refer to Division 1, General Requirements, Record Drawings.

14 15 **PART 2 - PRODUCTS**

16 17 **IDENTIFICATION**

18 **STENCILS:**

19 Not less than 1-inch-high letters/numbers for marking pipe and equipment.

20 21 **ENGRAVED NAME PLATES:**

22 White letters on a black background, 1/16-inch-thick plastic laminate, beveled edges, screw mounting, Setonply Style
23 2060 by Seton Name Plate Company or Emedolite Style EIP by EMED Co., or equal by W. H. Brady.

24 25 **ADHESIVE LABELS:**

26 Pressure-sensitive, adhesive backed, vinyl pipe markers with applicable labeling, 3/4" min. size for lettering and
27 surrounding tape on both ends. With flow arrows on piping. Conforming to ANSI, ANSI and NFPA standards. Seton
28 Opti-Code, MSI, Brady or approved equal. Clean piping before application.

29 30 **SNAP-AROUND PIPE MARKERS:**

31 One-piece, preformed, vinyl construction, snap-around or strap-around pipe markers with applicable labeling and flow
32 direction arrows, 3/4" min. size for lettering. Provide nylon ties on each end of pipe markers. Equal to Seton Setmark.

33 34 **VALVE TAGS:**

35 Round brass tags with 1/2-inch numbers, 1/4 inch system identification abbreviation, 1-1/4 inch minimum diameter,
36 with brass jack chains, brass "S" hooks or one piece nylon ties around the valve stem, available from EMED Co., Seton
37 Name Plate Company, or W. H. Brady.

38 39 **SEALING AND FIRE STOPPING**

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

41 Provide all fire stopping of fire rated penetrations and sealing of smoke rated penetrations in compliance with section
42 07 84 00 "Fire Stopping".

43 44 **NON-RATED PENETRATIONS:**

45 In exterior wall openings below grade, use a modular mechanical type seal consisting of interlocking synthetic rubber
46 links shaped to continuously fill the annular space between the uninsulated pipe and the cored opening or a water-stop
47 type wall sleeve. The operating bolts of the mechanical type seal shall be accessible from the interior of the building.

48
49 At pipe penetrations of non-rated interior partitions, floors, and exterior walls, use urethane caulk in annular space
50 between pipe insulation and sleeve. For non-rated drywall, plaster, or wood partitions where sleeve is not required use
51 urethane caulk in annular space between pipe insulation and wall material

52 53 **PART 3 - EXECUTION**

54 55 **DEMOLITION**

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

6
7 All pipe, fixtures, equipment, wiring and associated conduit, insulation and similar items demolished, abandoned, or
8 deactivated are to be removed from the site by the Contractor except as specifically noted otherwise. All designated
9 equipment is to be turned over to the user agency for their use at a place and time so designated. Maintain the condition
10 of material and/or equipment that is indicated to be reused equal to that existing before work began.

11 12 **CUTTING AND PATCHING**

13 Refer to Division 1, General Requirements, Cutting and Patching.

14 15 **BUILDING ACCESS**

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

19 20 **EQUIPMENT ACCESS**

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

25
26 Provide color coded thumb tacks or screws, depending on the surface, for use in accessible ceilings which do not
27 require access panels.

28 29 **COORDINATION**

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

32
33 Verify that all devices are compatible for the type of construction and surfaces on which they will be used.

34 35 **IDENTIFICATION**

36 Identify equipment in mechanical equipment rooms by stenciling equipment number and service with one coat of black
37 enamel against a light background or white enamel against a dark background. Use a primer where necessary for
38 proper paint adhesion.

39
40 Where stenciling is not appropriate for equipment identification, engraved name plates may be used.

41
42 Identify interior piping not less than once every 30 feet, not less than once in each room, adjacent to each access door
43 or panel, and on both side of the partition where accessible piping passes through walls or floors. Place flow directional
44 arrows at each pipe identification location. Use one coat of black enamel against a light background or white enamel
45 against a dark background.

46
47 Identify all exterior buried piping for entire length with underground warning tape except for sewer piping which is routed
48 in straight lines between manholes or cleanouts. Place tape 6"-12" below finished grade along entire length of pipe.
49 Extend tape to surface at building entrances, meters, hydrants, and valves. Where existing underground warning tape
50 is broken during excavation, replace with new tape identifying appropriate service and securely spliced to ends of
51 existing tape.

52
53 Identify valves with brass tags bearing a system identification and a valve sequence number. Identify medical gas and
54 vacuum valves with brass tags and wall or cabinet mounted color-coded engraved nameplate with the following "(Type
55 of Gas) Shutoff Valve for (Location or Zone)". Valve tags are not required at a terminal device unless the valves are

1 greater than ten feet from the device, located in another room or not visible from device. Provide a typewritten valve
2 schedule and pipe identification schedule indicating the valve number and the equipment or areas supplied by each
3 valve and the symbols used for pipe identification; locate schedules in mechanical room and in each Operating and
4 Maintenance manual. Schedule in mechanical room to be framed under clear plastic.

5
6 **SLEEVES AND OPENINGS**

7 Pipe penetrations in existing concrete floors: Core drill openings.

8
9 Pipe penetrations through existing floors located in food service areas that do not require a T rating: Core drill sleeve
10 opening large enough to insert schedule 40 sleeve, extend sleeve 2 inches above the floor and grout area around
11 sleeve with hydraulic setting, non-shrink grout. Size sleeve to allow insulated pipe to run through sleeve and paint the
12 sleeve.

13
14 Where penetrating pipe or conduit weight is supported by floor, provide manufactured product or structural bearing
15 collar designed to carry load.

16
17 **SEALING AND FIRE STOPPING**

18 FIRE AND/OR SMOKE RATED PENETRATIONS:

19 Provide all fire stopping of fire rated penetrations and sealing of smoke rated penetrations in compliance with section
20 07 84 00 Fire Stopping.

21
22 NON-RATED PARTITIONS:

23 In exterior wall openings below grade, assemble rubber links of mechanical seal to the proper size for the pipe and
24 tighten in place, in accordance with manufacturer's instructions. . The bolt heads for the mechanical seal shall face the
25 inside of the building to facilitate repair or replacement of the seal.

26
27 At all interior partitions and exterior walls, pipe penetrations are required to be sealed. Apply sealant to both sides of
28 the penetration in such a manner that the annular space between the pipe sleeve or cored opening and the pipe or
29 insulation is completely blocked.

30
31 **END OF SECTION**

SECTION 22 05 23
GENERAL DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

SCOPE

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

PART 1 - GENERAL

- Scope
- Related Work
- Reference
- Lead Free Requirements
- Quality Assurance
- Submittals
- Operation and Maintenance Data
- Design Criteria

PART 2 - PRODUCTS

- Water System Valves - Ball Valves

PART 3 - EXECUTION

- General
- Shut-off Valves

RELATED WORK

Section 22 05 00 Common Work Results for Plumbing

REFERENCE

Applicable provisions of Division 1 govern work under this section.

LEAD FREE REQUIREMENTS

All materials that contact potable water shall be lead free. Lead free refers to the wetted surface of pipe, fittings and fixtures in potable water systems that have a weighted average lead content $\leq 0.25\%$ per the Federal Safe Drinking Water Act as amended January 4th, 2011, Section 1417.

QUALITY ASSURANCE

Substitution of Materials: Refer to Section GC - General Conditions of the Contract, Equals and Substitutions.

SUBMITTALS

Refer to Division 1, General Conditions, Submittals.

Schedule of all valves indicating type of service, dimensions, materials of construction, and pressure/temperature ratings for all valves to be used on the project. Temperature ratings specified are for continuous operation.

OPERATION AND MAINTENANCE DATA

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

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

DESIGN CRITERIA

Where valve types (ball, butterfly, etc.) are specified for individual plumbing services (i.e. domestic water, gas, etc.), each valve type shall be of the same manufacturer unless prior written approval is obtained from the Owner.

1 Valves to be line size unless specifically noted otherwise.
2

3 **PART 2 - PRODUCTS**
4

5 **WATER SYSTEM VALVES**

6 All water system valves to be rated at not less than 125 water working pressure at 240 degrees F unless noted
7 otherwise.
8

9 **BALL VALVES:**

10 3" and smaller: Two-piece bronze body; sweat or threaded ends, chrome plated bronze ball; glass filled teflon seat;
11 teflon packing and threaded packing nut; blowout-proof stem; 600 psig WOG. Provide valve stem extensions for valves
12 installed in all piping with insulation. Apollo 70LF-200, Hammond UP8511, Milwaukee UPBA150, Nibco S580-80-LF,
13 Watts LFB-6081G2.
14

15 **PART 3 - EXECUTION**
16

17 **GENERAL**

18 Properly align piping before installation of valves. Install and test valves in strict accordance with valve manufacturer's
19 installation recommendations. Do not support weight of piping system on valve ends.
20

21 Mount valves in locations which allow access for operation, servicing and replacement.
22

23 Provide valve handle extensions for all valves installed in insulated piping.
24

25 Install all valves with the stem in the upright or horizontal position. If possible, install butterfly valves with the stem in
26 the horizontal position. Valves installed with the stems down will not be accepted.
27

28 Prior to flushing of piping systems, place all valves in the full-open position.
29

30 **SHUT-OFF VALVES**

31 Install shut-off valves at each piece of equipment, at each branch take-off from mains for isolation or repair and
32 elsewhere as indicated.
33

34 **END OF SECTION**

SECTION 22 05 29
HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

SCOPE

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

PART 1 - GENERAL

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

PART 2 - PRODUCTS

- Manufacturers
- Structural Supports
- Pipe Hangers and Supports
- Beam Clamps
- Riser Clamps

PART 3 - EXECUTION

- Installation
- Hanger and Support Spacing
- Riser Clamps

RELATED WORK

Section 22 07 00 - Plumbing Insulation for insulation protection at support devices.

REFERENCE

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

REFERENCE STANDARDS

MSS SP-58

REFERENCE

Applicable provisions of Division 1 govern work under this section.

QUALITY ASSURANCE

Substitution of Materials: Refer to Section GC - General Conditions of the Contract, Equals and Substitutions.

DESCRIPTION

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

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

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

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

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

2
3 **SHOP DRAWINGS**

4 Refer to Division 1, General Conditions, Submittals.

5
6 Schedule of all hanger and support devices indicating attachment methods and type of device for each pipe size and
7 type of service.

8
9 **DESIGN CRITERIA**

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

12
13 Piping connected to pumps, compressors, or other rotating or reciprocating equipment is to have vibration isolation
14 supports for a distance of one hundred pipe diameters or three supports away from the equipment, whichever is
15 greater. Standard pipe hangers/supports as specified in this section are required beyond the 100 pipe diameter/3
16 support distance.

17
18 **PART 2 - PRODUCTS**

19
20 **MANUFACTURERS**

21 Anvil, B-Line, Pate, Piping Technology, Roof Products & Systems or approved equal.

22
23 **STRUCTURAL SUPPORTS**

24 Provide all supporting steel required for the installation of mechanical equipment and materials, including angles,
25 channels, beams, etc. to suspended or floor supported tanks and equipment. All of this steel may not be specifically
26 indicated on the drawings.

27
28 **PIPE HANGERS AND SUPPORTS**

29 HANGERS FOR PIPE SIZES 1/2" THROUGH 2":

30 Carbon steel, adjustable swivel ring. B-Line B3170NF, Anvil 69 or 70.

31 Carbon steel, adjustable clevis, standard. B-Line B3100, Anvil 260.

32
33 HANGERS FOR PIPE SIZES 2" AND LARGER:

34 Carbon steel, adjustable clevis, standard. B-Line B3100, Anvil 260.

35
36 MULTIPLE OR TRAPEZE HANGERS:

37 Steel channels with welded spacers and hanger rods.

38
39 VERTICAL SUPPORT:

40 Carbon steel riser clamp. B-Line B3373, Anvil 261 for above floor use.

41
42 FLOOR SUPPORT:

43 Carbon steel pipe saddle, stand and bolted floor flange. B-Line B3088T/B3093.

44
45 COPPER PIPE SUPPORTS:

46 All supports, fasteners, clamps, etc. directly connected to copper piping shall be copper plated or polyvinylchloride
47 coated. Where steel channels are used, provide isolation collar between supports/clamps/fasteners and copper
48 piping.

49
50 **PIPE HANGER RODS**

51 STEEL HANGER RODS:

52 Threaded both ends, threaded one end, or continuous threaded, complete with adjusting and lock nuts.

53
54 Size rods for individual hangers and trapeze support as indicated in the following schedule.

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

3	Maximum Load (Lbs.)	Rod Diameter
4	<u>(650°F Maximum Temp.)</u>	<u>(inches)</u>
5	610	3/8
6	1130	1/2
7	1810	5/8
8	2710	3/4
9	3770	7/8
10	4960	1
11	8000	1-1/4

12
13 **BEAM CLAMPS**

14 MSS SP-58 Types 19 & 23 malleable black iron clamp for attachment to beam flange to 0.62 inches thick with a
15 retaining ring and threaded rod of 3/8, 1/2-, and 5/8-inch diameter. Furnish with a hardened steel cup point set
16 screw. B-Line B3036L/B3034, Anvil 86/92.

17
18 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
19 sizes to 1-1/2 inch diameter. B-Line B3054, Anvil 228.

20
21 **PART 3 - EXECUTION**

22
23 **INSTALLATION**

24 Size, apply and install supports and anchors in compliance with manufacturers recommendations.

25
26 Install supports to provide for free expansion of the piping system. Support all piping from the structure using
27 concrete inserts, beam clamps, ceiling plates, wall brackets, or floor stands. Fasten ceiling plates and wall brackets
28 securely to the structure and test to demonstrate the adequacy of the fastening.

29
30 Coordinate hanger and support installation to properly group piping of all trades.

31
32 Where piping can be conveniently grouped to allow the use of trapeze type supports, use standard structural shapes
33 or continuous insert channels for the supporting steel. Where continuous insert channels are used, pipe supporting
34 devices made specifically for use with the channels may be substituted for the specified supporting devices provided
35 that similar types are used, and all data is submitted for prior approval.

36
37 Size and install hangers and support, except for riser clamps, for installation on the exterior of piping insulation.
38 Where a vapor barrier is not required, hangers may be installed either on the exterior of pipe insulation or directly on
39 piping.

40
41 **HANGER AND SUPPORT SPACING**

42 Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.

43
44 Place a hanger within 12 inches of each horizontal elbow, valve, strainer, or similar piping specialty item.

45
46 Use hangers with 1-1/2 inch minimum vertical adjustment.

47
48 Where several pipes can be installed in parallel and at the same elevation, provide multiple or trapeze hangers.

49
50 Support riser piping independently of connected horizontal piping.

51
52 Adjust hangers to obtain the slope specified in the piping section of these specifications.

53
54 Space hangers for pipe as follows:

	<u>Pipe Material</u>	<u>Pipe Size</u>	<u>Max. Horiz. Spacing</u>	<u>Max. Vert. Spacing</u>
1				
2	Copper	1/2" through 3/4"	5'-0"	10'-0"
3	Copper	1" through 1-1/4"	6'-0"	10'-0"
4	Copper	1-1/2" through 2-1/2"	8'-0"	10'-0"
5	Plastic	Drain and Vent	4'-0"	10'-0"
6	Plastic	1" or less	32"	4'-0"
7	Plastic	1-1/4" and over	4'-0"	6'-0"

8

9 Greater hanger support distances may be used for CPVC and PEXa piping systems where metallic carrier channels
10 are used in conformance with the manufacturer's recommendations and meet all code requirements.

11

12 **RISER CLAMPS**

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

15

16

END OF SECTION

**SECTION 22 07 00
PLUMBING INSULATION**

PART 1 - GENERAL

SCOPE

This section includes insulation specifications for plumbing piping and equipment. Included are the following topics:

PART 1 - GENERAL

- Scope
- Related Work
- Reference Standards
- Quality Assurance
- Description
- Definitions
- Shop Drawings
- Operation and Maintenance Data

PART 2 - PRODUCTS

- Materials
- Insulation & Jackets
- Accessories

PART 3 - EXECUTION

- Installation
- Piping, Valve and Fitting Insulation

RELATED WORK

- Section 22 05 00 - Common Work Results for Plumbing
- Section 22 11 00 - Facility Water Distribution
- Section 22 05 29 - Hangers and Supports for Plumbing Piping and Equipment
- Section 22 30 00 - Plumbing Equipment

REFERENCE

Applicable provisions of Division 1 govern work under this section.

REFERENCE STANDARDS

- ASTM B209 Aluminum and Aluminum Alloy Sheet and Plate
- ASTM C165 Test Method for Compressive Properties of Thermal Insulations
- ASTM C177 Heat Flux and Thermal Transmission Properties
- ASTM C195 Mineral Fiber Thermal Insulation Cement
- ASTM C240 Cellular Glass Insulation Block
- ASTM C302 Density of Preformed Pipe Insulation
- ASTM C303 Density of Preformed Block Insulation
- ASTM C449 Mineral Fiber Hydraulic Setting Thermal Insulation Cement
- ASTM C518 Heat Flux and Thermal Transmission Properties
- ASTM C533 Calcium Silicate Block and Pipe Thermal Insulation
- ASTM C534 Preformed Flexible Elastomeric Thermal Insulation
- ASTM C547 Mineral Fiber Preformed Pipe Insulation
- ASTM C552 Cellular Glass Block and Pipe Thermal Insulation
- ASTM C553 Mineral Fiber Blanket and Felt Insulation
- ASTM C578 Preformed, Block Type Cellular Polystyrene Thermal Insulation
- ASTM C591 Preformed Rigid Cellular Polyurethane Thermal Insulation
- ASTM C610 Expanded Perlite Block and Thermal Pipe Insulation
- ASTM C612 Mineral Fiber Block and Board Thermal Insulation

1	ASTM C921	Properties of Jacketing Materials for Thermal Insulation
2	ASTM C1136	Flexible Low Permeance Vapor Retarders for Thermal Insulation
3	ASTM E84	Surface Burning Characteristics of Building Materials
4	MICA	National Commercial & Industrial Insulation Standards
5	NFPA 225	Surface Burning Characteristics of Building Materials
6	UL 723	Surface Burning Characteristics of Building Materials

7

8 **QUALITY ASSURANCE**

9 Substitution of Materials: Refer to Section GC - General Conditions of the Contract, Equals and Substitutions.

10

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

12

13 **DESCRIPTION**

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

- 16 • Pipe Insulation
- 17 • Equipment Insulation

18

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

23

24 **DEFINITIONS**

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

27

28 **SHOP DRAWINGS**

29 Refer to Division 1, General Conditions, Submittals.

30

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

34

35 **OPERATION AND MAINTENANCE DATA**

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

38

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

41

42 **PART 2 - PRODUCTS**

43

44 **MATERIALS**

45 Materials or accessories containing asbestos will not be accepted.

46

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

49

50 Insulation which is not located in an air plenum may have a flame spread rating not over 25 and a smoke
51 developed rating no higher than 150.

52

53

1 **INSULATION AND JACKETS**

2 Manufacturers: Armstrong, Certainteed Manson, Childers, Dow, Extol, Halstead, H.B. Fuller, Imcoa, Knauf, Owens-
3 Corning, Pittsburgh Corning, Rubatex, Johns-Mansville, or approved equal.

4
5 Insulating materials shall be fire retardant, moisture and mildew resistant, and vermin proof. Insulation shall be suitable
6 to receive jackets, adhesives and coatings as indicated.

7
8 **RIGID FIBERGLASS INSULATION:**

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

11
12 White kraft reinforced foil vapor barrier all service jacket, factory applied to insulation with a self-sealing pressure
13 sensitive adhesive lap, maximum permeance of .02 perms and minimum beach puncture resistance of 50 units.

14
15 **SEMI-RIGID FIBERGLASS INSULATION:**

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

19
20 White kraft reinforced foil vapor barrier all service jacket, factory applied to insulation with a maximum permeance of
21 .02 perms and minimum beach puncture resistance of 50 units.

22
23 **PVC FITTING COVERS AND JACKETS:**

24 White PVC film, gloss finish one side, semi-gloss other side, FS LP-535D, Composition A, Type II, Grade GU. Ultraviolet
25 inhibited indoor/outdoor grade to be used where exposed to high humidity, ultraviolet radiation, in kitchens or food
26 processing areas or installed outdoors. Jacket thickness to be .02 inch (20 mil).

27
28 **INSULATION INSERTS AND PIPE SHIELDS**

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

30
31 Construct inserts with calcium silicate, minimum 140 psi compressive strength. Piping 12" and larger, supplement with
32 high density 600 psi structural calcium silicate insert. Provide galvanized steel shield. Insert and shield to be minimum
33 180 degree coverage on bottom of supported piping and full 360 degree coverage on clamped piping. On roller mounted
34 piping and piping designed to slide on support, provide additional load distribution steel plate.

35
36 Where contractor proposes shop/site fabricated inserts and shields, submit schedule of materials, thicknesses, gauges
37 and lengths for each pipe size to demonstrate equivalency to pre-engineered pre-manufactured product described
38 above. On low temperature systems, extruded polystyrene may be substituted for calcium silicate provided insert and
39 shield length and gauge are increased to compensate for lower insulation compressive strength.

40
41 Precompressed 20# density molded fiberglass blocks, Hamfab or equal, of same thickness as adjacent insulation may
42 be substituted for calcium silicate inserts with one 1"x 6" block for piping through 2-1/2" and three 1" x 6" blocks for
43 piping through 4". Submit shield schedule to demonstrate equivalency to pre-engineered/pre-manufactured product
44 described above.

45
46 Wood blocks will not be accepted.

47
48 **ACCESSORIES**

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

51
52 Adhesives, sealants, and protective finishes shall be as recommended by insulation manufacturer for applications
53 specified.

1
2 Insulation bands to be 3/4 inch wide, constructed of aluminum or stainless steel. Minimum thickness to be .015 inch
3 for aluminum and .010 inch for stainless steel.

4
5 Tack fasteners to be stainless steel ring grooved shank tacks.

6
7 Staples to be clinch style.

8
9 Insulating cement to be ANSI/ASTM C195, hydraulic setting mineral wool.

10
11 Finishing cement to be ASTM C449.

12
13 **PART 3 - EXECUTION**

14
15 **INSTALLATION**

16 Install insulation, jackets and accessories in accordance with manufacturer's instructions and under ambient
17 temperatures and conditions recommended by manufacturer. Surfaces to be insulated must be clean and dry.

18
19 Do not insulate systems or equipment which are specified to be pressure tested or inspected, until testing, inspection
20 and any necessary repairs have been successfully completed.

21
22 Install insulation with smooth and even surfaces. Poorly fitted joints or use of filler in voids will not be accepted. Cover
23 and seal exposed fiberglass insulation when insulation is terminated, no raw fiberglass insulation is allowed. Provide
24 neat and coated terminations at all nameplates, uninsulated fittings, or at other locations where insulation terminates.
25 Install with longitudinal joints facing wall or ceiling.

26
27 Install fabric reinforcing without wrinkles. Overlap seams a minimum of 2 inches.

28
29 Use full-length material (as delivered from manufacturer) wherever possible. Scrap piecing of insulation or pieces cut
30 undersize and stretched to fit will not be accepted.

31
32 Insulation shall be continuous through sleeves and openings. Vapor barriers shall be maintained continuous through
33 all penetrations.

34
35 **PIPING, VALVE, AND FITTING INSULATION**

36 **GENERAL:**

37 Install insulation with butt joints and longitudinal seams closed tightly. Provide minimum 2" lap on jacket seams and 2"
38 tape on butt joints, firmly cemented with lap adhesive. Additionally secure with staples along seams and butt joints.
39 Coat staples with vapor barrier mastic on systems requiring vapor barrier.

40
41 Water supply piping insulation shall be continuous throughout the building and installed adjacent to and within building
42 walls to a point directly behind the fixture that is being supplied.

43
44 Install insulation continuous through pipe hangers and supports with hangers and supports on the exterior of insulation.
45 Where a vapor barrier is not required, hangers and supports may be attached directly to piping with insulation
46 completely covering hanger or support and jacket sealed at support rod penetration. Where riser clamps are required
47 to be attached directly to piping requiring vapor barrier, extend insulation and vapor barrier jacketing/coating around
48 riser clamp.

49
50 **INSULATION INSERTS AND PIPE SHIELDS:**

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

1 FITTINGS AND VALVES:

2 Fittings, valves, unions, flanges, couplings and specialties may be insulated with factory molded or built up insulation
3 of the same thickness as adjoining insulation. Cover insulation with fabric reinforcing and mastic or where temperatures
4 do not exceed 150 degrees, PVC fitting covers. Secure PVC fitting covers with tack fasteners and 1-1/2" band of mastic
5 over ends, throat, seams or penetrations. On systems requiring vapor barrier, use vapor barrier mastic.
6

7 PIPE INSULATION SCHEDULE:

8 Provide insulation on new and existing remodeled piping as indicated in the following schedule:

9 Service	10 Insulation Types	11 Insulation Thickness by Pipe Size				
		12 1" and 13 to 2"	14 1-1/4" 15 to 4"	2-1/2"	5" to 6"	8" and larger
Hot Water Supply	Rigid Fiberglass	1"	1"	1.5"	1.5"	1.5"
Cold Water	Rigid Fiberglass	0.5"	0.5"	1"	1"	1"

END OF SECTION

SECTION 22 11 00
FACILITY WATER DISTRIBUTION

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PART 1 - GENERAL

SCOPE

This section contains specifications for plumbing pipe and pipe fittings for this project. Included are the following topics:

PART 1 - GENERAL

- Scope
- Reference
- Reference Standards
- Shop Drawings
- Quality Assurance
- Delivery, Storage, and Handling
- Design Criteria

PART 2 - PRODUCTS

- Domestic Water
- Dielectric Unions and Flanges
- Unions and Flanges

PART 3 - EXECUTION

- General
- Preparation
- Erection
- Copper Pipe Joints
- Domestic Water
- Flushing and Disinfection of Potable Water Systems
- Dielectric Unions and Flanges
- Unions and Flanges
- Piping System Leak Tests

RELATED WORK

22 05 29 - Hangers and Supports for Plumbing Piping and Equipment

REFERENCE

Applicable provisions of Division 1 govern work under this section.

REFERENCE STANDARDS

- ANSI B16.22 Wrought Copper and Wrought Copper Alloy Solder Joint Pressure Fittings
- ANSI B16.29 Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings - DWV
- ASTM B32 Solder Metal
- ASTM B88 Seamless Copper Water Tube
- ASTM B280 Seamless Copper Tube for Air Conditioning and Refrigeration Field Service
- ASTM B813 Liquid and Paste Fluxes for Soldering Applications of Copper and Copper Alloy Tube
- ASTM F876 Standard Specification for Crosslinked Polyethylene (PEX) Tubing
- ASTM F877 Standard Specification for Crosslinked Polyethylene (PEX) Plastic Hot- and Cold-Water Distribution Systems
- ASTM F1960 Standard Specification for Cold Expansion Fittings with PEX Reinforcing Rings
- AWWA C904 Standard for Crosslinked Polyethylene (PEX) Pressure Pipe, 1/2-inch Through 3-inch, for Water Service
- AWS A5.8 Brazing Filler Metal

1 **SHOP DRAWINGS**

2 Refer to Division 1, General Conditions, Submittals.

3
4 Schedule from the contractor indicating the ASTM, AWWA or CISPI specification number of the pipe being proposed
5 along with its type and grade if known at the time of submittal, and sufficient information to indicate the type and
6 rating of fittings for each service.

7
8 **QUALITY ASSURANCE**

9 Substitution of Materials: Refer to Section GC – General Conditions of the Contract, Equals and Substitutions.

10
11 Order all copper and polyethylene pipe with each length marked with the name or trademark of the manufacturer
12 and type of pipe; with each shipping unit marked with the purchase order number, metal or alloy designation,
13 temper, size, and name of supplier.

14
15 Any installed material not meeting the specification requirements must be replaced with material that meets these
16 specifications without additional cost to the State.

17
18 **DELIVERY, STORAGE, AND HANDLING**

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

20
21 Cover pipe to prevent corrosion or deterioration while allowing sufficient ventilation to avoid condensation. Do not
22 store materials directly on grade. Protect pipe, tube, and fitting ends so they are not damaged. Where end caps are
23 provided or specified, take precautions so the caps remain in place. Protect fittings, flanges, and unions by storage
24 inside or by durable, waterproof, above ground packaging.

25
26 Offsite storage agreements will not relieve the contractor from using proper storage techniques.

27
28 Storage and protection methods must allow inspection to verify products.

29
30 **DESIGN CRITERIA**

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

33
34 Construct all piping for the highest pressures and temperatures in the respective system.

35
36 Non-metallic piping will be acceptable only for the services indicated. It will not be acceptable in ventilation plenum
37 spaces, including plenum ceilings unless approved for this use.

38
39 Where ASTM A53 type F pipe is specified, grade A Type E or S, or grade B Type E or S may be substituted at
40 Contractor's option. Where the grade or type is not specified, Contractor may choose from those commercially
41 available.

42
43 Where ASTM B88, type L H (drawn) temper copper tubing is specified, ASTM B88, type K H (drawn) temper copper
44 tubing may be substituted at Contractor's option.

45
46 **PART 2 - PRODUCTS**

47
48 **DOMESTIC WATER**

49 ABOVE GROUND:

50 Type L copper water tube, H (drawn) temper, ASTM B88; wrought copper pressure fittings, ANSI B16.22; lead free
51 (<.2%) solder, ASTM B32; flux, ASTM B813; copper phosphorous brazing alloy, AWS A5.8 BCuP. Copper
52 mechanical grooved fittings and couplings on roll grooved pipe may be used in lieu of soldered fittings. Mechanically
53 formed brazed tee connections may be used in lieu of specified tee fittings for branch takeoffs up to one-half (1/2)
54 the diameter of the main.

1 Crosslinked Polyethylene (PEX-a Engel Method) plastic pipe and fittings, 1/2" to 2" sizes: ASTM F876, ASTM F877,
2 AWWA C904, with ASTM F1960 cold expansion fittings, rated for a temperature of 180 degrees F at 100 psi, copper
3 tube size (CTS). Transition fittings PEX-to-Metal, one-piece lead free, brass threaded or sweat adapter, with PEX-a
4 reinforcing cold expansion ring. Fittings for PEXa-to-PEXa connection to be poly plastic. Multiport manifolds with
5 valves shall be accessible. Multiport tees are not required to be accessible. Pipe and fittings by the same
6 manufacturer, Uponor, Rehau, Sioux Chief or equal. Pipe system shall be installed and supported in accordance
7 with the manufacturer's instructions and include full manufacturer warranty. Fixture connection stub-out piping shall
8 transition to copper piping within wall, before entry into finished space, and include manufactured rigid support.
9 PEXa pipe 1" to 2" shall be provided in straight lengths, coil stock may be used for 1/2" and 3/4" sizes. 1/2" and 3/4" pipe
10 sizes shall be color coded blue for cold water, and red for hot and hot water return water.
11

12 **BELOW GROUND 2-1/2" AND SMALLER:**

13 Type K copper water tube, O (annealed) temper, ASTM B88; with cast copper pressure fittings, ANSI B16.18;
14 wrought copper pressure fittings, ANSI B16.22; lead free (<.2%) solder, ASTM B32; flux, ASTM B813; or cast
15 copper flared pressure fittings, ANSI B16.26.
16

17 **DIELECTRIC UNIONS AND FLANGES**

18 Watts Regulator Company, Lochinvar, Wilkins or EPCO Sales, Inc., dielectric unions 2" and smaller; dielectric
19 flanges 2" and larger; with iron female pipe thread to copper solder joint or brass female pipe thread end
20 connections, non-asbestos gaskets, having a pressure rating of not less than 175 psig at 180 degrees.
21

22 **UNIONS AND FLANGES**

23 Unions, flanges and gasket materials to have a pressure rating of not less than 150 psig at 180 degrees. Gasket
24 material for flanges and flanged fittings shall be teflon type. Treated paper gaskets are not acceptable.
25

26 **2" AND SMALLER COPPER:**

27 ANSI B16.18 cast bronze union coupling or ANSI B15.24 Class 150 cast bronze flanges.
28

29 **PART 3 - EXECUTION**

30
31 **GENERAL**

32 Install pipe and fittings in accordance with reference standards, manufacturers recommendations and recognized
33 industry practices.
34

35 **PREPARATION**

36 Cut pipe ends square. Ream ends of piping to remove burrs. Clean scale and dirt from interior and exterior of each
37 section of pipe and fitting prior to assembly.
38

39 **ERECTION**

40 Install all piping parallel to building walls and ceilings and at heights which do not obstruct any portion of a window,
41 doorway, stairway, or passageway. Where interferences develop in the field, offset or reroute piping as required to
42 clear such interferences. Coordinate locations of plumbing piping with piping, ductwork, conduit and equipment of
43 other trades to allow sufficient clearances. In all cases, consult drawings for exact location of pipe spaces, ceiling
44 heights, door and window openings, or other architectural details before installing piping.
45

46 Where copper, steel, or plastic piping is embedded in masonry or concrete, provide protective sleeve covering of
47 elastomeric pipe insulation.
48

49 Maintain piping in clean condition internally during construction.
50

51 Provide clearance for installation of insulation, access to valves and piping specialties.
52

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

1 Do not route piping through transformer vaults or above transformers, panelboards, or switchboards, including the
2 required service space for this equipment, unless the piping is serving this equipment
3

4 PEXa pipe joint connections shall be installed per manufacturer's recommendations. Use manufacturer
5 recommended cold-expansion tool for ASTM F 1960 connections.
6

7 Do not expose PEXa piping to direct sunlight. Provide cover to portions of piping exposed to direct
8 sunlight.
9

10 Install all valves and piping specialties, including items furnished by others, as specified and/or detailed. Provide
11 access to valves and specialties for maintenance. Make connections to all equipment, fixtures and systems installed
12 by others where same requires the piping services indicated in this section.
13

14 **COPPER PIPE JOINTS**

15 Remove all slivers and burrs remaining from the cutting operation by reaming and filing both pipe surfaces. Clean
16 fitting and tube with metal brush, emery cloth or sandpaper. Remove residue from the cleaning operation, apply flux
17 and assemble joint to socket stop. Apply flame to fitting until solder melts when placed at joint. Remove flame and
18 feed solder into joint until full penetration of cup and ring of solder appears. Wipe excess solder and flux from joint.
19

20 **DOMESTIC WATER**

21 Maintain piping system in clean condition during installation. Remove dirt and debris from assembly of piping as
22 work progresses. Cap open pipe ends where left unattended or subject to contamination.
23

24 Install interior water piping with drain valves where indicated and at low points of system to allow complete drainage.
25 Install shutoff valves where indicated and at the base of risers to allow isolation of portions of system for repair. Do
26 not install water piping within exterior walls.
27

28 **FLUSHING AND DISINFECTION OF POTABLE WATER SYSTEMS**

29 Prior to use, isolate and fill system with potable water. Allow to stand 24 hours. Flush each outlet proceeding from
30 the service entrance to the furthest outlet for minimum of 1 minute and until water appears clear. Fill system with a
31 solution of water and chlorine containing at least 10 parts per million of chlorine and allow to stand for 24 hours.
32 Flush system with potable water until chlorine concentration is no higher than source water level.
33

34 Wait 24 hours after final flushing. Take samples of water for lab testing. The number and location of samples shall
35 be representative of the system size and configuration and are subject to approval by Engineer. Test shall show the
36 absence of coliform bacteria. If test fails, repeat disinfection and testing procedures until no coliform bacteria are
37 detected. Submit test report indicating date and time of test along with test results.
38

39 Piping that is pressure tested shall be drained completely dry. The piping system is not to be left full of
40 stagnant water. The piping system, water heaters and water softeners shall not be filled until within 10 days of
41 occupancy to guard against microbial growth.
42

43 **DIELECTRIC UNIONS AND FLANGES**

44 Install dielectric unions or flanges at each point where a copper-to-steel pipe connection is required in domestic
45 water systems.
46

47 **UNIONS AND FLANGES**

48 Install a union or flange at each connection to each piece of equipment and at other items which may require
49 removal for maintenance, repair, or replacement. Where a valve is located at a piece of equipment, locate the flange
50 or union connection on the equipment side of the valve. Concealed unions or flanges are not acceptable.
51
52
53
54

1 **PIPING SYSTEM LEAK TESTS**

2 Isolate or remove components from system which are not rated for test pressure. Test piping in sections or entire
3 system as required by sequence of construction. Do not insulate or conceal pipe until it has been successfully
4 tested.

5
6 For hydrostatic tests, use clean water and remove all air from the piping being tested by means of air vents or
7 loosening of flanges/unions. Measure and record test pressure at the high point in the system.

8
9 Inspect system for leaks. Where leaks occur, repair the area with new materials and repeat the test; caulking will not
10 be acceptable.

11
12

	Test	<u>Initial Test</u>		<u>Final Test</u>	
<u>System</u>	<u>Medium</u>	<u>Pressure</u>	<u>Duration</u>	<u>Pressure</u>	<u>Duration</u>
14 Above Ground Domestic Water	Water	N/A		100 psig	8 hr

15

16 * Leakage on exterior mains 3" and larger may not exceed leakage calculated as follows:

17
$$\text{GPH Allowable Leakage} = \frac{(\text{Feet of Pipe}) (\text{Inches Dia. of Pipe}) (\text{Test Pressure})^5}{133,200}$$

18
19

20 **END OF SECTION**

PIPING SYSTEM TEST REPORT

1
2
3 **State of Wisconsin**
4 **Department of Administration**
5 **Division of Facilities Development**

Date Submitted: _____

6
7 **Project Name:** _____

8
9 **Location:** _____ **DFD Project No:** _____

10
11 **Contractor:** _____

12
13 Plumbing Fire Sprinkler

14 Test Medium: Air Water Other _____

15
16 Test performed per specification section No. _____

17
18 Specified Test Duration _____ Hours Specified Test Pressure _____ PSIG

19
20 System Identification: _____

21 Describe Location: _____

22 _____

23	
24 Test Date: _____	
25 Start Test Time: _____	Initial Pressure: _____ PSIG
26	
27 Stop Test Time: _____	Final Pressure: _____ PSIG
28	

29 Tested By: _____ Witnessed By: _____

30 Title: _____ Title: _____

31 Signed: _____ Signed: _____

32 Date: _____ Date: _____

33 Comments: _____

34 _____

35 _____

36 _____

37 _____

38 _____

39 _____

SECTION 22 13 00
FACILITY SANITARY SEWERAGE

PART 1 - GENERAL

SCOPE

This section contains specifications for plumbing pipe and pipe fittings for this project. Included are the following topics:

PART 1 - GENERAL

- Scope
- Reference
- Reference Standards
- Shop Drawings
- Quality Assurance
- Delivery, Storage, and Handling
- Design Criteria

PART 2 - PRODUCTS

- Sanitary Waste and Vent

PART 3 - EXECUTION

- General
- Preparation
- Erection
- Copper Pipe Joints
- Sanitary Waste and Vent
- Piping System Leak Tests

RELATED WORK

22 05 29 - Hangers and Supports for Plumbing Piping and Equipment

REFERENCE

Applicable provisions of Division 1 govern work under this section.

REFERENCE STANDARDS

- ANSI B16.22 Wrought Copper and Wrought Copper Alloy Solder Joint Pressure Fittings
- ANSI B16.29 Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings - DWV
- ASTM B32 Solder Metal
- ASTM B306 Copper Drainage Tube (DWV)
- ASTM B813 Liquid and Paste Fluxes for Soldering Applications of Copper and Copper Alloy Tube
- ASTM D1785 Poly Vinyl Chloride (PVC) Plastic Pipe
- ASTM D2241 Poly Vinyl Chloride (PVC) Pressure-Rated Pipe (SDR Series)
- ASTM D2466 Poly Vinyl Chloride (PVC) Plastic Pipe Fittings, Schedule 40
- ASTM D2564 Solvent Cements for Poly Vinyl Chloride (PVC) Plastic Pipe and Fittings
- ASTM D2665 Poly Vinyl Chloride (PVC) Plastic Drain, Waste and Vent Pipe and Fittings
- ASTM D2729 Poly Vinyl Chloride (PVC) Sewer Pipe and Fittings
- ASTM D2855 Making Solvent Cemented Joints with Poly Vinyl Chloride (PVC) Pipe and Fittings
- ASTM D3311 Drain, Waste and Vent (DWV) Plastic Fitting Patterns

SHOP DRAWINGS

Refer to Division 1, General Conditions, Submittals.

Schedule from the contractor indicating the ASTM, or CISPI specification number of the pipe being proposed along with its type and grade if known at the time of submittal, and sufficient information to indicate the type and rating of fittings for each service.

1 Statement from manufacturer on his letterhead that pipe furnished meets the ASTM, or CISPI specification contained
2 in this section.

3
4 **QUALITY ASSURANCE**

5
6 Substitution of Materials: Refer to Section GC – General Conditions of the Contract, Equals and Substitutions.

7
8 Order all copper, PVC and polyethylene pipe with each length marked with the name or trademark of the
9 manufacturer and type of pipe; with each shipping unit marked with the purchase order number, metal or alloy
10 designation, temper, size, and name of supplier.

11
12 Any installed material not meeting the specification requirements must be replaced with material that meets these
13 specifications without additional cost to the State.

14
15 **DELIVERY, STORAGE, AND HANDLING**

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

17
18 Cover pipe to prevent corrosion or deterioration while allowing sufficient ventilation to avoid condensation. Do not
19 store materials directly on grade. Protect pipe, tube, and fitting ends so they are not damaged. Where end caps are
20 provided or specified, take precautions so the caps remain in place. Protect fittings, flanges, and unions by storage
21 inside or by durable, waterproof, above ground packaging.

22
23 Storage and protection methods must allow inspection to verify products.

24
25 **DESIGN CRITERIA**

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

28
29 Construct all piping for the highest pressures and temperatures in the respective system.

30
31 Piping that is not in accordance with ASTM E-84/UL723 for flame spread of <25 and smoke development of <50
32 shall not be utilized in ventilation plenum spaces, including plenum ceilings.

33
34 Where weld fittings or mechanical grooved fittings are used, use only long radius elbows having a centerline radius of
35 1.5 pipe diameters.

36
37 Where ASTM A53 type F pipe is specified, grade A type E or S, or grade B type E or S may be substituted at
38 Contractor's option. Where the grade or type is not specified, Contractor may choose from those commercially
39 available.

40
41 Where ASTM B88, type L H (drawn) temper copper tubing is specified, ASTM B88, type K H (drawn) temper copper
42 tubing may be substituted at Contractor's option.

43
44 **PART 2 - PRODUCTS**

45
46 **SANITARY WASTE AND VENT**

47 INTERIOR ABOVE GROUND:

48
49 Type M copper water tube, H (drawn) temper, ASTM B88; with cast copper drainage fittings (DWV), ANSI B16.23;
50 wrought copper drainage fittings (DWV), ANSI B16.29; lead free (<.2%) solder, ASTM B32; flux, ASTM B813; copper
51 phosphorous brazing alloy, AWS A5.8 BCuP.

52
53 PVC plastic pipe, Schedule 40, Class 12454 (PVC 1120), ASTM D1785; PVC plastic drain, waste and vent pipe and
54 fittings, ASTM D2665; socket fitting patterns, ASTM D3311; primer, ASTM F656; solvent cement, ASTM D2564.

1 **PART 3 - EXECUTION**

2
3 **GENERAL**

4 Install pipe and fittings in accordance with reference standards, manufacturers recommendations and recognized
5 industry practices.

6
7 **PREPARATION**

8 Cut pipe ends square. Ream ends of piping to remove burrs. Clean scale and dirt from interior and exterior of each
9 section of pipe and fitting prior to assembly.

10
11 **ERECTION**

12 Install all piping parallel to building walls and ceilings and at heights which do not obstruct any portion of a window,
13 doorway, stairway, or passageway. Where interferences develop in the field, offset or reroute piping as required to
14 clear such interferences. Coordinate locations of plumbing piping with piping, ductwork, conduit and equipment of
15 other trades to allow sufficient clearances. In all cases, consult drawings for exact location of pipe spaces, ceiling
16 heights, door and window openings, or other architectural details before installing piping.

17
18 Maintain piping in clean condition internally during construction.

19
20 Provide clearance for installation of insulation, access to valves and piping specialties.

21
22 Provide anchors, expansion joints, swing joints and/or expansion loops so that piping may expand and contract
23 without damage to itself, equipment, or building.

24
25 Do not route piping through transformer vaults or above transformers, panelboards, or switchboards, including the
26 required service space for this equipment, unless the piping is serving this equipment

27
28 **COPPER PIPE JOINTS**

29 Remove all slivers and burrs remaining from the cutting operation by reaming and filing both pipe surfaces. Clean
30 fitting and tube with metal brush, emery cloth or sandpaper. Remove residue from the cleaning operation, apply flux
31 and assemble joint to socket stop. Apply flame to fitting until solder melts when placed at joint. Remove flame and
32 feed solder into joint until full penetration of cup and ring of solder appears. Wipe excess solder and flux from joint.

33
34 **SANITARY WASTE AND VENT**

35 Verify invert elevations and building elevations prior to installation. Install exterior piping pitched to drain at indicated
36 elevations and slope. Install interior piping pitched to drain at minimum slope of 1/4" per foot where possible and in no
37 case less than 1/8" per foot for piping 3" and larger.

38
39 Flush piping inlets (floor drains, hub drains, mop basins, fixtures, etc.) with high flow of water at completion of project
40 to demonstrate full flow capacity. Remove blockages and make necessary repairs where flow is found to be impeded.

41
42 **PIPING SYSTEM LEAK TESTS**

43 Isolate or remove components from system which are not rated for test pressure. Perform final testing for medical
44 and lab gas with all system components in place. Test piping in sections or entire system as required by sequence of
45 construction. Do not insulate or conceal pipe until it has been successfully tested.

46
47 If required for the additional pressure load under test, provide temporary restraints at fittings or expansion joints.
48 Backfill underground water mains prior to testing with the exception of thrust restrained valves which may be exposed
49 to isolate potential leaks.

50
51 For hydrostatic tests, use clean water and remove all air from the piping being tested by means of air vents or
52 loosening of flanges/unions. Measure and record test pressure at the high point in the system.

1 For air or nitrogen tests, gradually increase the pressure to not more than one half of the test pressure; then increase
2 the pressure in steps of approximately one-tenth of the test pressure until the required test pressure is reached.
3 Examine all joints and connections with a soap bubble solution or equivalent method. System will not be approved
4 until it can be demonstrated that there is no measurable loss of test pressure during the test period.

5
6 Inspect system for leaks. Where leaks occur, repair the area with new materials and repeat the test; caulking will not
7 be acceptable.

8
9

	Test	<u>Initial Test</u>	<u>Final Test</u>		
<u>System</u>	<u>Medium</u>	<u>Pressure</u>	<u>Duration</u>	<u>Pressure</u>	<u>Duration</u>
Sanitary Waste and Vent	Water	N/A		10' water	2 hr

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END OF SECTION

SECTION 22 42 00
COMMERCIAL PLUMBING FIXTURES

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PART 1 - GENERAL

SCOPE

This section includes specifications for plumbing fixtures, faucets and trim.

PART 1 - GENERAL

- Scope
- Related Work
- Quality Assurance
- Shop Drawings
- Operation and Maintenance Data
- Design Criteria
- Energy Efficiency Requirements

PART 2 - PRODUCTS

- Plumbing Fixtures

PART 3 - EXECUTION

- Installation

RELATED WORK

- Section 22 11 00 - Facility Water Distribution
- Section 22 13 00 - Facility Sanitary Sewerage
- Section 22 05 29 – Hangers and Supports for Plumbing Piping and Equipment

REFERENCE

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

QUALITY ASSURANCE

Substitution of Materials: Refer to Section GC - General Conditions of the Contract, Equals and Substitutions.

SHOP DRAWINGS

Refer to Division 1, General Conditions, Submittals.

Include data concerning sizes, utility sizes, rough in-dimensions, capacities, materials of construction, ratings, weights, trim, finishes, manufacturer's installation requirements, manufacturer's performance limitations, and appropriate identification.

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:

DESIGN CRITERIA

- ANSI A112.6.1M-88 - Supports for Off-the Floor Plumbing Fixtures for Public Use.
- ANSI A112.18.1-94 - Finished and Rough Brass Plumbing Fixture Fittings.
- ANSI A112.19.1-90 - Enameled Cast Iron Plumbing Fixtures.
- ANSI A112.19.2M-82 - Vitreous China Plumbing Fixtures.
- ANSI A112.19.5-79(R1990) - Trim for Water Closet Bowls, Tanks and Urinals.

1 **ENERGY EFFICIENCY REQUIREMENTS**

2 Plumbing fixtures must meet the following maximum water usage requirements which are based upon Federal Energy
3 Management Program (FEMP) performance requirements.

- 4 a. Lavatory Faucets, flow of 2 gpm or less and .25 gallon per cycle or less (based on inlet pressure of 60 p.s.i.)
5 c. Urinal Flush Valves, 1.0 gallon per flush or less.
6 d. Water Closet Flush Valves, 1.6 gallon per flush or less.

7
8 **PART 2 - PRODUCTS**

9
10 **PLUMBING FIXTURES**

11 Manufacturers: Fixture descriptions establish fixture type, quality, materials, features and size. Products of the
12 following manufacturers determined to be equal by the Architect/Engineer will be accepted.

13
14 Refer to "Plumbing Fixture Schedule" on Plumbing Drawings for basis of design for all plumbing fixtures required for
15 this project.

- 16
17 • Water Closets – Mansfield, American Standard, Kohler, Zurn.
18 • Water Closet Seats - Bemis, Beneke, Centoco, Olsonite Sperzel.
19 • Urinals – Mansfield, American Standard, Kohler, Zurn.
20 • Lavatories – Sloan, Corian, American Standard, Kohler, Zurn.
21 • Faucets – Sloan, American Standard, Chicago Faucet, Kohler, Zurn.
22 • Drains - Chicago Faucet, Engineered Brass Co., Kohler, McGuire.
23 • Stops and Supplies - Chicago Faucet Co., McGuire. (Heavy Duty Type Only)
24 • Flush Valves - Coyne & Delany, Sloan, Zurn .
25 • Traps - Kohler, McGuire, Dearborn, Engineered Brass Co. (17 gauge Min.)
26 • Carriers and Supports - Josam, Smith, Wade, Watts Drainage, Zurn.
27 • Sinks - American Standard, Elkay, Just, Kohler.

28
29 **PART 3 - EXECUTION**

30
31 **INSTALLATION**

32 Install plumbing fixtures in accordance with manufacturer's instructions. Set level and plumb. Secure in place to counters,
33 floors and walls providing solid bearing and secure mounting. Bolt fixture carriers to floor and wall. Secure rough-in
34 fixture piping to prevent movement of exposed piping.

35
36 Install each fixture with trap easily removable for servicing and cleaning. Install fixture stops in readily accessible location
37 for servicing.

38
39 Install barrier free fixtures in compliance with IBC 1108 and 3408, COMM 52, 69 and Federal ADA Accessibility
40 Guidelines. Install barrier free lavatory traps parallel and adjacent to wall and supplies and stops elevated to 27" above
41 floor to avoid contact by wheelchair users.

42
43 Each fixture shall have a stop valve installation to control the fixture. Stop valves shall be heavy duty type with brass
44 stems and screwed or sweat inlet connections. Compression type inlets are not acceptable.

45
46 Cover pipe penetrations with escutcheons. Exposed traps, stops, piping and escutcheons to be chrome plated brass,
47 same items in concealed locations may be of rough brass finish.

48
49 Set floor mounted water closets, counter mounted lavs and sinks; lav and sink faucets and drains with full setting bed of
50 flexible non-staining plumber's putty. Cover exposed water closet bolts with bolt covers.

51
52 Seal openings between walls, floors and fixtures with mildew-resistant silicone sealant same color as fixture.
53 Test fixtures to demonstrate proper operation. Replace malfunctioning units or components. Adjust valves for intended
54 water flow rate to fixtures without splashing, noise or overflow. Adjust self-closing lavatory faucets to 15 second cycle.

ICA
30 NOVEMBER 2022

1 Protect fixtures during construction. At completion clean plumbing fixtures and trim using manufacturer's recommended
2 cleaning methods and materials.

3
4

END OF SECTION

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

PART 1 - GENERAL

SCOPE

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

PART 1 - GENERAL

- Scope
- Related Work
- Reference
- Reference Standards
- Quality Assurance
- Continuity of Existing Services
- Protection of Finished Surfaces
- Sleeves and Openings
- Sealing and Fire Stopping
- Equipment Furnished By Others
- Provisions for Future
- 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
- Excavation and Backfill
- Concrete Work
- Cutting and Patching
- Building Access
- Equipment Access
- Coordination
- Identification
- Lubrication
- Sleeves and Openings
- Sealing and Fire Stopping
- Agency Training

RELATED WORK

- Section 01 91 01 or 01 91 02 – Commissioning Process
- Section 07 84 00 - Fire Stopping
- Section 23 05 13 - Common Motor Requirements for HVAC.
- Section 23 33 00 - Air Duct Accessories.

REFERENCE

Applicable provisions of Division 1 govern work under this section.

REFERENCE STANDARDS

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

- | | |
|------|---|
| AABC | Associated Air Balance Council |
| ABMA | American Boiler Manufacturers Association |
| ADC | Air Diffusion Council |
| AGA | American Gas Association |
| AMCA | Air Movement and Control Association |
| ANSI | American National Standards Institute |

1	ARI	Air-Conditioning and Refrigeration Institute
2	ASHRAE	American Society of Heating, Refrigerating and Air Conditioning Engineers
3	ASME	American Society of Mechanical Engineers
4	ASTM	American Society for Testing and Materials
5	AWWA	American Water Works Association
6	AWS	American Welding Society
7	CGA	Compressed Gas Association
8	CTI	Cooling Tower Institute
9	EPA	Environmental Protection Agency
10	GAMA	Gas Appliance Manufacturers Association
11	IEEE	Institute of Electrical and Electronics Engineers
12	ISA	Instrument Society of America
13	MCA	Mechanical Contractors Association
14	MICA	Midwest Insulation Contractors Association
15	MSS	Manufacturer's Standardization Society of the Valve & Fitting Industry, Inc.
16	NBS	National Bureau of Standards
17	NEBB	National Environmental Balancing Bureau
18	NEC	National Electric Code
19	NEMA	National Electrical Manufacturers Association
20	NFPA	National Fire Protection Association
21	SMACNA	Sheet Metal and Air Conditioning Contractors' National Association. Inc.
22	UL	Underwriters Laboratories Inc.
23	ASTM E814	Standard Test Method for Fire Tests of Through-Penetration Fire Stops
24	ASTM E84	Standard Test Method for Surface Burning Characteristics of Building Materials
25	UL1479	Fire Tests of Through-Penetration Firestops
26	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.

EQUIPMENT FURNISHED BY OTHERS

PROVISIONS FOR FUTURE

SUBMITTALS

Refer to Division 1, General Conditions, Submittals.

1 Submit for all equipment and systems as indicated in the respective specification sections, marking each submittal
2 with that specification section number. Mark general catalog sheets and drawings to indicate specific items being
3 submitted and proper identification of equipment by name and/or number, as indicated in the contract documents.
4

5 Before submitting electrically powered equipment, verify that the electrical power and control requirements for the
6 equipment are in agreement with the motor starter schedule on the electrical drawings. Include a statement on the
7 shop drawing transmittal to the architect/engineer that the equipment submitted, and the motor starter schedules
8 are in agreement or indicate any discrepancies. See related comments in Section 23 05 13 in Part 1 under Electrical
9 Coordination.
10

11 Include wiring diagrams of electrically powered equipment.
12

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

- 14 • Operating and Maintenance Manuals 2 copies
 - 15 • Testing, Adjusting and Balancing Contractor 1 copy
 - 16 • Division of Facilities Development 1 copy
 - 17 • A/E 1 copy
- 18

19 **OFF SITE STORAGE**

20 Prior approval by the owner and the A/E will be needed. The contractor shall submit Storage Agreement Form AD-
21 BDC-74 to the owner for consideration of offsite materials storage.
22

23 Generally, ductwork, metal for making ductwork, duct lining, sleeves, pipe/pipe fittings and similar rough-in material
24 will not be accepted for offsite storage. For material that can be stored off site, no material will be accepted for
25 offsite storage unless shop drawings for that material have been approved.
26

27 **CERTIFICATES AND INSPECTIONS**

28 Refer also to Division 1, General Conditions, Permits, Regulations, Utilities and Taxes.
29

30 Obtain and pay for all required State installation inspections except those provided by the Architect/Engineer in
31 accordance with code. Deliver originals of these certificates to the Division Project Representative. Include copies
32 of the certificates in the Operating and Maintenance Instructions.
33

34 **OPERATION AND MAINTENANCE DATA**

35 All operations and maintenance data shall comply with the submission and content requirements specified under
36 section GENERAL REQUIREMENTS.
37

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

- 40 1. Records of tests performed a to certify compliance with system requirements
- 41 2. Certificates of inspection by regulatory agencies
- 42 3. Valve schedules
- 43 4. Lubrication instructions, including list/frequency of lubrication
- 44 5. Copies of all approved shop drawings.
- 45 6. Manufacturer's wiring diagrams for electrically powered equipment
- 46 7. Temperature control record drawings and control sequences
- 47 8. Parts lists for manufactured equipment
- 48 9. Warranties
- 49 10. Additional information as indicated in the technical specification sections
50

51 **TRAINING OF OWNER PERSONNEL**

52 Instruct user agency personnel in the proper operation and maintenance of systems and equipment provided as
53 part of this project; video tape all training sessions. Include not less than 4 hours of instruction, using the
54 Operating and Maintenance manuals during this instruction. Demonstrate startup and shutdown procedures for all
55 equipment. All training to be during normal working hours.
56

57 **RECORD DRAWINGS**

58 Refer to Division 1, General Requirements, Record Drawings.
59

60 In addition to the data indicated in the General Requirements, maintain temperature control record drawings on
61 originals prepared by the installing contractor/subcontractor. Include copies of these record drawings with the
62 Operating and Maintenance manuals.
63
64

1 **PART 2 - PRODUCTS**

2
3 **ACCESS PANELS AND DOORS**

4
5 LAY-IN CEILINGS:

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

8
9 CONCEALED SPLINE CEILINGS:

10 Removable sections of ceiling tile held in position with metal slats or tabs compatible with the ceiling system used
11 will be provided under Section 09500.

12
13 METAL PAN CEILINGS:

14 Removable sections of ceiling tile held in position by a pressure fit will be provided under Section 09500.

15
16 PLASTER WALLS AND CEILINGS:

17 16-gauge frame with not less than a 20-gauge hinged door panel, prime coated steel for general applications,
18 stainless steel for use in toilets, showers, and similar wet areas, concealed hinges, screwdriver operated cam latch
19 for general applications, key lock for use in public areas, UL listed for use in fire rated partitions if required by the
20 application. Use the largest size access opening possible, consistent with the space and the equipment needing
21 service; minimum size is 12" by 12".

22
23 **IDENTIFICATION**

24 **STENCILS:**

25 Not less than 1-inch-high letters/numbers for marking pipe and equipment.

26
27 **SNAP-ON PIPE MARKERS:**

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

31
32 **ENGRAVED NAME PLATES:**

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

36
37 **VALVE TAGS:**

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

41
42 **SEALING AND FIRE STOPPING**

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

44 Provide all fire stopping of fire rated penetrations and sealing of smoke rated penetrations in compliance with section
45 07 84 00 "Fire Stopping".

46
47 **NON-RATED PENETRATIONS:**

48
49 **Pipe Penetrations Through Below Grade Walls:**

50 In exterior wall openings below grade, use a modular mechanical type seal consisting of interlocking synthetic rubber
51 links shaped to continuously fill the annular space between the uninsulated pipe and the cored opening or a water-
52 stop type wall sleeve.

53
54 **Pipe Penetrations:**

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

58
59 **Duct Penetrations:**

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

1 Where shown or specified, pack annular space with fiberglass batt insulation or mineral wool insulation. Provide
2 4" sheet metal escutcheon around duct on both sides of partition or floor to cover annular space.
3

4 **PART 3 - EXECUTION**

5
6 **DEMOLITION**

7 Perform all demolition as indicated on the drawings to accomplish new work. Where demolition work is to be
8 performed adjacent to existing work that remains in an occupied area, construct temporary dust partition to minimize
9 the amount of contamination of the occupied space. Where pipe or duct is removed and not reconnected with new
10 work, cap ends of existing services as if they were new work. Coordinate work with the user agency to minimize
11 disruption to the existing building occupants.
12

13 All pipe, wiring and associated conduit, insulation, ductwork, and similar items demolished, abandoned, or
14 deactivated are to be removed from the site by the Contractor. All piping and ductwork specialties are to be removed
15 from the site by the Contractor unless they are dismantled and removed or stored by the user agency. All designated
16 equipment is to be turned over to the user agency for their use at a place and time so designated. Maintain the
17 condition of material and/or equipment that is indicated to be reused equal to that existing before work began.
18

19 **EXCAVATION AND BACKFILL**

20 Perform all excavation and backfill work to accomplish indicated mechanical systems installation in accordance with
21 Division 31 - Earthwork. Blasting will not be allowed without written permission of the Architect/Engineer and the
22 user agency.
23

24 Install lines passing under foundations with minimum of 1-1/2-inch clearance to concrete and insure there is no
25 disturbance of bearing soil.
26

27 **CONCRETE WORK**

28 All cast-in-place concrete will be performed by the Division 3 Contractor unless otherwise noted. Provide all layout
29 drawings, anchor bolts, metal shapes, and/or templates required to be cast into concrete or used to form concrete
30 for support of mechanical equipment.
31

32 **CUTTING AND PATCHING**

33 Refer to Division 1, General Requirements, Cutting and Patching.
34

35 **BUILDING ACCESS**

36 Arrange for the necessary openings in the building to allow for admittance of all apparatus. When the building
37 access was not previously arranged and must be provided by this contractor, restore any opening to its original
38 condition after the apparatus has been brought into the building.
39

40 **EQUIPMENT ACCESS**

41 Install all piping, conduit, ductwork, and accessories to permit access to equipment for maintenance and service.
42 Coordinate the exact location of wall and ceiling access panels and doors with the General Contractor, making sure
43 that access is available for all equipment and specialties. Access doors in general construction are to be furnished
44 by the Mechanical Contractor and installed by the General Contractor.
45

46 Provide color coded thumb tacks or screws, depending on the surface, for use in accessible ceilings which do not
47 require access panels.
48

49 **COORDINATION**

50 Verify that all devices are compatible for the surfaces on which they will be used. This includes, but is not limited
51 to, diffusers, register, grilles, and recessed or semi-recessed heating and/or cooling terminal units installed in/on
52 architectural surfaces.
53

54 Coordinate all work with other contractors prior to installation. Any installed work that is not coordinated and that
55 interferes with other contractor's work shall be removed or relocated at the installing contractor's expense.
56

57 Cooperate with the test and balance agency in ensuring Section 23 05 93 specification compliance. Verify system
58 completion to the test and balance agency (flushing, pressure testing, chemical treatment, filling of liquid systems,
59 proper pressurization and air venting of hydronic systems, clean filters, clean strainers, duct and pipe systems
60 cleaned, controls adjusted and calibrated, controls cycled through their sequences, etc.), ready for testing, adjusting
61 and balancing work. Install dampers, shutoff and balancing valves, flow measuring devices, gauges, temperature
62 controls, etc., required for functional and balanced systems. Demonstrate the starting, interlocking and control
63 features of each system so the test and balance agency can perform its work.
64

1 **IDENTIFICATION**

2 Identify equipment in mechanical equipment rooms by stenciling equipment number and service with one coat of
3 black enamel against a light background or white enamel against a dark background. Use a primer where necessary
4 for proper paint adhesion. Do not label equipment such as cabinet heaters and ceiling fans in occupied spaces.
5

6 Where stenciling is not appropriate for equipment identification, engraved name plates may be used.
7

8 Identify piping not less than once every 30 feet, not less than once in each room, adjacent to each access door or
9 panel, and on both side of the partition where exposed piping passes through walls, floors or roofs. Place flow
10 directional arrows at each pipe identification location. Use one coat of black enamel against a light background or
11 white enamel against a dark background for stenciling or provide snap-on pipe markers as specified in Part 2 –
12 Products.
13

14 Identify valves with brass tags bearing a system identification and a valve sequence number. Valve tags are not
15 required at a terminal device unless the valves are greater than ten feet from the device or located in another room
16 not visible from the terminal unit. Provide a typewritten valve schedule indicating the valve number and the
17 equipment or areas supplied by each valve; locate schedules in each mechanical room and in each Operating and
18 Maintenance manual. Schedules in mechanical rooms to be framed under clear plastic.
19

20 Use engraved name plates to identify control equipment.
21

22 Label fire, smoke and combination fire smoke dampers on the exterior surface of ductwork directly adjacent to
23 access doors using a minimum of 0.5-inch height lettering reading, "SMOKE DAMPER" or "FIRE DAMPER". Smoke
24 and combination fire smoke dampers shall also include a second line listing the individual damper tag. The tags
25 must be coordinated with the mechanical schedules. Utilize stencils or manufactured labels. All other forms of
26 identification are unacceptable. All labels shall be clearly visible from the ceiling access point.
27

28 **LUBRICATION**

29 Lubricate all bearings with lubricant as recommended by the manufacturer before the equipment is operated for any
30 reason. Once the equipment has been run, maintain lubrication in accordance with the manufacturer's instructions
31 until the work is accepted by owner. Maintain a log of all lubricants used and frequency of lubrication; include this
32 information in the Operating and Maintenance Manuals at the completion of the project.
33

34 **SLEEVES AND OPENINGS**

35 Pipe penetrations in new poured concrete horizontal construction requiring F and T rating: Form opening using hole
36 form or core drill opening. Alternatively provide cast in place fire stopping devices/sleeves.
37

38 Pipe penetrations in new poured concrete horizontal construction requiring F rating but no T rating: Same as pipe
39 penetrations in new poured concrete construction requiring F and T ratings except that schedule 40 steel sleeves
40 may also be used.
41

42 Pipe penetrations in new poured concrete horizontal construction that do not require F or T ratings: Provide
43 schedule 40 steel pipe sleeve, form opening using hole form or core drill opening.
44

45 Pipe penetrations in existing concrete floors: Core drill openings.
46

47 Pipe penetrations through existing floors located in food service areas that do not require a T rating: Core drill sleeve
48 opening large enough to insert schedule 40 sleeve, extend sleeve 2 inches above the floor and grout area around
49 sleeve with hydraulic setting, non-shrink grout. Size sleeve to allow insulated pipe to run through sleeve and paint
50 the sleeve.
51

52 Where penetrating pipe or conduit weight is supported by floor, provide manufactured product or structural
53 bearing collar designed to carry load.
54

55 **DUCT SLEEVES:**

56 Duct sleeves are not required in non-rated partitions or floors.
57

58 Provide sleeve required for fire dampers in fire-rated partitions and floors. Reference fire damper details on
59 drawings.
60

61 **SEALING AND FIRE STOPPING**

62 **FIRE AND/OR SMOKE RATED PENETRATIONS**

63 Provide all fire stopping of fire rated penetrations and sealing of smoke rated penetrations in compliance with section
64 07 84 00 Fire Stopping.

1 NON-RATED PENETRATIONS:

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

5
6 At all interior walls and exterior walls, pipe penetrations are required to be sealed. Apply sealant to both sides of
7 the penetration in such a manner that the annular space between the pipe sleeve or cored opening and the pipe or
8 insulation is completely blocked.

9
10 Duct penetrations through non-rated partitions shall require sheet metal escutcheons with fiberglass or mineral wool
11 insulation fill for spaces that include laboratories, clean rooms, animal rooms, kitchens, cart washrooms, janitor
12 closets, toilet rooms, mechanical rooms, conference rooms, private consultation rooms, where ducts are exposed
13 and where noted on drawings elsewhere.

14
15 PENETRATIONS SUBJECT TO WATER INTRUSION:

16 For penetrations (both rated and non-rated) in floors subject to water intrusion or in rooms housing electrical
17 equipment (but not within walls) provide one of the following:

- 18 • Pipe penetration where steel pipe sleeve is used extend steel sleeve 2" above the floor.
- 19 • Pipe penetration where cast in place fire stopping device/sleeve is used, extend device/sleeve 2" above
20 the floor (provided it meets the device's UL listing).
- 21 • Pipe penetration where there is no steel sleeve or cast in place fire stopping device/sleeve, provide 2"x
22 2" x 1/8" galvanized steel angles fastened to floor surrounding the penetration or group of penetrations to
23 prevent water from getting to penetration. Provide urethane caulk between angles and floor and fasten
24 angles to floor minimum 8" on center. Seal corners watertight with urethane caulk.
- 25 • Duct penetrations. Provide 2"x 2" x 1/8" galvanized steel angles fastened to floor surrounding the
26 penetration or group of penetrations to prevent water from getting to penetration. Provide urethane caulk
27 between angles and floor and fasten angles to floor minimum 8" on center. Seal corners watertight with
28 urethane caulk.

29
30 Floors subject to water intrusion or rooms housing electrical equipment include the following locations:

- 31 • Food Service/Kitchen Areas
- 32 • Walk In Coolers/Freezers
- 33 • Laundries
- 34 • Restrooms
- 35 • Locker/Shower Rooms
- 36 • Janitor Rooms w/ Sinks
- 37 • Wet Laboratories
- 38 • Mechanical/Plumbing Equipment Rooms
- 39 • Swimming Pool Rooms/Pool Equipment Rooms
- 40 • Chemical/Hazardous Waste Storage
- 41 • Maintenance/Industrial Shops
- 42 • Vehicle Storage and Parking Ramps
- 43 • Greenhouses
- 44 • Data/Telecommunications Rooms
- 45 • Electrical Equipment Rooms

46
47 Provide waterproof caulk sealant top coating on fire stopping system (or other approved means to protect the fire
48 stopping system from water) in areas subject to wash down such as Food Service and Dish Washing Areas.

49
50 **AGENCY TRAINING**

51 All training provided for agency shall comply with the format, general content requirements and submission
52 guidelines specified under Section 01 91 01 or 01 91 02.

53
54 **END OF SECTION**

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

PART 1 - GENERAL

SCOPE

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

PART 1 - GENERAL

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

PART 2 - PRODUCTS

- Pipe Hanger and Support Manufacturers
- Structural Supports
- Beam Clamps
- Wood Structure Supports
- Concrete Inserts
- Anchors

PART 3 - EXECUTION

- Installation
- Hanger and Support Spacing
- Vertical Riser Clamps
- Anchors

RELATED WORK

- Section 01 91 01 or 01 91 02 – Commissioning Process
- 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.

1 **DESIGN CRITERIA**

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

4
5 Piping connected to base mounted pumps, compressors, or other rotating or reciprocating equipment is to have
6 vibration isolation supports for a distance of one hundred pipe diameters or three supports away from the
7 equipment, whichever is greater. Standard pipe hangers/supports as specified in this section are required beyond
8 the 100-pipe diameter/3 support distance.

9
10 Piping flexible connections and vibration isolation supports are required for piping connected to coils that are in a
11 fan assembly where the entire assembly is mounted on vibration supports; the vibration isolation supports are
12 required for a distance of one hundred pipe diameters or three supports away from the equipment, whichever is
13 greater. Piping flexible connection and vibration isolation supports are not required when the fan section is
14 separately and independently isolated by means of vibration supports and duct flexible connections. Standard
15 pipe hangers/supports as specified in this section are required when there are no vibration isolation devices in the
16 piping and beyond the 100-pipe diameter/3 support distance.

17
18 Piping supported by laying on the bottom chord of joists or trusses will not be accepted.

19
20 Fasteners depending on soft lead for holding power or requiring powder actuation will not be accepted.

21
22 Allow sufficient space between adjacent pipes and ducts for insulation, valve operation, routine maintenance, etc.

23
24 **PART 2 - PRODUCTS**

25
26 **PIPE HANGER AND SUPPORT MANUFACTURERS**

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

29
30 **STRUCTURAL SUPPORTS**

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

34
35 **PIPE HANGERS AND SUPPORTS**

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

37 Carbon steel, adjustable, clevis, black finish. Anvil figure 65 or 260.

38
39 **HANGERS FOR STEEL PIPE SIZES 2-1/2" AND OVER:**

40 Carbon steel, adjustable, clevis, black finish. Anvil figure 260.

41
42 Adjustable steel yoke, cast iron roll, double hanger. Anvil figure 181.

43
44 **MULTIPLE OR TRAPEZE HANGERS:**

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

46
47 **WALL SUPPORT:**

48 Welded steel bracket with hanger. B-Line 3068 Series, Anvil 194 Series.

49
50 Perforated epoxy painted finish, 16-12-gauge min., steel channels securely anchored to wall structure with
51 interlocking, split type, bolt secured, galvanized pipe/tubing clamps. B-Line type S channel with B-2000 series
52 clamps, Anvil type AS200 H with AS 1200 clamps. When copper piping is being supported, provide flexible
53 elastomeric/thermoplastic isolation cushion material to completely encircle the piping and avoid contact with the
54 channel or clamp, equal to B-Line B1999 Vibra Cushion or provide manufacturers clamp and cushion assemblies,
55 B-Line BVT series, Anvil cushion clamp assembly.

56
57 **VERTICAL RISER SUPPORT:**

58 Carbon steel riser clamp, copper plated when used with copper pipe. Anvil figure 261 for steel pipe, figure CT121
59 for copper pipe.

60
61 **FLOOR SUPPORT FOR PIPE SIZES THROUGH 4":**

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

63
64 **FLOOR SUPPORT FOR PIPE SIZES 5" AND OVER:**

Adjustable cast iron roll and stand, steel screws, 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.

WOOD STRUCTURE SUPPORTS

Carbon steel pipe short strap for piping 1/2" through 2". Fastened with two No. 24 x 2 (minimum size) wood screws. Anvil Figure 262.

Carbon steel coach screw rods machine threaded on opposite ends, minimum 3/8" diameter. Anvil Figure 142.

Carbon steel side beam bracket with minimum 3/8" rod size and fastened with minimum 1/2" x 3" lag screws. Anvil Figure 207

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

1 SUPPORTS 18" OR LESS IN HEIGHT:

2
3 Prefabricated Metal Sleeper Curb:

4
5 Constructed of not less than 18 gauge galvanized steel reinforced so it is structurally capable of supporting the
6 intended load with no penetrations through the curb flashing, inside and outside corner sections that are mitered
7 and continuously welded, filled with 3 pound density rigid fiberglass insulation, integral deck mounting flange,
8 nominal two inch wood nailer, galvanized steel counter flashing with metal receiver cap Attach a galvanized steel
9 channel track for securing pipe or duct roller and roller support. Do not use built-in metal base flashings or cants.

10
11 Wood Build Sleeper Curb:

12
13 Constructed of wood blocking anchored to the deck. The curb must be structurally capable of supporting the
14 intended load with no penetrations through the curb flashing. Galvanized steel counter flashing with metal
15 receiver cap. Attach a steel channel track for securing pipe or duct roller support. Do not use built-in metal base
16 flashings or cants.

17
18 Use galvanized structural steel members supported by pipe supports and use pipe or duct rollers fastened to the
19 structural member. Pipe supports to be secured to the roof structure and sealed per pipe penetrations through
20 roof specifications as specified in this section.

21
22 SUPPORTS 36" OR MORE IN HEIGHT:

23
24 Roof Support Stand/Equipment Roof Support Stand:

25
26 Use galvanized structural steel members supported by pipe supports and use pipe or duct rollers fastened to the
27 structural member. Pipe supports to be secured to the roof structure and sealed per pipe penetrations through
28 roof specifications as specified in this section

29
30 **EQUIPMENT CURBS**

31
32 Prefabricated Metal Curb:

33
34 Constructed of not less than 18-gauge galvanized steel reinforced so it is structurally capable of supporting the
35 intended load with no penetrations through the curb flashing, inside and outside corner sections that are mitered
36 and continuously welded, filled with 3-pound density rigid fiberglass insulation, integral deck mounting flange,
37 nominal two-inch wood nailer, galvanized steel counter flashing. Do not use built-in metal base flashings or cants.
38 Use 18-inch-high equipment curbs where the curb completely surrounds the perimeter of the equipment and there
39 is no roof exposed to the weather.

40
41 Wood Build Sleeper Curb:

42
43 Constructed of wood blocking and anchored to the deck. The curb must be structurally capable of supporting the
44 intended load with no penetrations through the curb flashing. Galvanized steel counter flashing. Do not use built-
45 in metal base flashings or cants. Use 18-inch-high equipment curbs where the curb completely surrounds the
46 perimeter of the equipment and there is no roof exposed to the weather.

47
48 **PIPE PENETRATIONS THROUGH ROOF**

49
50 Multiple Pipe Penetrations:

51
52 Refer to acceptable Equipment Curb types listed above for curb specifications. An 8" high (minimum) curb height
53 is required. The coping cap shall be constructed from laminated acrylic clad thermoplastic (ABS) with graduated
54 step boots to accommodate various size pipes, stainless steel fastening screws for cover, stainless steel band
55 clamps for securing boots around the pipe, and stainless-steel band clamp or mechanical locking seal for securing
56 boots around the ABS coping cap flanges.

57
58 Single Pipe Penetrations:

59
60 A stack flashing penetration may be utilized for single pipe penetrations through built up roofs and single ply
61 membrane roofs. Utilize high temperature sealant for all high temperature applications. This includes but is not
62 limited to steam condensate vent piping, steam safety relief piping, and flues.

63
64 A single pre-manufactured boot may be utilized for single pipe penetrations through single ply membrane roofs
only.

1 CORROSIVE ATMOSPHERE COATINGS

2 Factory coat supports and anchors used in corrosive atmospheres with hot dip galvanizing after fabrication, ASTM
3 A123, 1.5 ounces/square foot of surface, each side. Mechanical galvanize threaded products, ASTM B695 Class
4 150, 2.0 mil coating. Field cuts and damaged finishes to be field covered with zinc rich paint of comparable
5 thickness to factory coating.

6
7 Corrosive atmospheres include the following locations:

- 8 • Exterior locations
- 9 • Parking ramps
- 10 • Swimming pool equipment rooms
- 11 • Chemical storage and hazardous waste storage rooms
- 12 • Wet wells
- 13 • Sanitary pumping stations
- 14 • Food service/kitchen areas
- 15 • Walk-in coolers/freezers
- 16 • Locker/shower rooms
- 17 • Greenhouses
- 18 • Meter Pits

19
20 **PART 3 - EXECUTION**

21
22 **INSTALLATION**

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

26
27 Piping shall be supported independently from ductwork and all other trades.

28
29 Where piping can be conveniently grouped to allow the use of trapeze type supports, use standard structural
30 shapes for the supporting steel.

31
32 Perform all welding in accordance with standards of the American Welding Society. Clean surfaces of loose
33 scale, rust, paint or other foreign matter and properly align before welding. Use wire brush on welds after welding.
34 Welds shall show uniform section, smoothness of weld metal and freedom from porosity and clinkers. Where
35 necessary to achieve smooth connections, joints shall be dressed smooth.

36
37 **HANGER AND SUPPORT SPACING**

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

39
40 Where several pipes can be installed in parallel and at the same elevation, provide multiple or trapeze hangers.

41
42 Support riser piping independently of connected horizontal piping.

43
44 Adjust hangers to obtain the slope specified in the piping section of this specification.

45
46 Space hangers for pipe as follows:

47

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"

56

57 **VERTICAL RISER CLAMPS**

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

60
61 **ANCHORS**

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

ICA
30 NOVEMBER 2022

1 **ROOF MOUNTED SUPPORTS**

2 Use for all pipe and ductwork on roof. Secure bottom of support flat on roof deck. Apply two coats of zinc rich
3 paint to cut edges of all galvanized steel elements. Flashing and counter flashing by the Division 07 Contractor.
4

5

END OF SECTION

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

PART 1 - GENERAL

SCOPE

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

PART 1 - GENERAL

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

PART 2 - PRODUCTS

- Instrumentation

PART 3 - EXECUTION

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

RELATED WORK

- Section 01 91 01 or 01 91 02 – Commissioning Process
- Section 23 05 00 Common Work Results for HVAC
- Section 23 07 00 HVAC Insulation
- Section 23 08 00 – Commissioning of HVAC
- Section 23 09 14 Pneumatic and Electric Instrumentation and Control Devices for HVAC
- Section 23 09 23 Direct Digital Control System for HVAC
- Section 23 09 24 Direct Digital Control System for HVAC (Informational Purposes Only)
- Section 23 09 25 Direct Digital Control System for HVAC Integrated Terminal Units

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

1 in the time stated in the Instruction to Bidders and in accordance with the completion schedule established for this
2 project.

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

6
7 **QUALITY ASSURANCE**

8
9 **Qualifications**

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

14
15 A certified member of AABC or certified by NEBB or TABB in the specific area of work performed. Maintain
16 certification for the entire duration of the project. If certification of firm or any staff performing work is terminated or
17 expires during the duration of the project, contact owner immediately.

18
19 Technicians on this project must have satisfactorily completed work on a minimum of (3) three projects of at least
20 50% in size, and of similar complexity. Size is defined as the quantity of each specific individual item requiring
21 testing and balancing such as, but not limited to, equipment, devices, terminal devices, and grilles and diffusers.

22
23 Submit Qualifications of firm and project staff to owner upon requested.

24
25 **PRE-INSTALLATION MEETING AND SCHEDULING**

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

29
30 **PRE-BALANCE CONFERENCE**

31 90 days prior to beginning testing, adjusting, and balancing, schedule and conduct a conference with the
32 Architect/Engineer, owner's Project Representative and the mechanical system and temperature control system
33 installing Contractors. Provide AE and Commissioning Provider (CxP) with a complete copy of the TAB plan for the
34 project. The objective is final coordination and verification of system operation and readiness for testing, adjusting
35 and balancing procedures and scheduling procedures with the above-mentioned parties. Indicate work required to
36 be completed prior to testing, adjusting, and balancing and identify the party responsible for completion of that work.

37
38 **SUBMITTALS**

39 See also Related Work in this section.

40
41 Submit testing, adjusting and balancing reports bearing the seal and signature of the NEBB, AABC or TABB Certified
42 Test and Balance Supervisor. The reports certify that the systems have been tested, adjusted and balanced in
43 accordance with the referenced standards; are an accurate representation of how the systems have been installed
44 and are operating; and are an accurate record of all final quantities measured to establish normal operating values
45 of the systems.

46
47 Enter an RFI, requesting review of the report.

48
49
50 Enter an RFI, with a copy of the Testing and Balancing Report Summary as an upload, indicating that the Testing
51 and Balancing Report is posted on the WisBuild Project Overview page and requesting review of the report.

52
53 Format: Cover page identifying project name, project number and descriptive title of contents. Divide the contents
54 of the report into the below listed divisions:

- 55
56
 - General Information
 - Summary
 - Air Systems
 - Hydronic Systems
 - Special Systems

60
61
62 Contents: Provide the following minimum information, forms, and data:

1 General Information: Inside cover sheet identifying Test and Balance Agency, Contractor, Architect, Engineer,
2 Project Name and Project Number. Include addresses, contact names, and telephone numbers. Also include a
3 certification sheet containing the seal and signature of the Test and Balance Supervisor.
4

5 Summary: Provide summary sheet describing mechanical system deficiencies. Describe objectionable noise or
6 drafts found during testing, adjusting, and balancing. Provide recommendations for correcting unsatisfactory
7 performances and indicate whether modifications required are within the scope of the contract, are design related
8 or installation related. List instrumentation used during testing, adjusting and balancing procedures.
9

10 The remainder of the report to contain the appropriate standard NEBB, AABC, or TABB forms for each respective
11 item and system. Fill out forms completely. Where information cannot be obtained or is not applicable indicate
12 same.
13

14 **PART 2 - PRODUCTS**

15 **INSTRUMENTATION**

16 Provide all required instrumentation to obtain proper measurements. Application of instruments and accuracy of
17 instruments and measurements to be in accordance with the requirements of NEBB, AABC, or TABB Standards
18 and instrument manufacturer's specifications.
19

20 All instruments used for measurements shall be accurate, and calibration histories for each instrument to be
21 available for examination by DD upon request. Calibration and maintenance of all instruments to be in accordance
22 with the requirements of NEBB, AABC, or TABB Standards
23

24 **PART 3 - EXECUTION**

25 **DAILY REPORTS**

26 Submit to owner's Project Representative daily work activity reports for each day on which testing and balancing
27 work is performed. Reports shall include description of day's activities and description of any system deficiencies.
28

29 **PRELIMINARY PROCEDURES**

30 Review preconstruction meeting report, applicable construction bulletins, applicable change orders and approved
31 shop drawings of equipment, outlets/inlets and temperature controls.
32

33 Check filters for cleanliness, dampers and valves for correct positioning, equipment for proper rotation and belt
34 tension, temperature controls for completion of installation and hydronic systems for proper charge and purging of
35 air.
36

37 Notify owner's Project Representative on a daily basis during balancing. Identify deficiencies preventing completion
38 of testing, adjusting and balancing procedures. Do not proceed until systems are fully operational with all
39 components necessary for complete testing, adjusting and balancing. Installing Contractors are required to provide
40 personnel to check and verify system completion, readiness for balancing and assist Balancing Agency in providing
41 specified system performance.
42

43 **EXISTING EQUIPMENT**

44 **PERFORMING TESTING, ADJUSTING AND BALANCING**

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

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

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

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

60 In air systems employing filters, blank off sufficient filter area to simulate a pressure drop that is midway between
61 that of a clean filter and that of a dirty filter.
62
63
64

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

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

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

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

17
18 Provide fan and motor drive sheave adjustments necessary to obtain design performance. Provide drive changes
19 specifically noted on drawings, if any. If work of this section indicates that any drive or motor is inadequate for the
20 application, advise the owner's project representative by giving the representative properly sized motor/drive
21 information (in accordance with manufacturers original service factor and installed motor horsepower requirements);
22 Confirm any change will keep the duct/piping system within its design limitations with respect to speed of the device
23 and pressure classification of the distribution system. Required motor/drive changes not specifically noted on
24 drawings or in specifications will be considered an extra cost and will require an itemized cost breakdown submitted
25 to owner's project representative. Prior authorization is needed before this work is started.

26
27 Areas or rooms designed to maintain positive, negative or balanced air pressures with respect to adjacent spaces,
28 as indicated by the design air quantities, require special attention. Adjust fan drives, distribution dampers, terminals
29 and controls to maintain indicated pressure relationship.

30
31 Final air system measurements to be within the following range of specified cfm:

32 Fans	0% to +10%
33 Supply grilles, registers, diffusers	0% to +10%
34 Return/exhaust grilles, registers	0% to -10%
35 Room pressurization air	-5% to +5%

36
37 Final water system measurements must be within the following range of specified gpm:

38 Heating flow rates	0% to -10%
39 Cooling flow rates	-5% to +5%

40
41 Contact the temperature control Contractor for assistance in operation and adjustment of controls during testing,
42 adjusting and balancing procedures. Cycle controls and verify proper operation and setpoints. Include in report
43 description of temperature control operation and any deficiencies found.

44
45 Permanently mark equipment settings, including damper and valve positions, control settings, and similar devices
46 allowing settings to be restored. Set and lock memory stops.

47
48 Leave systems in proper working order, replacing belt guards, closing access doors and electrical boxes, and
49 restoring temperature controls to normal operating settings.

50
51 Coordinate and assist CxP with all verification activities defined within section (01 91 01, 02) including providing all
52 required sampling data necessary for the commissioning process.

53
54 Verify and record, in the T&B Report, "K" factors for all VAV air terminal devices and air flow stations.

55
56 Coordinate air handling unit minimum outside air set points with the Temperature Control Contractor.

57
58 Coordinate Fume Hood Monitor calibration with the Fume Hood Manufacturer.

59
60 **LABORATORY FUME HOODS**

61 Adjust airflow from fume hoods to the scheduled airflow by measuring the airflow in the duct connected to the fume
62 hood and adjusting the air terminal device as needed. Then measure the fume hood face velocity with the sash
63 wide open. If the wide-open sash face velocity is below 50 fpm then adjust airflow to be at 50 fpm. After this
64 balancing is complete and the other air balancing in the space containing the hood is complete, the fume hood

1 supplier will calibrate the fume hood monitor and perform an "as installed" ASHRAE 110 test to verify that hood is
2 properly containing fumes.
3

4 **LABORATORY BIOLOGICAL SAFETY CABINETS (BSC)**

5 Adjust airflow from BSC by measuring the airflow in the duct connected to the BSC and adjusting the air terminal
6 device as needed. After this balancing is complete and the other air balancing in the space containing the BSC is
7 complete, the University will test and certify the BSC. Adjust the BSC airflow as directed by the University staff
8 during the certification process.
9

10 **VAV SUPPLY AND EXHAUST DUCT SYSTEM STATIC PRESSURE SET POINT**

11 For VAV supply and exhaust systems with VAV air terminal devices, determine the minimum required duct static
12 pressure at the DDC static pressure sensor location(s) needed to ensure that all VAV air terminals are operating at
13 their design airflows with the most demanding VAV terminal wide open. Provide these static pressure numbers to
14 the DDC temperature controls contractor and record them in the T&B report for each system.
15

16 **HYDRONIC SYSTEM DIFFERENTIAL PRESSURE CONTROL SET POINT**

17 For hydronic systems with variable speed pumping, determine the minimum required system differential pressure
18 set point needed to ensure that all terminal devices are operating at their design water flows with the most
19 demanding terminals device control valve wide open. Provide the differential control setting set point to the DDC
20 temperature control contractor and record them in the T&B report for each system.
21

22 **DEFICIENCIES**

23 Division 23 00 00 contractor to correct any installation deficiencies found by the test and balance agency that were
24 specified and/or shown on the Contract Documents to be performed as part of that division of work. Test and
25 balance agency will notify the owners Project Representative of these items and instructions will be issued to the
26 Division 23 00 00 contractor for correction of the deficient work. All corrective work to be done at no cost to the State
27 of Wisconsin. Retest mechanical systems, equipment, and devices once corrective work is complete as specified.
28

29 **FUNCTIONAL PERFORMANCE TESTING**

30 Contractor is responsible for utilizing the functional performance test forms supplied under specification Section 23
31 08 00 Commissioning of HVAC in accordance with the procedures defined for functional performance testing in
32 Section 01 91 01 or 01 91 02. Notify the A/E and commissioning provider 5 business days prior to performing
33 functional performance testing so that they may witness.
34

END OF SECTION

**SECTION 23 07 00
HVAC INSULATION**

PART 1 - GENERAL

SCOPE

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

PART 1 - GENERAL

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

PART 2 - PRODUCTS

- Materials
- Insulation Types
- Adhesives, Mastics, Sealants, and Reinforcing Materials
- Jackets
- Insulation Inserts and Pipe Shields
- Expansion Joint and Valve Insulation Blankets
- Accessories

PART 3 - EXECUTION

- Examination
- Installation
 - Protective Jacket Installation
 - Piping, Valve and Fitting Insulation
 - Piping Protective Jackets
 - Removable Insulation Blankets
- Pipe Insulation Schedule
- Duct Insulation
 - Ductwork Protective Coverings
 - Duct Insulation Schedule
- Equipment Insulation
 - Equipment Insulation Schedule
 - Construction Verification Items

RELATED WORK

- Section 01 91 01 or 01 91 02 – Commissioning Process
- Section 23 05 00 - Common Work Results for HVAC
- Section 23 08 00 - Commissioning of HVAC
- Section 23 11 00 - Facility Fuel Piping
- Section 23 21 13 - Hydronic Piping
- Section 23 22 13 - Steam and Condensate Heating Piping
- Section 23 24 00 - Internal-Combustion Engine Piping
- Section 23 83 16 - Radiant-Heating Hydronic Piping
- Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment
- Section 23 31 00 - HVAC Ducts and Casings

REFERENCE

Applicable provisions of Division 1 govern work under this section.

REFERENCE STANDARDS

- ASTM B209 Aluminum and Aluminum Alloy Sheet and Plate
- ASTM C165 Test Method for Compressive Properties of Thermal Insulations
- ASTM C177 Heat Flux and Thermal Transmission Properties
- ASTM C195 Mineral Fiber Thermal Insulation Cement
- ASTM C240 Cellular Glass Insulation Block
- ASTM C302 Density of Preformed Pipe Insulation

1	ASTM C272	Water Absorption of Core Materials for Sandwich Constructions
2	ASTM C303	Density of Preformed Block Insulation
3	ASTM C355	Test Methods for Test for Water Vapor Transmission of Thick Materials
4	ASTM C449	Mineral Fiber Hydraulic Setting Thermal Insulation Cement
5	ASTM C518	Heat Flux and Thermal Transmission Properties
6	ASTM C533	Calcium Silicate Block and Pipe Thermal Insulation
7	ASTM C534	Preformed Flexible Elastomeric Thermal Insulation
8	ASTM C547	Mineral Fiber Preformed Pipe Insulation
9	ASTM C552	Cellular Glass Block and Pipe Thermal Insulation
10	ASTM C553	Mineral Fiber Blanket and Felt Insulation
11	ASTM C578	Preformed, Block Type Cellular Polystyrene Thermal Insulation
12	ASTM C591	Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation
13	ASTM C610	Expanded Perlite Block and Thermal Pipe Insulation
14	ASTM C612	Mineral Fiber Block and Board Thermal Insulation
15	ASTM C921	Properties of Jacketing Materials for Thermal Insulation
16	ASTM C1136	Flexible Low Permeance Vapor Retarders for Thermal Insulation
17	ASTM C1728	Standard for Aerogel Insulation
18	ASTM D412	Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers-Tension
19	ASTM D1000	Methods for Pressure-Sensitive Adhesive-Coated Tapes Used for Electrical and Electronic Applications
20		
21	ASTM D1621	Standard Test Method for Compressive Properties Of Rigid Cellular Plastics
22	ASTM D1622	Standard Test Method for Apparent Density of Rigid Cellular Plastics
23	ASTM D1940	Method of Test for Porosity of Rigid Cellular Plastics
24	ASTM D2126	Method for Response of Rigid Cellular Plastics to Thermal and Humid Aging
25	ASTM D2240	Standard Test Method for Rubber Property—Durometer Hardness
26	ASTM D5590	Test Method for Determining the Resistance of Coatings to Fungal Defacement
27	ASTM E84	Surface Burning Characteristics of Building Materials
28	ASTM E814	Standard Test Method for Fire Tests of Penetration Firestop Systems
29	ASTM E2336	Standard Test Methods for Fire Resistive Grease Duct Enclosure Systems
30	MICA	National Commercial & Industrial Insulation Standards
31	NFPA 225	Surface Burning Characteristics of Building Materials
32	UL 723	Surface Burning Characteristics of Building Materials

QUALITY ASSURANCE

Refer to division 1, General Conditions, Equals and Substitutions

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

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

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
- Duct Insulation
- Equipment 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.

1 **DEFINITIONS**

2 Concealed: shafts, furred spaces, space above finished ceilings, utility tunnels and crawl spaces. All other areas,
3 including walk-through tunnels, shall be considered as exposed.
4

5 **SHOP DRAWINGS**

6 Refer to division 1, General Conditions, Submittals.
7

8 Submit a schedule of all insulating materials to be used on the project, including adhesives, fastening methods,
9 fitting materials along with material safety data sheets and intended use of each material. Include manufacturer's
10 technical data sheets indicating density, thermal characteristics, jacket type, and manufacturer's installation
11 instructions. Include copies of the MICA plates that are applicable to this project.
12

13 **OPERATION AND MAINTENANCE DATA**

14 All operations and maintenance data shall comply with the submission and content requirements specified under
15 section GENERAL REQUIREMENTS.
16

17 In addition to the general content specified under GENERAL REQUIREMENTS supply the following additional
18 documentation:
19

20 **ENVIRONMENTAL REQUIREMENTS**

21 Do not store insulation materials on grade or where they are at risk of becoming wet. Do not install insulation
22 products that have been exposed to water.
23

24 Protect installed insulation work with plastic sheeting to prevent water damage.
25

26 **PART 2 - PRODUCTS**

27 **MATERIALS**

28 Manufacturers: Armacell, CertainTeed, Manson, Childers, Dow, Extol, Fibrex, Halstead, Foster, Imcoa, ITW,
29 Johns Manville, Knauf Insulation, Owens-Corning, Pittsburgh Corning, VentureTape or approved equal.
30

31 Materials or accessories containing asbestos will not be accepted.
32

33 Use composite insulation systems (insulation, jackets, sealants, mastics, and adhesives) that have a flame spread
34 rating of 25 or less and smoke developed rating of 50 or less, with the following exceptions:
35

36 Pipe insulation which is not located in an air plenum may have a flame spread rating not over 25 and a smoke
37 developed rating no higher than 450 when tested in accordance with UL 723 and ASTM E84.
38

39 **INSULATION TYPES**

40 Insulating materials shall be fire retardant, moisture, and mildew resistant, and vermin proof. Insulation shall be
41 suitable to receive jackets, adhesives and coatings as indicated.
42

43 **FLEXIBLE FIBERGLASS INSULATION:**

44 Minimum nominal density of 0.75 lbs. per cu. ft., and thermal conductivity of not more than 0.30 at 75 degrees F
45 mean temperature, rated for maximum service temperature of 250 degrees F.
46

47 **RIGID FIBERGLASS INSULATION:**

48 Minimum nominal density of 3 lbs. per cu. ft., and thermal conductivity of not more than 0.23 at 75 degrees F mean
49 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
50 compressive strength of 25 PSF at 10% deformation, rated for maximum service temperature of 450 degrees F.
51

52 **SEMI-RIGID FIBERGLASS INSULATION:**

53 Minimum nominal density of 3 lbs. per cu. ft., thermal conductivity of not more than 0.28 at 75 degrees F mean
54 temperature, minimum compressive strength of 25 PSF at 10% deformation, rated for service temperature range
55 of 0 degrees F to 450 degrees F. Insulation fibers perpendicular to jacket and scored for wrapping cylindrical
56 surfaces.
57

58 **CALCIUM SILICATE INSULATION:**

59 Rigid hydrous calcium silicate, ASTM C533, Type I, minimum dry density of 12.5 lbs. per cu. ft., thermal conductivity
60 of not more than 0.44 at 300 degrees F mean temperature, maximum water absorption of 90% by volume, minimum
61 compressive strength 140 psi at 5% deformation, rated for service temperature range of 0 degrees F to 1,200
62 degrees F. Material to be visually coded or marked to indicate it is asbestos free.
63

1 HIGH TEMPERATURE CALCIUM SILICATE INSULATION:

2 Rigid hydrous calcium silicate, ASTM C533, Type II, minimum dry density of 12.5 lbs. per cu. ft., thermal
3 conductivity of not more than 0.44 at 300 degrees F mean temperature, maximum water absorption of 90% by
4 volume, minimum compressive strength 140 psi at 5% deformation, rated for service temperature range of 0
5 degrees F to 1,800 degrees F. Material to be visually coded or marked to indicate it is asbestos free.

6
7 ELASTOMERIC INSULATION:

8 Flexible closed cell, minimum nominal density of 5.5 lbs. per cu. ft., thermal conductivity of not more than 0.28 at
9 75 degrees F mean temperature, minimum compressive strength of 4.5 psi at 25% deformation, maximum water
10 vapor permeability of 0.08 perm inch, maximum water absorption of 6% by weight, rated for service temperature
11 range of -20 degrees F to 220 degrees F on piping and 180 degrees F where adhered to equipment.

12
13 POLYOLEFIN INSULATION:

14 Flexible closed cell, minimum nominal density of 1.5 lbs. per cu. ft., thermal conductivity of not more than 0.25 at
15 75 degrees F mean temperature, minimum compressive strength of 5 psi at 25% deformation, maximum water
16 vapor permeability of 0.0 perm inch, maximum water absorption of 0% by weight and volume, rated for service
17 temperature range of -165 degrees F to 210 degrees F.

18
19 PHENOLIC INSULATION:

20 Rigid closed cell, minimum nominal density of 2.2 lbs. per cu. ft., thermal conductivity of not more than 0.13 at 75
21 degrees F mean temperature, minimum compressive strength of 31 psi parallel and 18 psi perpendicular, maximum
22 water vapor permeability 0.117 perm inch, maximum water absorption of 0.5% by volume, rated for service
23 temperature range of -290 degrees F to 250 degrees F.

24
25 EXTRUDED POLYSTYRENE INSULATION:

26 Rigid closed cell, minimum nominal density of 1.6 lbs. per cu. ft., thermal conductivity of not more than 0.26 at 75
27 degrees F mean temperature, minimum compressive strength of 20 psi, maximum water vapor permeability of 1.5
28 perm inch, maximum water absorption of 0.5 % by volume (ASTM C272), rated for service temperature range of -
29 290 degrees F to 165 degrees F.

30
31 POLYISOCYANURATE INSULATION:

32 Rigid closed cell polyisocyanurate, minimum nominal density of 2.0 lbs. per cu. ft., thermal conductivity of not more
33 than 0.19 at 75 degrees F mean temperature aged 180 days, minimum compressive strength of 24 psi parallel and
34 13 psi perpendicular, maximum water vapor permeability of 4 perm inch, maximum water absorption of 2% by
35 volume, rated for service temperature range of -290 degrees F to 300 degrees F.

36
37 CELLULAR GLASS INSULATION:

38 Rigid closed cell, minimum nominal density of 7.5 lbs. per cu. ft., thermal conductivity of not more than 0.28 at 50
39 degrees F mean temperature, 0.29 at 75 degrees F mean temperature, 0.38 at 200 degrees F mean temperature,
40 minimum compressive strength of 90 psi, maximum water vapor permeability of 0.0 perm inch, maximum water
41 absorption of 0.2% by volume, rated for service temperature range of -450 degrees F to 900 degrees F.

42
43 MINERAL WOOL INSULATION:

44 Rigid preformed mineral wool, minimum nominal density of 8 lbs. per cu. ft., thermal conductivity of not more than
45 0.24 at 75 degrees F mean temperature, 0.30 at 200 degrees F, 0.38 at 300 degrees F, minimum compressive
46 strength of 3 psi, maximum wicking of 1%, maximum water adsorption of 1% by volume, rated for service
47 temperature range of -120 degrees F to 1200 degrees F.

48
49 Pipe insulation shall be pre-formed in two (2) half cylinder sections. Cut V-groove sheet insulation is not acceptable.
50 Provide three (3) stainless steel bands for each section of insulation.

51
52 AEROGEL INSULATION:

53 Flexible sheet with a minimum nominal density of 11 lbs. per cu. ft., thermal conductivity of not more than 0.146 at
54 100 degrees F mean temperature, 0.19 at 200 degrees F, 0.22 at 250 degrees F, material shall be hydrophobic,
55 and rated for service temperature range of -40 degrees F to 1200 degrees F.

56
57 FIREPROOFING INSULATION:

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

62
63 Foil-scrim-polyethylene vapor retarding jacket, factory applied to insulation, maximum permeance of .02 perms.

1 FIRE RATED INSULATION:

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

6
7 FLUID-APPLIED DUCTWORK INSULATION (FDI):

8 Pre-approved Polyurea/Manufacturers: Technical Roofing Solutions, Inc.; Volatile Free Inc.; BASF Corp.; Gaco
9 Western Inc. or equal. (Manufacturers must be approved prior to bid opening.)

10
11 Coatings shall be U.L. Listed to retain existing system UL ratings when applied as specified in this project.

12
13 Polyurea: (approved polyurea coating) A two-component 1:1 ratio polyurea-urethane hybrid with excellent strength
14 and weathering characteristics.

15
16 Performance Values:

PHYSICAL PROPERTY	ASTM TEST METHOD	TYPICAL VALUE
Tensile Strength	D 412	>1,600 psi
Elongation	D 412	>300%
Shore A Hardness (inst-5 sec.)	D 2240	85 - 90 Shore A
Tack-Free Time		10 to 30 Seconds
Service Temperature		-40°F to 300°F
Application Temperature		40°F to 150°F
Tear Resistance	D 264 Die C	125 Pli
Spread of Flame	ASTM E-84	<75 (Smoke<450)

17
18
19 Approved Spray Polyurethane Foam (SPF) used for thermal insulation.

20
21 Performance Values:

PHYSICAL PROPERTY	ASTM TEST METHOD	TYPICAL VALUE
Density (nominal)	ASTM D-1622	2.5 pcf
Compressive Strength (min) (parallel to rise)	ASTM D-1621	40 psi
K Factor (Initial)	ASTM C-177	0.15 btu.in/ft2.hr. °F
Closed Cell Content	ASTM D-1940	90%
Dimensional Stability (aged 28 days, % volume change)	ASTM D-2126	<2.5 @ 158°F/98% RH
Moisture (Perm/Inch)	ASTM C-355	0.8
Spread of Flame* (2 inch thick sample)	ASTM E-84	<75 (Smoke<450)

22
23
24 Final coating shall be a polyurea compatible, fire-retardant coating (Flame spread <25 Smoke <50).

25
26 Water-Based Epoxy Primer: A two-component, water-based, multi-purpose, easy spreading epoxy primer.

27
28 Urethane, high build mastic for applications where high performance, all temperature flexibility, and strength is
29 required.

30
31 Urethane-based, low solids, fast drying, penetrating, rust and general-purpose primer.

32
33 Highly concentrated, low-sudsing biodegradable cleaner used to remove grease and grime.

34
35 Hydrocarbon modified, moisture-cured, urethane coating for use over asphalt products and as a basecoat /primer
36 for polyurea coating.

37
38 Other products required by coating manufacturer.

1 Fluid-Applied Ductwork Insulation Guarantee:

2 *State of Wisconsin Guarantee:* Provide written guarantee warranting installation required under contract, to be
3 watertight and free from defects in materials or workmanship for period of time, as stipulated in guarantee form. A
4 *copy of the required guarantee form is appended hereto.*

5
6 Liquid Coating Manufacturer's Warranty:

7 Provide written manufacturer's (NDL) no-dollar-limit warranty covering installation required under contract, to be
8 watertight and free from defects in materials and workmanship of the Polyurea coating and other system
9 components supplied by the manufacturer for a period of fifteen (15) years from date of installation.

10
11 Completed project requires installation inspection and approval by the manufacture of the Polyurea coating.

12
13 Note: Warranty may not contain clause(s) voiding warranty due to contractor solvency, improper
14 workmanship, contractor error, or contractor failure to follow manufacturer specification(s) and
15 requirements to obtain the warranty requested by this project.

16
17 (Contractors Performance-Payment Bond is only required to apply to this trade section during the construction
18 period and the first year of the guarantee period. Said Bond shall not apply to any extended guarantee period
19 beyond the first year. Such extended guarantees are limited to the applicable Contractor and manufacturer as
20 herein specified.)

21
22 **ADHESIVES, MASTIC, SEALANTS, AND REINFORCING MATERIALS**

23 Products shall be compatible with surfaces and materials on which they are applied and shall be suitable for use
24 at operating temperatures of systems to which they are applied.

25
26 FIBERGLASS INSULATION ADHESIVE:

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

28
29 VAPOR RETARDING MASTIC:

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

33
34 For below ambient equipment/piping use water based, anti-fungal mastic that meets ASTM D 5590 with a 0-growth
35 rating (AF) and a water vapor permeance that is less than 0.013 perms at 43 mils dry film thickness per ASTM E
36 96 Procedure B: Foster 30-80AF Vapor Safe Mastic or equal.

37
38 Anti-fungal mastic to be used in the following locations:

- 39 • Exterior locations
- 40 • Parking ramps
- 41 • Swimming pool equipment rooms
- 42 • Chemical storage and hazardous waste storage rooms
- 43 • Wet wells
- 44 • Sanitary pumping stations
- 45 • Food service/kitchen areas
- 46 • Walk-in coolers/freezers
- 47 • Locker/shower rooms
- 48 • Greenhouses
- 49 • Meter Pits

50
51 WEATHER BARRIER BREATHER MASTIC:

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

55
56 LAGGING ADHESIVE / COATINGS:

57 For all indoors applications used in conjunction with canvas/glass cloth: Foster 30-36, Childers CP-50A MV1,
58 Vimasco 713.

59
60 For all indoor applications used in conjunction with canvas/glass cloth: the coating must be anti-fungal and shall
61 meet ASTM D 5590 with 0 growth rating (AF): Foster 30-36 AF Seal Fas, Childers CP-137 AF Chil-Seal.

62
63 Anti-fungal adhesive/coating to be used in the following locations:

- 64 • Exterior locations

- 1 • Parking ramps
- 2 • Swimming pool equipment rooms
- 3 • Chemical storage and hazardous waste storage rooms
- 4 • Wet wells
- 5 • Sanitary pumping stations
- 6 • Food service/kitchen areas
- 7 • Walk-in coolers/freezers
- 8 • Locker/shower rooms
- 9 • Greenhouses
- 10 • Meter Pits

11
12 **REINFORCING MESH:**

13 Use Foster 42-24 Mast A Fab, Childers Chil Glas #10 or Pittsburgh Corning PC 79.

14
15 **METAL JACKETING SEALANT FOR ALL ALUMINUM JACKETING:**

16 Metal jacketing sealants to be non-shrinking and permanently flexible.

17 Use Foster 95-44 Elastolar, Childers CP-76 Chil-Byl, Pittsburgh Corning 727.

18 For Polystyrene use Foster 30-45N, or Childers CP-70.

19
20 **INSULATION JOINT SEALANT:**

21 Joint sealants to be non-shrinking and permanently flexible.

22 Used on all below ambient piping to prevent moisture ingress.

23 For Cellular Glass, Polyisocyanurate, Phenolic use Foster 95-44 Elastolar, Childers CP-76 Chil-Byl, Pittsburgh
24 Corning CW Sealant.

25 For Polystyrene use Foster 30-45N, Childers CP-70.

26 For Elastomeric use Armaflex 520 or equal.

27
28 **JACKETS**

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

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

34
35 **ALL SERVICE JACKETS (ASJ):**

36 Heavy-duty, fire-retardant material with polymer coated white kraft reinforced foil vapor retarder jacket, factory
37 applied to insulation with a self-sealing pressure sensitive adhesive lap, maximum permeance of .02 perms and
38 minimum beach puncture resistance of 50 units.

39
40 **FOIL SCRIM KRAFT ALL SERVICE JACKETS (FSK):**

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

43
44 **PROTECTIVE METAL JACKETS (PMJ):**

45 0.016-inch-thick aluminum or 0.010 inch thick stainless steel with safety edge for indoor installations and 0.024
46 inch thick aluminum or 0.016 inch thick stainless steel with safety edge for outdoor installations.

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

49 5-ply, self-adhering multiple laminated waterproofing material with reflective aluminum foil, high density polymer
50 films and cold weather acrylic adhesive providing zero (0.0) permeance. Minimum 6 mils material thickness, 25lb
51 puncture resistance when tested in accordance with ASTM D1000 and flame spread/smoke developed rating of
52 10/20 when tested in accordance with UL 723.

53
54 Vapor retarding tape shall be specifically designed and manufactured for use with the self-adhering jacket specified
55 above. Tape shall be provided by the same manufacturer that provides jacketing. Vapor retarding tapes used with
56 self-adhering jackets shall have a maximum permeance of 0.0 perms.

57
58 **FABRIC REINFORCED MASTIC JACKETS (FMJ):**

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

1 VAPOR RETARDING JACKETS (VRJ):

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

5
6 Vapor retarding tape shall be specifically designed and manufactured for use with the vapor retarding jacket
7 specified above. Tape shall be provided by the same manufacturer that provides jacketing. Vapor retarding tapes
8 used with vapor retarding jackets shall have a maximum permeance of 0.01 perms.
9

10 **INSULATION INSERTS AND PIPE SHIELDS**

11 Manufacturers: B-Line, Pipe Shields, Value Engineered Products.

12
13 Construct inserts with calcium silicate or polyisocyanurate (service temperatures below 300 degrees F only),
14 minimum 140 psi compressive strength. Piping 12" and larger, supplement with high density 600 psi structural
15 calcium silicate insert. Provide galvanized steel shield. Insert and shield to be minimum 180-degree coverage on
16 bottom supported piping and full 360-degree coverage on clamped piping. On roller mounted piping and piping
17 designed to slide on support, provide additional load distribution steel plate.
18

19 Where contractor proposes shop/site fabricated inserts and shields, submit schedule of materials, thicknesses,
20 gauges, and lengths for each pipe size to demonstrate equivalency to pre-engineered/premanufactured product
21 described above. On low temperature systems, high density rigid polyisocyanurate may be substituted for calcium
22 silicate provided insert and shield length and shield gauge are increased to compensate for lower insulation
23 compressive strength.
24

25 Precompressed 20# density molded fiberglass blocks, Hamfab or equal, of the same thickness as adjacent
26 insulation may be substituted for calcium silicate inserts with one 1"x6" block for piping through 2-1/2" and three
27 1"x6" blocks for piping through 4". Submit shield schedule to demonstrate equivalency to pre-
28 engineered/premanufactured product described above.
29

30 Wood blocks will not be accepted.
31

32 **EXPANSION JOINT AND VALVE INSULATION BLANKETS**

33 Manufacturers: Advance Thermal Corporation, TANI Division B.D. Schiffler, or approved equal. Site fabricated
34 blankets are not acceptable.
35

36 Blanket shall be 17 ounce per square yard PTFE (polytetrafluoroethylene) or FCF 1800 coated fiberglass fabric
37 which is designed for wet and dry steam applications to 550°F. Equal to Advance Thermal Corp. Steamguard-2.
38 Jacket shall have coated fabric on both exterior and interior. Wire mesh interior is not acceptable.
39

40 The Blankets shall be installed to shed water and have a 3-inch-wide cinchable rain flap on each end.
41

42 All seams shall be sewn twice with double locked stitching. One seam shall be sewn with 3-ply Nomex and the
43 other with 3-ply stainless steel. Hog rings and staples shall not be used.
44

45 The insulation shall be a 2-inch thick, compressed "E" glass fiber with no chemical binders, held in place with 12-
46 gauge stainless quilt pins which do not puncture the inner surface of the blanket.
47

48 Blankets shall be designed to allow access to the expansion and ball joints packing cylinder plungers for repacking
49 without removing the blanket.
50

51 Removable expansion joint blanket shall be constructed to allow the pipe and rigid insulation to expand/contract
52 with the pipe. Blanket shall have a close fit without sagging or gaps.
53

54 Blanket shall allow for normal operation of the valve or joint without removing the cover.
55

56 Valve blankets shall come in two pieces and cover the valve yoke (if applicable).
57

58 Blankets shall have D-ring, hook and loop or buckle securing straps. Pins and wire or spring and ring securement
59 is not acceptable.
60

61 Blankets shall have a stainless-steel identifying plaque on the exterior identifying equipment information.
62
63
64

1 **ACCESSORIES**

2 All products shall be compatible with surfaces and materials on which they are applied and be suitable for use at
3 operating temperatures of the systems to which they are applied.
4

5 Adhesives, sealants, and protective finishes shall be as recommended by insulation manufacturer for applications
6 specified.
7

8 Insulation bands to be 3/4 inch wide, constructed of aluminum or stainless steel. Minimum thickness to be 0.015
9 inch for aluminum and 0.010 inch for stainless steel.
10

11 Tack fasteners to be stainless steel ring grooved shank tacks.
12

13 Staples to be clinch style.
14

15 Insulating cement to be ANSI/ASTM C195, hydraulic setting mineral wool.
16

17 Finishing cement to be ASTM C449.
18

19 Fibrous glass or canvas fabric reinforcing used with lagging adhesive shall have a minimum untreated weight of 6
20 oz./sq. yd.
21

22 Fungicidal water base duct liner coating (Foster 40-20 or equal) to be compatible with vapor retarding coating. This
23 product must be EPA registered to be used inside HVAC ducts. Coating must comply with ASTM D 5590 with 0
24 growth rating.
25

26 **PART 3 - EXECUTION**

27
28 **EXAMINATION**

29 Verify that all piping, equipment, and ductwork are tested and approved prior to installing insulation. Do not insulate
30 systems until testing and inspection procedures are completed.
31

32 Verify that all surfaces are clean, dry and without foreign material before applying insulation materials.
33

34 **INSTALLATION**

35 All materials shall be installed by skilled labor regularly engaged in this type of work. All materials shall be installed
36 in strict accordance with manufacturer's recommendations, building codes, and industry standards. Do not install
37 products when the ambient temperature or conditions are not consistent with the manufacturer's
38 recommendations. Surfaces to be insulated must be clean and dry.
39

40 Locate insulation and cover seams in the least visible location. All surface finishes shall be extended in such a
41 manner as to protect all raw edges, ends and surfaces of insulation.
42

43 Install insulation with smooth and even surfaces. Poorly fitted joints or use of filler in voids will not be accepted.
44 Provide neatly beveled and coated terminations at all nameplates, uninsulated fittings, or at other locations where
45 insulation terminates.
46

47 Install fabric reinforcing without wrinkles. Overlap seams a minimum of 2 inches.
48

49 Use full length material (as delivered from manufacturer) wherever possible. Scrap piecing of insulation or pieces
50 cut undersize and stretched to fit will not be accepted.
51

52 All pipe and duct insulation shall be continuous through walls, ceiling, or floor openings and through sleeves except
53 where firestop or fire safing materials are required. Vapor retarding jacket shall be maintained continuous through
54 all penetrations.
55

56 Provide a continuous unbroken moisture vapor retarding jacket on insulation applied to systems noted below.
57 Attachments to cold surfaces shall be insulated and vapor sealed to prevent condensation.
58

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

- 60 • Cold Water Make-Up
- 61 • Chilled Water
- 62 • Refrigerant
- 63 • Glycol/Brine
- 64 • Insulated Duct

- Equipment, ductwork, or piping with a surface temperature below 65 degrees F

PROTECTIVE JACKET INSTALLATION

PVC FITTING COVERS AND JACKETS (PFJ):

Lap seams and joints a minimum of 2 inches and continuously seal PVC with welding solvent recommended by jacket manufacturer. 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.

ALL SERVICE JACKETS (ASJ) and FOIL SCRIM KRAFT JACKETS (FSK):

Install according to manufacturer's recommendations using factory supplied lap seals and butt strip seals. In addition to factory adhesive, secure lap seals and tape with clinch type staples.

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

1 from crushing the insulation. Pipe shields are required at all support locations. The insulation shall not be notched
2 or cut to accommodate the supporting channels.

3
4 Fully insulate all reheat coil piping, fittings, and valves (with the exception of unions) up to coil connection to prevent
5 condensation when coil is inactive during cooling season. Provide a vapor proof seal between the pipe insulation
6 and the insulated coil casing.

7
8 **INSULATION INSERTS AND PIPE SHIELDS:**

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

13
14 Provide insulation inserts and pipe shields at all hanger and support locations. Inserts may be omitted on 3/4" and
15 smaller copper piping provided 12" long 22-gauge pipe shields are used.

16
17 **FITTINGS AND VALVES:**

18 Fittings, valves, unions, flanges, couplings and specialties may be insulated with factory molded or built-up
19 insulation of the same thickness as adjoining insulation. Where the ambient temperature exceeds 150 degrees F,
20 cover insulation with fabric reinforcing and mastic. Where the ambient temperatures do not exceed 150 degrees,
21 furnish and install PVC fitting covers.

22
23 **MINERAL FIBER:**

24 Secure each 3' section with three metal bands snip off excess and turn ends over into insulation to prevent exposed
25 sharp edges. Stagger joints where more than one layer is used.

26
27 **AEROGEL INSULATION:**

28 Secure each 3' or larger sections with stainless steel bands evenly spaced at 12" and at ends. For elbows use 16-
29 gauge stainless steel or annealed copper tie wires evenly spaced. Twist wire ends, snip off excess and turn ends
30 over into insulation. Stagger joints where more than one layer is used.

31
32 **ELASTOMERIC AND POLYOLEFIN:**

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

38
39 **EXTRUDED POLYSTYRENE AND POLYISOCYANURATE:**

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

51
52 **PIPING PROTECTIVE JACKETS**

53 In addition to the jackets specified in the pipe insulation schedule below the following protective jackets are
54 required:

55
56 Provide a protective PVC jacket (PFJ) for the following insulated piping:

- 57 • Chilled water piping and valves in walk-thru tunnels and valve pits
- 58 • Exposed piping in kitchens
- 59 • Piping exposed in finished locations
- 60 • Exterior refrigeration piping.

61
62 Provide a protective PVC (PFJ) or Fabric Reinforced Mastic (FMJ) jacket for the following insulated piping:

- 63 • All piping within mechanical rooms.

1 Provide a protective metal (PMJ) or self-adhering (SAJ) jacket for the following insulated piping:

- 2 • Exterior installed refrigeration piping.

4 Provide a protective metal jacket (PMJ) for the following insulated piping:

- 5 • Steam and condensate piping and fittings located in walk-thru tunnels and steam pits.

7 Provide a protective covering of 2 coats of vapor retarding mastic with fibrous glass or canvas fabric reinforcing (FMJ) for the following insulated piping:

10 Provide a protective self-adhering (SAJ) jacket for the following insulated piping:

REMOVABLE INSULATION BLANKETS: (EXPANSION SLIP JOINT AND VALVES 2-1/2" AND LARGER)

14 Provide removable reusable insulated cover on new and existing expansion slip joints, ball joints and valves.

16 Install blankets to be field removable without tools.

18 Blankets shall be installed to allow the normal expansion and contraction associated with these systems, without crushing or damaging the blanket.

21 Expansion Joint blankets shall extend over the adjacent rigid insulation to allow for pipe expansion.

23 Blankets shall be installed without sagging or gaps.

25 Blankets shall be installed to shed water.

27 Steam system will not be allowed to turn on until removable jackets are installed.

PIPE INSULATION SCHEDULE:

30 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
Heating Hot Water	Rigid Fiberglass	ASJ	1.5"	1.5"	2"	2"	2"
Chilled Water	Polyisocyanurate / Polystyrene	VRJ or SAJ	1.5"	1.5"	1.5"	1.5"	1.5"
Chilled Beam Piping	Rigid Fiberglass	ASJ	1"	1"	1"	1"	1"
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"
Cold Water Piping	Rigid Fiberglass	ASJ	0.5"	0.5"	1"	1"	1"
Cooling Coil Condensate Drain	Rigid Fiberglass	ASJ	0.5"	0.5"	1"	1"	1"
Low Pressure Steam	Rigid Fiberglass	ASJ	2.5"	2.5"	2.5"	3"	3"
In Conduits	Mineral Wool	None	2.5"	2.5"	2.5"	3"	3"
Low Pressure Cond.	Rigid Fiberglass	ASJ	1.5"	1.5"	2"	2"	2"
In Conduits	Mineral Wool	None	1.5"	1.5"	2"	2"	2"
High Pressure Steam (15 psig to 119 psig)	Rigid Fiberglass	ASJ	3"	4"	4.5"	4.5"	4.5"

In Pits	Mineral Wool	PMJ	2.5"	3.5"	4"	4"	4"
In Conduits	Mineral Wool	None	2.5"	3.5"	4"	4"	4"
High Pressure Steam (120 psig or greater)	Rigid Fiberglass	ASJ	4.5"	5"	5"	5"	5"
In Pits	Mineral Wool	PMJ	4"	4.5"	4.5"	5"	5"
In Conduits	Mineral Wool	None	4"	4.5"	4.5"	5"	5"
High Pressure Cond. In Conduits	Mineral Wool	None	2.5"	3.5"	4"	4"	4"
High Pressure Cond. In Pits	Mineral Wool	PMJ	2.5"	3.5"	4"	4"	4"
Cond. Pump Disch. In conduits	Mineral Wool	None	1.5"	1.5"	2"	2"	2"
Boiler Feed Piping (201-250 deg F)	Mineral Wool	ASJ	2.5"	2.5"	2.5"	3"	3"
Boiler Feed Piping (251-350 deg F)	Mineral Wool	PMJ	2.5"	3.5"	4"	4"	4"
Valves and Exp. Joints in Pits	E Glass Fiber	Blanket	2"	2"	2"	2"	2"
Boiler Blow Down (201-250 deg F)	Mineral Wool	ASJ	1"	1"	1"	1"	1"
Boiler Blow Down (251-350 deg F)	Mineral Wool	PMJ	1"	1.5"	1.5"	2"	2"
Remote Generator Radiator Piping	Rigid Fiberglass	ASJ	1.5"	1.5"	2"	2"	2"

1
2 Insulation on all steam distribution systems and high-pressure steam over 2" shall be installed in multiple layers
3 not exceeding 2" in thickness.
4

5 The following piping and fittings are not to be insulated:

- 6 • Hot water piping inside radiation, convector, or cabinet heater enclosures
- 7 • Steam Traps
- 8 • Piping unions for systems not requiring a vapor retarding Jacket

9
10 For systems with fluid temperatures 65° F or less, furnish and install removable elastomeric insulation covers,
11 plugs or caps for all mechanical equipment and devices that require access by balancing contractors or service
12 and maintenance personnel. Examples include but are not limited to: flow sensing devices, circuit setters, manual
13 ball valve air vents, drain valves, blowdown valves, pressure/temperature test plugs, grease fittings, pump bearing
14 caps, equipment labels, etc. Covers shall be tight fitting to ensure a complete vapor retarding barrier.
15

16 **DUCT INSULATION**

17 **GENERAL:**

18 Secure flexible blanket duct insulation on sides and bottom of ductwork over 24" wide with weld pins. Space
19 fasteners 18" on center or less as required to prevent sagging. Compress insulation no more than 25%.
20

21 Secure rigid board insulation to ductwork with weld pins. Apply insulation with joints firmly butted together and
22 placed as close as possible to the equipment surface. Pins shall be located a maximum of 3" from each edge and
23 spaced no greater than 12" on center.
24

25 Install weld pins without damage to the interior galvanized surface of the duct. Clip pins back to washer and cover
26 penetrations with tape of same material as jacket. Firmly butt seams and joints and cover with 4" tape of same
27 material as jacket. Seal tape with plastic applicator and secure with staples. All joints, seams, edges and
28 penetrations to be fully vapor sealed with vapor retarding mastic.
29

30 Stop and point insulation around access doors and damper operators to allow operation without disturbing
31 insulation or jacket material.
32

1 External supply duct insulation is not required where ductwork contains continuous 1" acoustical liner. Provide 4"
2 overlap of external insulation over ends of acoustically lined sections.

3
4 Where insulated ductwork is supported by trapeze hangers, the insulation shall be installed continuous through
5 the hangers. Drop the supporting channels required to facilitate the installation of the insulation. Where rigid board
6 or flexible insulation is specified, install high density inserts to prevent the weight of the ductwork from crushing
7 the insulation.

8
9 Where insulated low temperature (below 45°F) ductwork is supported by steel metal straps or wire ropes that are
10 secured directly to the duct, the straps or ropes shall be completely covered with insulation and sealed to provide
11 a complete vapor retarding barrier.

12
13 Where insulated duct risers are supported by steel channels secured directly to the duct, extend the insulation and
14 vapor retarding jacketing to encapsulate the support channels.

15
16 Where ductwork exposed to the weather is insulated with any product other than fluid-applied ductwork insulation,
17 the top surface of the insulation shall be sloped a minimum of 1/4" per foot to eliminate ponding and create positive
18 drainage off of insulation. Refer to fluid-applied ductwork insulation section below for slope requirements.

19
20 **BREECHING:**

21 Fasten insulation over weld pins and secure with washers. Space fasteners not less than 3" from edge or corner
22 and 12" on center longitudinally and 9" on center in the transverse direction. Clip pins back to washer and cover
23 penetrations with tape of same material as jacket. Firmly butt seams and joints and cover with 4" tape of same
24 material as jacket. Seal tape with plastic applicator and secure with staples.

25
26 **GREASE DUCTS:**

27 Strictly adhere to manufacturer's installation instructions and rating requirements for application of fire-stop
28 insulation. Cover all exhaust ducts serving Type I kitchen hoods with fire-stop insulation from a point prior to
29 penetration of ceiling, wall, floor or concealment through building to termination at outside of building. Extend fire-
30 stop insulation through roof curbs.

31
32 **FLUID-APPLIED DUCTWORK INSULATION (FDI):**

33 Proceed with work only when weather conditions comply with Manufacturer recommendations and other current
34 published data and MSDS information. Do not exceed temperature limitations recommended by coating
35 manufacturer.

36
37 The top of ducts insulated with fluid-applied ductwork insulation shall be sloped using tapered insulation prior to
38 applying fluid-applied insulation. Tapered Insulation shall be ASTM C1289, Type II, Class 1, Grade 2; rigid board
39 polyisocyanurate insulation with felt or fibrous mat facing on both sides, factory tapered to 1/2" per foot slope.
40 Tapered insulation board shall have a start thickness at the perimeter of 1/2". Tapered insulation board shall be
41 mechanically fastened to ductwork. Tapered insulation applied to rectangular ductwork less than or equal to 24" in
42 width may be sloped from one side. Tapered insulation applied to rectangular ductwork greater than 24" in width
43 shall be sloped in two directions with the high point at the centerline of the duct.

44
45 Air intake vents, blowers, air conditioning units and evaporative coolers shall be disconnected or otherwise
46 modified to prevent fumes from entering into the building or from contaminating the substrate surface with
47 condensate water.

48
49 Coordinate scheduling with the Owner in order to relocate or protect vehicles, building occupants and building
50 contents from damage during construction operations.

51
52 Existing materials designated to remain, which are damaged or defaced as a result of the work shall be replaced
53 at Contractor's expense to like new condition.

54
55 [Reinstall] [Install] all rooftop mounted equipment in a watertight manner and repair any damage to sheet metal or
56 other components related to connection and protection of the system.

57
58 Prevent materials from entering and clogging roof drains and conductors. Remove roof drain plugs when no work
59 is taking place or when rain is forecast.

60
61 **Protection of surfaces:**

62 Take every precaution to prevent water leakage or debris falling into the building interior, or other such
63 occurrences. Contractor is responsible for any damage to the building interior, or contents, during application.

1 Provide special protection or avoid heavy traffic on completed work or roof surfaces. Temporary walkways and
2 work platforms shall be provided as necessary.

3
4 Wall surfaces shall be protected with tarpaulins or other suitable cover to prevent damage, staining or discoloration
5 that might result from operations. Windows, doorways, docks, walkways, etc. may require special protection
6 measures.

7
8 Protect building and adjacent area and property within the area from over spray.

9
10 **Caution:**

11 Installation of primers, polyurethane foam or coatings shall not interfere with the proper function of: Manual Volume
12 Dampers, Turning Vanes, Fire Dampers, Smoke Dampers and Combination Fire/Smoke Dampers, Control
13 Dampers, Smoke Detectors, Access Doors, Duct Pressure Relief Doors, Flashings, Duct Flexible Connections,
14 Sound Attenuators, Hoods for Intake and Exhaust, Louvers, Air Blenders and Air Flow Stations.

15
16 Installation of Spray Polyurethane Foam (SPF) Insulation:

17 When required, install approved polyurethane foam to an average thickness as specified in the duct insulation
18 schedule (1" minimum required) and terminated neatly at designated places.

19
20 Mask areas where coating is to be terminated to prevent surface contamination with foam over spray.

21
22 Foam spray application shall be limited to that which can be completed to full foam thickness in one day. All
23 exposed foam tie-in end laps and side laps must be primed at the end of each workday.

24
25 The completed foam surface shall be smooth to orange peel texture; popcorn texture is not acceptable.

26
27 The completed foam surface shall be free of pinholes and/or "glass windows" caused by improper equipment
28 calibration or climatic conditions. The SPF shall not have any soft or spongy areas or areas with hard or brittle
29 strings of improperly proportioned material

30
31 Eliminate areas of ponding using approved polyurethane foam to create positive drainage.

32
33 Remove protective masking at terminations.

34
35 Apply protective coating to foam surface on the same day as polyurethane foam is installed.

36
37 The foam shall not be left exposed or uncoated for more than 4 hours. If coating application is delayed beyond
38 that time, consult manufacturer for primer recommendations.

39
40 Installation of Coating System:

41 Do not apply coating when moisture is present on the substrate.

42 Wind barriers shall be used if wind conditions could affect the quality of the material being applied.

43
44 Coating must cover all surfaces completely. An extra pass of coating material may be required at all edges and
45 penetrations.

46
47 Base coat(s) and primer(s) shall be allowed to cure before proceeding with subsequent applications.

48
49 All coating and primers shall be coated within recommended time period. If application is delayed beyond that
50 time, consult Manufacturer for primer recommendations.

51
52 Application Thickness:

53 15 Year NDL System

54 Average Application Thickness: Topcoat Average thickness shall be 36 Average TDM (Total Dry MILs), (3.0 gallons
55 per 100 sq. ft. minimum application recommended.)

56
57 Application rates must be checked periodically to assure proper coating thickness. This may be done by checking
58 dry film thickness.

59
60 Contractor to estimate coating requirements based on actual experience and needs to figure losses due to
61 applicator experience, surface texture, wind, waste, and other factors increasing estimated gallons required.

62
63 The total dry mil thickness of all coatings, as well as the total dry mil thickness of the topcoat(s) shall meet the
64 minimums required by Manufacturer.

1 Application of approved polyurea coating:
2 Spray apply the approved polyurea coating to achieve the required TDM. The polyurea shall completely cover the
3 SPF including all termination, penetrations, expansion joint covers, parapets, and flashings. Spray pattern shall
4 overlap the previous pass to insure complete coverage.

5
6 To assure complete coverage with approved polyurea coating, applicator needs to figure losses due to over-spray,
7 surface texture and wind and increase the gallons as needed to meet specifications.

8
9 Pay special attention to overspray, which can texture or discolor adjoining finished sections. Wind direction should
10 conduct overspray away from finished surfaces.

11
12 **Spray Equipment:**

13 This product must be applied with plural component spray equipment. The proportioning pump should be a positive
14 displacement type set up in a 1:1 ratio, capable of maintaining dynamic pressure of 1,500 psi and fluid
15 temperatures of 150° F during the maximum output of the proportioner. Fluid spray hoses should be of the dual
16 heated type with temperature controls capable of maintaining 150° F fluid temperatures the full length to the spray
17 gun. The heated hose assembly must be insulated and be high-pressure type with designed working pressure to
18 handle the maximum pressure delivered by the proportioner. The inside lining of the hose assembly must be of a
19 material that is unaffected by the coating or solvents used for cleanup. Contact Manufacturer for specific
20 instructions and spray equipment recommendations.

21
22 The polyurea shall not be left exposed or uncoated for more than 4 hours. If fire retardant coating application is
23 delayed beyond that time, consult manufacturer for primer recommendations.

24
25 Entire application shall receive a final coat of compatible, fire-retardant coating (Flame spread <25 Smoke <50).
26 Minimum thickness shall be no less than that tested for Spread of Flame rating (ASTM E-84 /UL-723).

27
28 Refasten all mechanical equipment and remount other rooftop equipment as necessary.

29
30 **DUCTWORK PROTECTIVE COVERINGS:**

31 In addition to the jackets specified in the duct insulation schedule below the following protective coverings are
32 required:

33
34 Provide a protective covering of 2 coats of indoor/outdoor vapor retarding mastic with fibrous glass or canvas fabric
35 covering (FMJ) or self-adhering jacket (SAJ) meeting 25/50 Flame Spread/Smoke Rating for the following
36 ductwork:

- 37 • Ductwork within 8' of floor, catwalks and mezzanines in mechanical rooms

38
39 Provide a protective self-adhering jacket (SAJ) for the following insulated ductwork:

40
41 **DUCT INSULATION SCHEDULE:**

42 Provide duct insulation on new and existing remodeled ductwork in the following schedule:

SERVICE	INSULATION TYPE	JACKET	THICKNESS
Outside air ducts	Rigid Fiberglass	FSK	2"
Mixed air ducts	Rigid Fiberglass	FSK	2"
Exposed supply ducts*	Rigid Fiberglass	FSK	2"
Concealed supply ducts	Flexible Fiberglass	FSK	1.5"
All Ducts located in unconditioned Attics/Shafts***	Flexible Fiberglass	FSK	3"
Exhaust and relief ducts downstream of motorized backdraft dampers	Rigid Fiberglass	FSK	2"
All ducts exposed to weather	Ext. Polystyrene or Fluid-Applied**	SAJ	3"
Exhaust ducts downstream of heat recovery units and desiccant dryers	Rigid Fiberglass	FSK	2"

Grease ducts serving Type I Kitchen hoods	Firestop	See Spec.	As Req'd. for Specified Hourly Rating
Heat recovery units other than kitchen hood exhaust	Rigid Fiberglass	FSK	1"
Breech. and boiler wind boxes	Fireproofing	See Spec.	3"
Louver blank-off panels ****	Ext. Polystyrene	SAJ	4"

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- * Exposed supply branch ducts located in the space they are serving do not require insulation. Exposed supply main ducts running through spaces they serve shall be insulated as exposed supply ducts scheduled above.
- ** No jacket is required for Fluid-Applied ductwork insulation. The two-part Fluid-Applied system serves as insulation and protective jacket.
- *** Outside air ductwork between the isolation damper and the outside air intake does not require insulation where it is located in an unheated attic.
- **** Insulating value of any louver or curb blank off panel needs to meet the building envelope insulating value required by current building code.

EQUIPMENT INSULATION

GENERAL:

Do not insulate over equipment access manholes, fittings, nameplates or ASME stamps. Bevel and seal insulation at these locations.

PROTECTIVE JACKETS:

Provide a protective metal jacket (PMJ) for the following:

- Generator exhaust pipe (that is not concealed in a shaft) and muffler.

SEMI-RIGID FIBERGLASS:

Apply insulation to equipment shells using weld pins, bonding adhesive, banded and wired in place. Fill all joints, seams and depressions with insulating cement to a smooth, even surface. Cover with reinforcing fabric and 2 coats of mastic (FMJ). Use vapor retarding mastic on systems requiring a vapor retarding barrier.

ELASTOMERIC/POLYOLEFIN:

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

REMOVABLE COVERS:

Provide insulated easily removable galvanized steel metal boxes for routine service access on the following equipment:

Provide insulated easily removable elastomeric insulation sections for the following equipment:

EQUIPMENT INSULATION SCHEDULE:

Provide equipment insulation as follows:

EQUIPMENT	INSULATION TYPE	JACKET	THICKNESS
Reheat coil casing in exposed supply ducts	Rigid Fiberglass	FSK	2"
Reheat coil casing in concealed supply ducts	Flexible Fiberglass	FSK	1-1/2"
Hot Water Storage tanks	Semi-Rigid Fiberglass	ASJ	2"
Hot Water Air separators	Semi-Rigid Fiberglass	ASJ/FMJ	1.5"
Chilled Water Air separators	Elastomeric/Polyolefin	None	1"
Chilled water compression tanks	Elastomeric/Polyolefin	None	1"
Chilled Water Pumps	Elastomeric/Polyolefin	None	1"

Chiller evaporator shell, suction piping, heads, and water boxes	Elastomeric/Polyolefin	None	1"
Heat exchangers	Semi-Rigid Fiberglass	ASJ/PMJ	2"
Condensate receivers (unless otherwise noted)	Semi-Rigid Fiberglass	ASJ/PMJ	2"
Flash tanks	Mineral Wool	PMJ	2"
Blowdown separator	Mineral Wool	PMJ	2"
Deaerators	Mineral Wool	PMJ	2-1/2"
Steam Economizer	Mineral Wool	PMJ	2"
Water cooled condenser shell *	Elastomeric/Polyolefin	None	1"
Humidifier separator	Rigid Fiberglass	ASJ	2"
Air Handling Unit Casings or attached component sections not factory insulated**	Rigid Fiberglass	ASJ	2"
Diesel generator exhaust pipe and muffler	Calcium Silicate/ Fireproofing	PMJ***	3"
NG generator exhaust pipe and muffler	High Temperature Calcium Silicate/ Fireproofing	PMJ***	3"

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* Condenser shell only needs to be insulated when condenser is city, lake, or river water cooled or when "free cooling" is used.

** The thickness and type of insulation provided for non-factory fabricated transitions or component sections shall be consistent with the sections constructed at the factory.

*** Protective metal jacket (PMJ) is only required in exposed locations.

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 31 00
HVAC DUCTS and CASINGS**

PART 1 - GENERAL

SCOPE

This section includes specifications for all duct systems used on this project. Included are the following topics:

PART 1 - GENERAL

- Scope
- Related Work
- Reference
- Reference Standards
- Quality Assurance
- Shop Drawings
- Design Criteria

PART 2 - PRODUCTS

- General
- Materials
- High Temperature Flexible Duct
- High Pressure Ductwork (Pressure class 3 inch and over)
- Low Pressure Ductwork (Maximum 2-inch pressure class)
- Kitchen Hood Exhaust Duct Construction
- Dishwasher Exhaust Duct Construction
- Fume Exhaust Duct Construction
- Perchloric Acid Exhaust Duct Construction
- Exhaust Duct (Moisture laden air)
- Duct Sealant
- Gaskets

PART 3 - EXECUTION

- Installation
- High Pressure Duct (Pressure class 3 inch and over)
- Low Pressure Duct (Maximum 2-inch pressure class)
- Kitchen Hood Exhaust Duct Construction
- Exhaust Duct (Moisture laden air)
- Fume Exhaust Duct Construction
- Perchloric Acid Exhaust Duct Construction
- Cleaning
- Leakage Test
- Construction Verification

APPENDIX

- Duct Leakage Test Report
- Duct Structural Test Report

RELATED WORK

- Section 23 01 30.51 – HVAC Air Duct Cleaning
- Section 23 05 93 - Testing, Adjusting, and Balancing for HVAC
- Section 23 08 00 – Commissioning of HVAC
- Section 23 33 00 – Air Duct Accessories

REFERENCE

Applicable provisions of Division 1 govern work under this Section.

REFERENCE STANDARDS

- | | |
|------------------|--|
| ANSI SS-EN 485-2 | Aluminum and Aluminum Alloys-Sheet, Strip and Plate-Part 2: Mechanical Properties |
| ASTM B209 | Specification for Aluminum and Aluminum-Alloy Sheet and Plate |
| ASTM A90 | Test Method for Weight of Coating on Zinc-Coated (Galvanized) Iron or Steel Articles |
| ASTM A167 | Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip |
| ASTM A623 | Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process |

1	ASTM A527	Specification for General Requirements for Steel Sheet, Zinc-Coated
2		(Galvanized) by the Hot-Dip Process, Lock-Forming Quality
3	ASTM 924	Standard Specification for General Requirements for Sheet Steel, Metallic-coated
4		by the Hot-dip Method
5	ASTM C 1071	Specification for Fibrous Glass Duct Lining Insulation
6	ASTM C 411	Test Method for Hot Surface Performance of High Temperature Thermal
7		Insulation
8	ASTM E 84	Test Method for Surface Burning Characteristics of Building Materials
9	ASTM C 1338	Test Method for Determining Fungal Resistance of Insulation Materials
10		and Facings
11	ASTM G 21	Standard Practice for Determining Resistance of Synthetic Polymeric Materials
12		to Fungi
13	ASTM C 916	Standard Specification for Adhesives for Duct Thermal Insulation
14	NFPA 90A	Standard for the Installation of Air Conditioning and Ventilating Systems
15	UL 181	Standard for Safety for Factory Made Air Ducts and Air Connectors.
16	NAIMA	Fibrous Glass Duct Liner Standard

18 **QUALITY ASSURANCE**

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

21 **SHOP DRAWINGS**

22 Refer to division 1, General Conditions, Submittals.

24 Include manufacturer's data and/or Contractor data for the following:

- 26 • Fabrication and installation drawings.
- 27 • Schedule of duct systems including material of construction, gauge, pressure class,
28 system class, method of reinforcement, joint construction, fitting construction, and support
29 methods, all with details as appropriate.
- 30 • Duct sealant and gasket material.
- 31 • Duct liner including data on thermal conductivity, air friction correction factor, and limitation
32 on temperature and velocity.

34 **DESIGN CRITERIA**

35 Construct all ductwork to be free from vibration, chatter, objectionable pulsations, and leakage under
36 specified operating conditions.

38 Use material, weight, thickness, gauge, construction, and installation methods as outlined in the following
39 SMACNA publications, unless noted otherwise:

- 41 • HVAC Duct Construction Standards, Metal and Flexible, 3rd Edition, 2005
- 42 • HVAC Air Duct Leakage Test Manual, 2nd Edition, 2012
- 43 • HVAC Systems - Duct Design, 4th Edition, 2006
- 44 • Rectangular Industrial Duct Construction Standard, 2nd Edition, 2004
- 45 • Round Industrial Duct Construction Standards, 2nd Edition, 1999
- 46 • Thermoplastic Duct (PVC) Construction Manual, 2nd Edition, 1995

48 Use products which conform to NFPA 90A, possessing a flame spread rating of not over 25 and a smoke
49 developed rating no higher than 50.

51 **DELIVERY, STORAGE AND HANDLING**

52 Promptly inspect shipments to ensure that Ductwork is undamaged and complies with the specification.

54 Protect Ductwork against damage.

56 Protect Ductwork by storing inside or by durable, waterproof, above ground packaging. Do not store material
57 on grade. Protect Ductwork from dirt, dust, construction debris and foreign material. Where end
58 caps/packaging are provided, take precautions so caps/packaging remain in place and free from damage.

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

62 Storage and protection methods must allow inspection to verify products.

1 **PART 2 - PRODUCTS**

2
3 **GENERAL**

4 All sheet metal used for construction of duct shall be 24 gauge or heavier except for round and spiral ductwork
5 and spiral duct take-offs 12" and below may be 26 gauge where allowed in SMACNA HVAC Duct
6 Construction Standards, Metal and Flexible, 3rd Edition, 2005.

7
8 Duct sizes indicated on plans are net inside dimensions; where duct liner is specified, dimensions are net,
9 inside of liner.

10
11 **DUCTWORK PRESSURE CLASS**

12
13 Minimum acceptable duct pressure class, for all ductwork except transfer ductwork, is 2 inch W.G. positive
14 or negative, depending on the application. Transfer ductwork minimum acceptable duct pressure class is 1
15 inch W.G. positive or negative, depending on the application. Duct system pressure classes not indicated on
16 the drawings to be as follows:

17
18

19	Supply duct upstream of VAV boxes	___ 3 ___ in. calc. S.P.
20	Supply duct downstream of VAV terminals	___ 2 ___ in. calc. S.P.
21	Transfer air ducts	___ 1 ___ in. calc. S.P.
22	Exhaust air ducts	___ 1 ___ in. calc. S.P.
23	Return air ducts	___ 2 ___ in. calc. S.P.
24	Relief air ducts	___ 1 ___ in. calc. S.P.
25	Outside air ducts	___ 2 ___ in. calc. S.P.
26	Mixed air ducts	___ 2 ___ in. calc. S.P.
27	Other duct systems	___ 2 ___ in. calc. S.P.

28
29

30 **MATERIALS**

31 **GALVANIZED STEEL SHEET:**

32 Use ASTM A 653 galvanized steel sheet of lock forming quality. Galvanized coating to be 1.25 ounces per
33 square foot, both sides of sheet, G90 in accordance with ASTM A90. Provide "Paint Grip" finish or galvanneal
34 sheet metal for ductwork that will be painted.

35
36 **UNCOATED BLACK STEEL SHEET:**

37 First quality, soft steel sheet capable of welding or double seaming without fracture.

38
39 **ALUMINUM SHEET:**

40 Use ANSI/ASTM B209 aluminum sheet, alloy 3003H-14, capable of double seaming without fracture.

41
42 **STAINLESS STEEL SHEET:**

43 Use ASTM A167, Type 304 or 316 stainless steel sheet as specified, 316L if welded ductwork, with No. 2B
44 finish for concealed work and No. 3 finish for exposed work.

45
46 **POLYVINYLCHLORIDE COATED STEEL SHEET:**

47 Use hot-dipped galvanized steel sheet with prime coat and a polyvinyl chloride film on both sides. Thickness
48 of coating to be a minimum of 4 mils on each side. United Sheet Metal Uni-Coat, made by United McGill Co.,
49 may be used at contractor's option.

50
51 Where any duct surface is scratched, marred, or otherwise damaged, paint with PVC aerosol spray.

52
53 All couplings shall be slip-joint construction with a minimum 2 inches insertion length. Seal all couplings with
54 sealants as specified.

55
56 **PREFABRICATED GREASE DUCTS**

57 Dual wall construction with stainless steel inner liner, insulation, and stainless steel (for exposed locations)
58 or aluminized steel (for concealed locations) shell. Furnish all items which form a part of the assembly,
59 including, tee sections, straight sections, elbows, end caps, cleanouts, expansion joints, fan/hood
60 transitions, supports, flashing, counter flashing, and insulated roof thimble where required. Each section
61 shall bear the factory applied Underwriters Laboratories Label.

62
63 **HIGH PRESSURE DUCTWORK (Pressure class 3 inch and over)**

64 Manufacturers: Ajax, Semco, United Sheet Metal, Sheet Metal Connectors or approved equal.

1 Machine formed round and/or flat oval spiral lock seam duct constructed of galvanized steel.

2
3 Rectangular high-pressure duct using a transverse joint system as manufactured by Ductmate, Nexus, TDC,
4 TDF, or approved equal, may be used at contractor's option. Duct to be flanged, gasketed and sealed.

5
6 Contractor fabricated ductwork meeting specified construction standards is acceptable with prior approval of
7 Architect/Engineer. Submit construction details, a description of materials to be used, type of service,
8 reinforcing methods, and sealing procedures.

9
10 Use a perforated inner liner on double wall high-pressure duct. Annular space between inner liner and outer
11 duct to be filled with 1 inch glass fiber insulation.

12
13 Use cemented slip joints with 2-inch minimum overlap, flanged connections, or welded/brazed connections,
14 unless noted otherwise for special applications. Prime coat welded joints.

15
16 Provide standard 90-degree conical tee takeoffs except for exhaust at velocities over 2000 feet per minute,
17 use 45° lateral connections; straight taps or bullhead tees are not acceptable.

18
19 Internal bracing will not be accepted on ductwork below 48 inches.

20
21 Use turning vanes as specified in Section 23 33 12.

22
23 Provide bellmouth fittings or expanded fittings at each duct connection to air plenums.

24
25 Provide pressure relief fittings as indicated on the plans and/or details.

26
27 Transform duct sizes gradually, not exceeding 15 degrees divergence and 30 degrees convergence.

28
29 **LOW PRESSURE DUCTWORK (Maximum 2-inch pressure class)**

30 Fabricate and install ductwork in sizes indicated on the drawings and in accordance with SMACNA
31 recommendations, except as modified below.

32
33 Construct so that all interior surfaces are smooth. Use slip and drive or flanged and bolted construction when
34 fabricating rectangular ductwork. Use spiral lock seam construction when fabricating round spiral ductwork.
35 Sheet metal screws may be used on duct hangers, transverse joints and other SMACNA approved locations
36 if the screw does not extend more than 1/2 inch into the duct.

37
38 Use elbows and tees with a center line radius to width or diameter ratio of 1.5 wherever space permits. When
39 a shorter radius must be used due to limited space, install single wall sheet metal splitter vanes in accordance
40 with SMACNA publications, Type RE 3. Where space will not allow and the C value of the radius elbow, as
41 given in SMACNA publications, exceeds 0.31, use rectangular elbows with turning vanes as specified in
42 Section 23 33 00. Square throat-radius heel elbows will not be acceptable. Straight taps or bullhead tees
43 are not acceptable.

44
45 Where rectangular elbows are used, provide turning vanes in accordance with Section 23 33 00.

46
47 Provide expanded take-offs or 45-degree entry fittings for branch duct connections with branch ductwork
48 airflow velocities greater than 700 fpm. Square edge 90-degree take-off fittings or straight taps will not be
49 accepted.

50
51 Button punch snaplock construction will not be accepted on aluminum ductwork.

52
53 Round ducts may be substituted for rectangular ducts if sized in accordance with ASHRAE table of equivalent
54 rectangular and round ducts. No variation of duct configuration or sizes permitted except by written
55 permission of the Architect/Engineer.

56
57 Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible. Divergence
58 upstream of equipment shall not exceed 30 degrees; convergence downstream shall not exceed 45 degrees.

59
60 **KITCHEN HOOD EXHAUST DUCT CONSTRUCTION**

61 In concealed locations use minimum 16-gauge black steel or minimum 18-gauge stainless steel with all joints
62 welded liquid tight or prefabricated grease duct, Underwriters Laboratory, Inc listed with aluminized steel
63 shell

64

1 In exposed areas, use 18 gauge or heavier stainless steel with a number 3 finish and with all joints welded
2 liquid tight or prefabricated Underwriters Laboratory, Inc listed duct with stainless steel shell. Grind and
3 polish all welded joints and seams to a number 3 finish.
4

5 Provide expanded take-offs for branch duct connections or 45-degree entry fittings. Square edge 90-degree
6 take-off fittings or straight taps will not be accepted.
7

8 Use elbows and tees with a center line radius to width or diameter ratio of 1.5 wherever space permits shall
9 be used wherever possible. Shorter radius elbows may be used in areas with limited space with prior
10 approval of the Architect/Engineer.
11

12 No turning vanes may be used in kitchen exhaust duct.
13

14 Supporting steel and hangers shall not be lighter than the duct gauge.
15

16 **DISHWASHER EXHAUST DUCT CONSTRUCTION**

17 Fabricate and install ductwork in sizes indicated on the drawings and in accordance with SMACNA
18 recommendations, except as indicated below.
19

20 Use 18 gauge or heavier stainless steel with all seams and joints welded and ground smooth. In exposed
21 areas, joints and seams to be polished to a #3 finish (minimum).
22

23 Use elbows and tees as specified for the appropriate duct pressure class.
24

25 Provide expanded take-offs for branch duct connections or 45-degree entry fittings. Square edge 90-degree
26 take-off fittings or straight taps will not be accepted.
27

28 **FUME EXHAUST DUCT CONSTRUCTION**

29 Use PVC coated steel or stainless-steel duct and fittings. Use stainless steel for all exposed installations
30 below suspended ceilings.
31

32 Use 316 stainless steel for flanged gasketed connections.
33

34 Use 18 gauge or heavier 316L stainless steel sheet for externally welded ductwork. Grind and polish joints
35 and seams to a #3 finish minimum.
36

37 **PERCHLORIC ACID EXHAUST DUCT CONSTRUCTION**

38 Use 18 gauge or heavier, 316 stainless steel with internally and externally welded, ground and polished joints
39 and seams.
40

41 **DUCT SEALANT**

42 Manufacturer: 3M 800, 3M 900, H.B. Fuller/Foster, Hardcast, Hardcast Peal & Seal, Lockformer cold
43 sealant, Mon-Eco Industries, United Sheet Metal, or approved equal. Silicone sealants are not allowed in
44 any type of ductwork installation.
45

46 Install sealants in strict accordance with manufacturer's recommendations, paying special attention to
47 temperature limitations. Allow sealant to fully cure before pressure testing of ductwork, or before startup of
48 air handling systems.
49

50 **GASKETS**

51 2 INCH PRESSURE CLASS AND LOWER:

52 Soft neoprene or butyl gaskets in combination with duct sealant for flanged joints.
53

54 3 INCH PRESSURE CLASS AND HIGHER:

55 Butyl gaskets.
56

57 FUME HOOD EXHAUST:

58 Butyl gaskets.
59

60 **PART 3 - EXECUTION**

61 **INSTALLATION** 62

1 Verify dimensions at the site, making field measurements and drawings necessary for fabrication and
2 erection. Check plans showing work of other trades and consult with Architect in the event of any
3 interference.
4

5 Make allowances for beams, pipes or other obstructions in building construction and for work of other
6 contractors. Transform, divide or offset ducts as required, in accordance with SMACNA HVAC Duct
7 Construction Standards, Figure 4-7, except do not reduce duct to less than six inches in any dimension and
8 do not exceed an 8:1 aspect ratio. Where it is necessary to take pipes or similar obstructions through ducts,
9 construct easement as indicated in SMACNA HVAC Duct Construction Standards, Figure 4-8, Fig. E. In all
10 cases, seal to prevent air leakage. Pipes or similar obstructions may not pass-through high pressure or fume
11 exhaust ductwork.
12

13 Test openings for test and balance work will be provided under Section 23 05 93.
14

15 Provide frames constructed of angles or channels for coils, filters, dampers or other devices installed in duct
16 systems, and make all connections to such equipment including equipment furnished by others. Secure
17 frames with gaskets and screws or nut, bolts and washers.
18

19 Install duct to pitch toward outside air intakes and drain to outside of building. Solder or seal seams to form
20 watertight joints.
21

22 Where two different metal ducts meet, the joint shall be installed in such a manner that metal ducts do not
23 contact each other by using proper seal or compound.
24

25 Install all motor operated dampers and connect to or install all equipment furnished by others. Blank off all
26 unused portions of louvers, as indicated on the drawings, with 1-1/2-inch board insulation with galvanized
27 sheet metal backing on both sides.
28

29 Do not install ductwork through dedicated electrical rooms or spaces unless the ductwork is serving this room
30 or space.
31

32 Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.
33

34 Provide adequate access to ductwork for cleaning purposes.
35

36 Provide temporary capping of ductwork openings to prevent entry of dirt, dust and foreign material.
37 Protect diffusers, registers and grilles with plastic wrap or some other approved form of protection to
38 maintain dirt and dust free and to prevent entry of dirt, dust and foreign material into the Ductwork.
39

40 Install prefabricated grease ductwork assemblies in accordance with manufacturer requirements and NFPA
41 96.
42

43 During construction provide temporary closures of metal or taped polyethylene on open ductwork to prevent
44 construction dust from entering ductwork system.
45

46 **DUCTWORK SUPPORT**

47 Support ductwork in accordance with SMACNA HVAC Duct Construction Standards, Figure 5-5, except
48 supporting ductwork with secure wire method is not allowed.
49

50 Stainless steel air-craft cable hanging systems are allowed on round ductwork under 12 inches diameter if
51 installed utilizing two fasteners with two cable loops. Support with 3/32-inch, 7 x 7, stainless steel air-craft
52 cable, with matching serrated spring-loaded wedge mechanism fasteners rated for actual load. Comply
53 with the manufacturer's installation instructions.
54

55 **HIGH PRESSURE DUCT (Pressure class 3 inch and over)**

56 Seal all duct in accordance with SMACNA seal class "A"; all seams, joints, and penetrations shall be sealed.
57

58 **LOW PRESSURE DUCT (Maximum 2-inch pressure class)**

59 Seal all duct, with the exception of transfer ducts, in accordance with SMACNA seal class "A"; all seams,
60 joints, and penetrations shall be sealed.
61

62 Install a manual balancing damper in each branch duct and for each diffuser or grille. The use of splitter
63 dampers, extractors, or grille face dampers will not be accepted for balancing dampers.

1 Hangers must be wrapped around bottom edge of duct and securely fastened to duct with sheetmetal screws
2 or pop rivets. Trapeze hangers may be used at contractor's option.

3
4 **KITCHEN HOOD EXHAUST DUCT CONSTRUCTION**

5 Where welded joints are used with black steel duct, coat all external welded joints and seams with paint.
6 Grind and polish to #3 finish all exposed stainless-steel joints and seams.

7
8 Apply bracing and reinforcement to the outside of the duct to prevent breathing, rattling, vibration or sagging
9 of duct.

10
11 Install without forming dips, sag or traps which might collect residue by supporting at not greater than 5-foot
12 intervals; fasteners at hangers shall not penetrate the duct. Do not use sheet metal screws on supports; use
13 bolted, riveted, or welded connections. Where ductwork is listed, install in accordance with listing.

14
15 Construct grease tight access doors of the same material and thickness as the duct and as large as possible,
16 up to 24 inches in any dimension. Locate on duct sides for ease of inspection and cleaning at each change
17 in direction, not less than every 10 lineal feet of duct, including risers, and not less than 1-1/2 inches from
18 the bottom of the duct.

19
20 Insulation or fire protection enclosure shall be removable at each access door and clean out.

21
22 Pitch horizontal ducts back to hood at 1 inch per foot.

23
24 **EXHAUST DUCT (Moisture laden air)**

25 Pitch duct to drain back to equipment or exhaust grille.

26
27 Provide watertight drain pan at low points or at locations where moisture may collect. Pipe drain pan to
28 nearest floor drain.

29
30 **FUME EXHAUST DUCT CONSTRUCTION**

31 For all rectangular duct and round duct 36-inch diameter and larger, apply a bead of PCD sealant at the
32 corrosive side of the gasket. For round duct less than 36-inch diameter, use slip coupling connection sealed
33 with PCD sealant.

34
35 Apply duct sealer on male end connectors before insertion, and afterwards to cover the entire joint.

36
37 Use 316 stainless steel fasteners to provide mechanical strength at all couplings; galvanized mechanical
38 fasteners will not be accepted. Maximum screw spacing shall be 12 inches o. c. with a minimum of 3 equally
39 spaced screws per joint.

40
41 Do not locate screws, rivets, or bolts on the bottom of the duct.

42
43 Repair any damage to the PVC coating with a PVC aerosol spray or similar PVC product as soon as
44 installation of the piece with a damaged coating is completed.

45
46 **PERCHLORIC ACID EXHAUST DUCT CONSTRUCTION**

47 Interior and exterior joints and seams shall be ground and polished smooth.

48
49 Pitch duct to drain back to hood or other drain point detailed on the drawings.

50
51 Proper operation of hood and duct washdown system must be demonstrated prior to acceptance by owner.

52
53 Pipe washdown drains to location indicated on plans.

54
55 Label perchloric acid exhaust ducts with 4-inch-high red stenciled "Perchloric Acid Exhaust" legend every ten
56 feet.

57
58 **DUST COLLECTION EXHAUST DUCT**

59
60 Provide access doors and clean outdoors where specified and indicated on the drawings and necessary for
61 routine maintenance and replacement of parts or inspection of items concealed in the ductwork.

62
63 Construct access and cleanout doors of the same material and thickness as the duct. Size as large as
64 possible, up to 0.5 times the diameter of the ductwork, as measured along its circumference and a maximum

1 of 24 inches. Locate on duct sides for ease of inspection and cleaning at each change in direction, at
2 junctions with vertical ducts, and at devices requiring periodic inspection and maintenance. Locate not less
3 than every 10 lineal feet of duct, including risers. Removable caps may be installed at termination ends on
4 ducts less than 12 inch in diameter.

5
6 **CLEANING**

7 Remove all dirt and foreign matter from the entire duct system and clean diffusers, registers, grilles and the
8 inside of air-handling units before operating fans.

9
10 Clean duct systems with high power vacuum machines where systems have been used for temporary heat,
11 air-conditioning, or ventilation purposes during construction. Protect equipment that may be harmed by
12 excessive dirt with filters, or bypass during cleaning.

13
14 **LEAKAGE TEST**

15 Test all ductwork in accordance with test methods described in Section 5 of SMACNA HVAC Air Duct
16 Leakage Test Manual. Do not insulate ductwork until it has been successfully tested. Test pressure shall
17 be equal to the duct pressure class.

18
19 If excessive air leakage is found locate leaks, repair the duct in the area of the leak, seal the duct, and retest.

20
21 Leakage rate shall not exceed more than 5% of the system air quantity for low pressure ductwork, determined
22 in accordance with Appendix C of the SMACNA HVAC Air Duct Leakage Test Manual.

23
24 Leakage rate shall not exceed more than 1% of the system air quantity for high pressure ductwork, determined
25 in accordance with Appendix C of the SMACNA HVAC Air Duct Leakage Test Manual.

26
27 Leakage test for ductwork downstream of air terminal devices may be omitted but will not relieve the
28 contractor from duct sealing requirements.

29
30 Submit a signed report to the Division's Construction Representative, indicating test apparatus used, results
31 of the leakage test, and any remedial work required to bring duct systems into compliance with specified
32 leakage rates.

33
34 **STRUCTURAL TEST**

35 Random test all ductwork per DFD direction. Do not insulate ductwork until it has been successfully tested.
36 Test pressure shall be equal to the duct pressure class.

37
38 Deflection limits shall not exceed those listed in accordance with Chapter 11 of SMACNA HVAC Duct
39 Construction Standards, 3.0 Performance Requirements.

40
41 Submit a signed report to the Division's Construction Representative, indicating test apparatus used,
42 results of the structural test, and any remedial work required.

43
44 **CONSTRUCTION VERIFICATION**

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

48
49 **END OF SECTION**

DUCT LEAKAGE TEST REPORT

State of Wisconsin Department of Administration Division of Facilities Development	DFD Project Number: _____ Date Submitted: _____
---	--

Project	Name: _____		
	Location: _____		
	Contractor: _____		
System	Fan No: _____	Leakage Class (C _L): _____	
Data	Fan Design CFM: _____	Duct Pressure Class (P _C): _____	
		Test Pressure (P _T): _____	
Test Equipment	Manufacturer: _____	Model No: _____	Serial No: _____

For large systems, use the reverse side for a simple sketch of the entire duct system. Then use letter designations to indicate the various duct sections being tested at one time. Also use the reverse side for test comments.

Note that due to normal construction sequencing it is usually necessary to test risers separately prior to enclosing chases.

Design Data					Field Test Data							
Duct Section	Duct Shape	Duct Surface (Ft ²)	Allowable Leakage		Diameter		Pressure (in. wc.)		Date	Performed By	Observed By	Actual CFM
			Leakage Factor (P ^{.65} C _L)	CFM for Section	Tube (D ₁)	Orifice (D ₂)	In Duct (P)	Across Orifice (P _{drop})				
TOTAL												

DUCT STRUCTURAL TEST REPORT

State of Wisconsin Department of Administration Division of Facilities Development	DFD Project Number: _____ Date Submitted: _____
---	--

Project	Name: _____		
	Location: _____		
	Contractor: _____		
System Data	Fan No: _____		
Description of Test Method:			

Test Equipment	Manufacturer: _____	Model No: _____	Serial No: _____

For large systems, use the reverse side for a simple sketch of the entire duct system. Then use letter designations to indicate the various duct sections being tested at one time. Also use the reverse side for test comments.

Note that due to normal construction sequencing it is usually necessary to test risers separately prior to enclosing chases.

Design Data							Field Test Data							
Duct Test Location	Ductwork Shape		Duct Pressure Class	Allowable Ductwork Wall Deflection		Allowable Joint/Reinforcement Deflection		Pressure (in. wc.) In Duct	Measured Ductwork Wall Deflection		Measured Joint/Reinforcement Deflection		Per-formed By/ Date	Wit-nessed By/ Date
	H	W		H	W	H	W		H	W	H	W		

ICA
30 NOVEMBER 2022

**SECTION 23 33 00
AIR DUCT ACCESSORIES**

PART 1 - GENERAL

SCOPE

This section includes accessories used in the installation of duct systems. Included are the following topics:

PART 1 - GENERAL

- Related Work
- Reference
- Reference Standards
- Quality Assurance
- Shop Drawings
- Operation and Maintenance Data

PART 2 - PRODUCTS

- Manual Volume Dampers
- Flexible Duct
- Duct Lining
- Duct Flexible Connections

PART 3 - EXECUTION

- Manual Volume Dampers
- Turning Vanes
- Fire Dampers
- Smoke Dampers and Combination Fire/Smoke Dampers
- Control Dampers
- Smoke Detectors
- Access Doors
- Duct Pressure Relief Doors
- Flashings
- Duct Flexible Connections
- Sound Attenuators
- Hoods for Intake and Exhaust
- Louvers
- Air Blenders
- Air Flow Stations
- Construction Verification

RELATED WORK

- Section 23 05 29 – Hanger and Supports for HVAC Piping and Equipment
- Section 23 05 48 – Vibration and Seismic Controls for HVAC Piping and Equipment
- Section 23 08 00 – Commissioning of HVAC
- Section 23 31 00 – HVAC Ducts and Casings

REFERENCE

Applicable provisions of Division 1 govern work under this Section.

REFERENCE STANDARDS

- NFPA 90A Standard for Installation of Air Conditioning and Ventilating Systems
- SMACNA HVAC Duct Construction Standards - Metal and Flexible, 3rd Edition, 2005
- UL 214
- UL 555 (6th edition) Standard for Fire Dampers and Ceiling Dampers
- UL 555S (4th edition) Leakage Rated Dampers for Use in Smoke Control Systems

QUALITY ASSURANCE

Refer to division 1, General Conditions, Equals and Substitutions

SHOP DRAWINGS

Refer to division 1, General Conditions, Submittals.

Submit for all accessories and include dimensions, capacities, ratings, installation instructions, and appropriate identification.

Include certified test data on dynamic insertion loss, self-noise power levels, and aerodynamic performance of sound attenuators.

1 Submit manufacturer's color charts where finish color is specified to be selected by the Architect/Engineer.
2

3 **OPERATION AND MAINTENANCE DATA**

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

6
7 In addition to the general content specified under GENERAL REQUIREMENTS supply the following additional
8 documentation:
9

10 **PART 2 - PRODUCTS**

11
12 **MANUAL VOLUME DAMPERS**

13 Manufacturers: Ruskin, Vent Products, Air Balance, or approved equal.
14

15 Dampers must be constructed in accordance with SMACNA Fig. 7-4, Fig. 7-5, and notes relating to these figures,
16 except as modified below.
17

18 Reinforce all blades to prevent vibration, flutter, or other noise. Construct dampers in multiple sections with
19 mullions where width is over 48 inches. Use rivets or tack welds to secure individual components; sheet metal
20 screws will not be accepted. Provide operators with locking devices and damper position indicators for each
21 damper; use an elevated platform on insulated ducts. Provide end bearings or bushings for all volume damper
22 rods penetrating ductwork constructed to a 3" w.c. pressure class or above.
23

24 **FLEXIBLE DUCT**

25 Manufacturers: Anco Products, Clevaflex, Thermaflex, Flexmaster or approved equal.
26

27 Factory fabricated, UL 181 listed as a class 1 duct, and having a flame spread of 25 or less and a smoke developed
28 rating of 50 or under in accordance with NFPA 90A.
29

30 Suitable for pressures and temperatures involved but not less than a 180°F service temperature and ±2-inch
31 pressure class, depending on the application.
32

33 Duct to be composed of polyester film, aluminum laminate or woven and coated fiberglass fabric bonded
34 permanently to corrosion resistant coated steel wire helix. Two-ply, laminated, and corrugated aluminum
35 construction may also be used.
36

37 Where duct is specified to be insulated, provide a minimum 1-inch fiberglass insulation blanket with maximum
38 thermal conductance of 0.23 K (75 degrees F.) and vapor barrier jacket of polyethylene or metalized reinforced
39 film laminate. Maximum perm rating of vapor barrier jacket to be 0.1 perm.
40

41 **DUCT LINING**

42 Manufacturer: Manville, Owens-Corning, Knauf, or approved equal.
43

44 1 inch thick, flexible, mat faced insulation made from inorganic glass fibers bonded with a thermosetting resin with
45 thermal conductivity of .25 Btu inch / hour sq.ft. deg F.
46

47 Meet erosion testing per UL 181 or ASTM C 1071 for 5000 fpm maximum air velocity. ASTM C 411 maximum
48 operating temperature rating of 250 deg F. ASTM E84 flame spread less than 25 and smoke developed less
49 than 50.
50

51 Meet requirements of ASTM C 1338 and ASTM G21 for fungi resistance.
52

53 Install liner using adhesive conforming to ASTM C 916.
54

55 **DUCT FLEXIBLE CONNECTIONS**

56 Material to be fire retardant, be UL 214 listed, and meet the requirements of NFPA 90A.
57

58 Connections to be a minimum of 3 inches wide, crimped into metal edging strip, and airtight. Connections to have
59 adequate flexibility and width to allow for thermal expansion/contraction, vibration of connected equipment, and
60 other movement.
61

62 Use coated glass fiber fabric for all applications. Material for inside applications other than corrosive environments,
63 fume exhaust, or kitchen exhaust to be double coated with neoprene, air and watertight, suitable for temperatures
64 between -10°F and 200°F and have a nominal weight of 30 ounces per square yard. Material used for outdoor

1 applications other than corrosive environments, fume exhaust, or kitchen exhaust to be double coated with
2 Hypalon, air and water tight, suitable for temperatures between -10°F and 250°F, and have a nominal weight of 26
3 ounces per square yard.
4

5 For corrosive environments or fume exhaust applications indoors or outdoors, use a material coated with Teflon
6 that is air and watertight, suitable for temperatures between -20°F and 500°F, and has a nominal weight of 14
7 ounces per square yard.
8

9 **PART 3 - EXECUTION**

10 **MANUAL VOLUME DAMPERS**

11 Install manual volume dampers in each branch duct and for each grille, register, or diffuser as far away from the
12 outlet as possible while still maintaining accessibility to the damper. Install so there is no flutter or vibration of the
13 damper blade(s).
14

15 **FLEXIBLE DUCT**

16 Flexible duct may only be used for final connections of air inlets and outlets at diffuser, register, and grille locations.
17 Where flexible duct is used, it shall be the minimum length required to make the final connections, but no greater
18 than 5 feet in length, and have no more than one (1) 90-degree bend.
19

20
21 Secure inner jacket of flexible duct in place with stainless steel metal band clamp. Secure insulation vapor barrier
22 jacket in place with steel or nylon draw band. Sheetmetal screws and/or duct tape will not be accepted.
23

24 Flexible duct used to compensate for misalignment of main duct or branch duct will not be accepted.
25

26 Individual sections of flexible ductwork shall be of one-piece construction. Splicing of short sections will not be
27 accepted.
28

29 Flexible ductwork used as transfer duct shall be sized for a maximum velocity of 300 fpm.
30

31 Penetration of any partition, wall, or floor with flexible duct will not be accepted.
32

33 **DUCT LINING**

34 Apply lining to the following ductwork:
35

36 Do not apply lining to the following ductwork:
37

- 38 • Outside air ductwork.
- 39 • Kitchen exhaust ductwork.
- 40 • Dishwashing exhaust ductwork.
- 41 • Shower exhaust ductwork.
- 42 • Pool ventilation ductwork.
- 43 • Supply, return, and exhaust ductwork associated with shop ventilation systems where air handling
44 units are located in the shops.
- 45 • Fume hood exhaust ductwork.
- 46 • Supply ductwork associated with ventilation systems serving hospital critical areas.
47

48 Install liner in compliance with the latest edition of NAIMA's Fibrous Glass Duct Liner Standard. Locate longitudinal
49 joints at the corners of duct only. Cut and fit to assure lapped, compressed joints. Coat all transverse and
50 longitudinal joints and edges with adhesive. Provide metal nosing on leading edge where lined duct is preceded
51 by unlined duct. Adhere liner to duct with full coverage area of adhesive. Additionally secure liner to duct using
52 mechanical fasteners spaced as recommended by the liner manufacturer without compressing liner more than 1/8"
53 with the fasteners.
54

55 **DUCT FLEXIBLE CONNECTIONS**

56 Install at all duct connections to rotating or vibrating equipment, including air handling units (unless unit is internally
57 isolated), fans, or other motorized equipment in accordance with SMACNA Figure 7-8. Install thrust restraints to
58 prevent excess strain on duct flexible connections at fan inlets and outlets; see Related Work.
59

60 For applications in corrosive environments or fume exhaust systems, use a double layer of the Teflon coated fabric
61 when making the connector.

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- 1 **CONSTRUCTION VERIFICATION**
- 2 Contractor is responsible for utilizing the construction verification checklists supplied under specification Section
- 3 23 08 00 in accordance with the procedures defined for construction verification in Section 01 91 01 or 01 91 02.
- 4
- 5 **END OF SECTION**

**SECTION 23 34 00
HVAC FANS**

PART 1 - GENERAL

SCOPE

This section includes specifications for fans that are not an integral part of a manufactured device. Included are the following topics:

PART 1 - GENERAL

- Scope
- Related Work
- Reference
- Reference Standards
- Quality Assurance
- Shop Drawings
- Operation and Maintenance Data
- Design Criteria

PART 2 - PRODUCTS

- General
- Ceiling Exhaust Fans

PART 3 - EXECUTION

- Installation
- Construction verification Items
- Functional performance Testing
- Agency Training

RELATED WORK

- Section 01 91 01 or 01 91 02 – Commissioning Process
- Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment
- Section 23 05 13 - Common Motor Requirements for HVAC Equipment
- Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment
- Section 23 08 00 – Commissioning of HVAC

REFERENCE

Applicable provisions of Division 1 govern work under this Section.

REFERENCE STANDARDS

- AMCA 203 AMCA Fan Application Manual - Troubleshooting
- AMCA 210 Laboratory Method of Testing Fans for Rating
- AMCA 300 Reverberant Room Method for Sound Testing of Fans
- NFPA 90A Standard for the Installation of Air Conditioning and Ventilating Systems
- NFPA 96 Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations
- UL 762 Power Roof Ventilators For Restaurant Exhaust Appliances

QUALITY ASSURANCE

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

SHOP DRAWINGS

Refer to division 1, General Conditions, Submittals.

Include dimensions, capacities, fan curves, materials of construction, ratings, weights, motors and drives, sound power levels, appropriate identification and vibration isolation for all equipment. Sound power levels to be based on tests performed in accordance with AMCA Standard 300.

Submit color selection charts for equipment where applicable.

Fan curves shall indicate the relationship of CFM to static or total pressure for various fan speeds. Brake horsepower, recommended selection range, and limits of operation are to also be indicated on the curves. Indicate operating point on the fan curves at design air quantity and indicate the manufacturer's recommended drive loss factor for the specific application. Tabular fan performance data is not acceptable.

For variable air volume application, include data which indicates the effect of capacity control devices on performance.

1 **OPERATION AND MAINTENANCE DATA**

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

4
5 In addition to the general content specified under GENERAL REQUIREMENTS supply the following additional
6 documentation:

7
8 **DESIGN CRITERIA**

9 Tested and certify all fans in accordance with the applicable AMCA test code.

10
11 Each fan and motor combination shall be capable of delivering 110% of air quantity scheduled at scheduled
12 static pressure. The motor furnished with the fan shall not operate into the motor service factor when operating
13 under these conditions.

14
15 Consider drive efficiency in motor selection according to manufacturer's published recommendation or
16 according to AMCA Publication 203, Appendix L.

17
18 Where inlet and outlet ductwork at any fan is changed from that shown on the drawings, provide any motor,
19 drive and/or wiring changes required due to increased static pressure or baffling necessary to prevent uneven
20 airflow or improve mixing.

21
22 All internal insulation and other components exposed to the airstream are to meet the flame spread and smoke
23 ratings contained in NFPA 90A.

24
25 All roof mounted equipment to be provided with curbs or equipment stands in accordance with specification in
26 Section 23 05 29.

27
28 **PART 2 - PRODUCTS**

29
30 **GENERAL**

31 Use fan size, class, type, arrangement, and capacity as scheduled.

32
33 Furnish complete with motors, wheels, drive assemblies, bearings, vibration isolation devices, and
34 accessories required for specified performance and proper operation. All single phase motors to have inherent
35 thermal overload protection.

36
37 Provide variable pitch sheaves for drives 3 hp and smaller, fixed pitch sheaves for drives 5 hp and larger.
38 Design all drives for 150% of motor rating.

39
40 Use OSHA approved belt guards that totally enclose the entire drive. Construct guards of expanded metal to
41 allow for ventilation; provide tachometer openings at shaft locations.

42
43 Statically and dynamically balance all fans so they operate without objectionable noise or vibration.

44
45 Use AMCA Type A spark resistant construction for all fans handling flammable or explosive vapors.

46
47 All fans handling grease laden vapors shall meet the requirements of UL 762 and NFPA 96.

48
49 Provide a corrosion resistant coating on all surfaces exposed to fume and other corrosive exhaust air. Coating
50 to be as scheduled.

51
52 **CEILING EXHAUST FANS**

53 Carnes, Greenheck, Penn, Jenn-Air, Cook, ACME, S&P or approved equal.

54
55 Centrifugal blower wheel, steel housing with acoustical lining, integral exhaust grille, adjustable mounting
56 brackets to allow for any ceiling thickness, permanently lubricated motor, integral junction box with
57 permanently lubricated and thermally protected motor factory wired, 24 volt electrically operated control
58 damper with blade edge and jamb seals, and damper operator.

59
60 Provide wall, eave, or roof discharge assembly, as indicated on the drawings.

1 **PART 3 - EXECUTION**

2
3 **INSTALLATION**

4 Install as shown on the drawings, as detailed, and according to manufacturer's installation instructions. On
5 units provided with a drain connection, reduce drain connection down to 1/2" fitting and leave open.

6
7 Install thrust restraints in accordance with the requirements of Section 23 05 48.

8
9 Contractor shall balance blade assembly of destratification fans after installation to assure stable operation.

10
11 **CONSTRUCTION VERIFICATION ITEMS**

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

14
15 **CONSTRUCTION VERIFICATION**

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

19
20 **FUNCTIONAL PERFORMANCE TESTING**

21 Contractor is responsible for utilizing the functional performance test forms supplied under specification
22 Section 23 08 00 in accordance with the procedures defined for functional performance testing in Section 01
23 91 01 or 01 91 02.

24
25 **END OF SECTION**

**SECTION 23 36 00
AIR TERMINAL UNITS**

PART 1 - GENERAL

SCOPE

This section includes specifications for air terminal equipment. Included are the following topics:

PART 1 - GENERAL

- Scope
- Related Work
- Reference
- Reference Standards
- Quality Assurance
- Shop Drawings
- Operation and Maintenance Data
- Design Criteria

PART 2 - PRODUCTS

- Supply Air Terminal Boxes
- Exhaust/Return Air Terminals
- Venturi Air Valves
- Terminal Air Box/Venturi Air Valve Controls
- Access Doors
- Insulation

PART 3 - EXECUTION

- Installation
- Adjusting
- Construction Verification
- Functional Performance Testing
- Agency Training

RELATED WORK

- Section 01 91 01 or 01 91 02 – Commissioning Process
- Section 23 08 00 – Commissioning of HVAC
- Section 23 09 14 - Pneumatic and Electric Instrumentation and Control Devices for HVAC
- Section 23 09 93 – Sequence of Operation for HVAC Controls
- Section 23 31 00 - HVAC Ducts and Casings
- Section 23 33 00 - Air Duct Accessories
- Section 23 82 00 - Convection Heating and Cooling Units

REFERENCE

Applicable provisions of Division 1 govern work under this section.

REFERENCE STANDARDS

- NFPA 90A - Installation of Air Conditioning and Ventilation Systems.
- UL 181 - Factory-Made Air Ducts and Connectors.
- ARI-ADC Standard 880
- ASTM E84 – Surface Burning Characteristics of Building Materials
- UL 723 – Surface Burning Characteristics of Building Materials

QUALITY ASSURANCE

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

SHOP DRAWINGS

Refer to division 1, General Conditions, Submittals.

Contractor shall submit air terminal unit data including materials of construction, dimensions, scheduled flow rates, pressure drops, radiated and discharge sound power levels, reset volume controller data, actuator spring range and torque data.

1 **OPERATION AND MAINTENANCE DATA**

2 All operations and maintenance data shall comply with the submission and content requirements specified under
3 section GENERAL REQUIREMENTS.
4 In addition to the general content specified under GENERAL REQUIREMENTS supply the following additional
5 documentation:
6

7 **DESIGN CRITERIA**

8 Select sizes, capacities, configuration, and operating characteristics as shown on the plans and/or as
9 scheduled.

10 **PART 2 - PRODUCTS**

11 **SUPPLY AIR TERMINAL BOXES**

12 Units shall be single duct and pressure independent.
13

14 **MANUFACTURERS:**

15 Carnes, Envirotec, Metal-Aire, Titus, Trane, Price, Nailor or equal.
16

17 **CONSTRUCTION:**

18 Unit casing shall be minimum 22-gauge steel and internally insulated with 13/16" rigid fiberglass insulation with
19 a foil scrim face or 3/4" thick polyolefin closed cell insulation. Construction to meet UL 181 and NFPA 90A.
20 Casing shall be sealed to limit leakage to a maximum of 15 cfm at 6.0 inches of static pressure. Casing outlet
21 shall have slip and drive joint for connection to discharge ductwork.
22

23 Metal damper blade shall be mounted to shaft having self-lubricated bearings. Shaft end shall be marked to
24 indicate damper position and shall have a built-in stop to prevent overstroking. Damper blade shall close off
25 against gasket to limit leakage to 10 cfm at 6.0 inches of differential static pressure. Damper linkage shall be
26 sized to accept at least 40 inch-pounds of torque to the damper shaft. Damper shaft shall be provided with a
27 marking indicating damper position.
28

29 Round inlet collar shall be equipped with a multi-point flow sensor that shall amplify the measured velocity
30 pressure. Pneumatic tubing from flow sensor to differential pressure transducer shall be UL listed, fire
31 retardant (FR) type.
32

33 **HOT WATER REHEAT COIL:**

34 Reference section 23 82 00 for hot water reheat coil specifications.
35

36 **EXHAUST/RETURN AIR TERMINALS (BUTTERFLY TYPE)**

37 Units shall be single duct and pressure independent.
38

39 **MANUFACTURERS:**

40 Carnes, Envirotec, Metal-Aire, Titus, Trane, Price, Nailor or equal.
41

42 **CONSTRUCTION:**

43 **EXHAUST/RETURN AIR TERMINALS**

44 Round duct assembly and damper shall be constructed from a minimum of 22-gauge galvanized steel.
45 Construction to meet UL 181 and NFPA 90A. Casing shall be sealed to limit leakage to a maximum of 15 cfm
46 at 6.0 inches of static pressure.
47

48 Galvanized steel damper blade shall be mounted to shaft having self-lubricated bearings. Shaft end shall be
49 marked to indicate damper position and shall have a built-in stop to prevent over stroking. Damper blade shall
50 close off against a gasket to limit leakage to 10 cfm at 6.0 inches of differential static pressure. Damper
51 linkage shall be sized to accept at least 40 inch-pounds of torque to the damper shaft. Damper shaft shall be
52 provided with a marking indicating damper position.
53

54 The round duct assembly shall be equipped with a multi-point flow sensor that shall amplify the measured
55 velocity pressure. Pneumatic tubing from flow sensor to differential pressure transducer shall be UL listed, fire
56 retardant (FR) type. The multi-point flow sensor shall be able to be readily removed for servicing and
57 replacement from the upstream access door.
58
59
60
61
62

1 FUME EXHAUST

2 Round duct assembly shall be constructed from a minimum of 24-gauge stainless steel and damper blade
3 constructed from a minimum of 22-gauge stainless steel. Construction to meet UL 181 and NFPA 90A.
4 Casing shall be sealed to limit leakage to a maximum of 15 cfm at 6.0 inches of static pressure.

5
6 Stainless steel damper blade shall be mounted to a stainless-steel shaft having self-lubricated bearings. Shaft
7 end shall be marked to indicate damper position and shall have a built-in stop to prevent over stroking.
8 Damper blade shall close off against a butyl gasket to limit leakage to 10 cfm at 6.0 inches of differential static
9 pressure. Damper linkage shall be sized to accept at least 40 inch-pounds of torque to the damper shaft.
10 Damper shaft shall be provided with a marking indicating damper position.

11
12 The round duct assembly shall be equipped with a stainless-steel multi-point flow sensor that shall amplify the
13 measured velocity pressure. Pneumatic tubing from flow sensor to differential pressure transducer shall be UL
14 listed, fire retardant (FR) type. The multi-point flow sensor shall be able to be readily removed for servicing
15 and replacement from the upstream access door.

16
17 **VENTURI AIR VALVES**

18 Factory calibrated, pressure independent venture type valve for constant volume or variable volume
19 applications.

20
21 **MANUFACTURERS:**

22 Phoenix Corp., Price Critical Controls, Rosemax, Siemens – Landis, TSI or equal

23
24 **CONSTRUCTION:**

25
26 **SUPPLY AND GENERAL EXHAUST CONSTRUCTION**

27 Valve body and cone shall be 16 gauge spun aluminum or 316 stainless steel with internal components of
28 aluminum or stainless steel. Valve body ends shall have slip connections. Control valve shall be mounted to
29 a 316 stainless steel shaft on teflon bearings.

30
31 The pressure independent spring shall be stainless steel.

32
33 **FUME EXHAUST CONSTRUCTION**

34 Valve body and cone shall be 16-gauge, 316 stainless steel. Valve body ends shall have slip connections.
35 Control valve shall be mounted to a 316 stainless steel shaft on teflon bearings. The pressure independent
36 spring shall be stainless steel. The shaft support brackets, pivot arm, internal mounting link, nuts, bolts and
37 rivets shall be constructed from 316 stainless steel. As an option the valve body may be constructed from 16
38 gauge spun aluminum and be completely coated with factory applied baked Heresite.

39
40 **ACID EXHAUST CONSTRUCTION**

41 Valve body and cone shall be 16 gauge spun aluminum or 316 stainless steel. Valve body ends shall have
42 flanged connections. Control valve shall be mounted to a 316 stainless steel shaft on teflon bearings. The
43 pressure independent spring shall be stainless steel. The shaft support brackets, pivot arm, internal mounting
44 link, nuts, bolts and rivets shall be constructed from 316 stainless steel.

45
46 The valve body, valve cone, internal components and housing shall be completely coated with factory applied
47 baked Heresite. Exposed aluminum or stainless steel shall be completely covered with Heresite. Exposed
48 aluminum or stainless-steel valve body, valve cone, internal components and housing are not allowed.

49
50 **PEFORMANCE:**

51 Valve shall be pressure independent without means of external control devices. Calibrated spring shall
52 maintain a cfm setting within +/- 5% over a calibrated range of [0.6 – 3.0 inches w.c.] or [.3 – 3.0 inches w.c.]
53 duct pressure range. Valve shall be capable of 16:1 turndown ratio. Valve shall be capable of 100% shutoff
54 where noted on the drawings.

55
56 **TERMINAL AIR BOX/VENTURI AIR VALVE CONTROLS**

57 **DDC CONTROLS:**

58 **BUTTERFLY DAMPER TERMINAL AIR BOX**

59 Damper actuator and differential pressure sensor for flow measurement shall be provided with the DDC
60 controller provided for the terminal air box as specified under Section 23 09 23, 23 09 24, or 23 09 25.

1 VENTURI AIR VALVE

2 Fume Hood Actuation (High Speed): Provide a damper actuator and all required linkages provided and
3 mounted by the manufacturer. Actuator shall be high speed with a maximum of a 1.5 second response time
4 for a 90° rotation. Size operators for smooth and positive operation of devices served, and with sufficient
5 torque capacity to provide tight shutoff against system temperatures and pressure encountered. All electric
6 actuators will be provided with overload protection to prevent motor from damage when stall condition is
7 encountered. Actuator shall use 24VAC power.

8
9 For modulating applications, signal input shall be 0-10VDC, 2-10VDC, or 4-20mA to match requirements of the
10 DDC controller. Provide a factory mounted feedback device/ controller that measures the valve position and
11 provides an electronic signal that is linear to the flow of the valve.

12
13 Low Speed Actuation: Provide a damper actuator and all required linkages provided and mounted by the
14 manufacturer. Actuator shall be low speed with a maximum of a 110 second response time for a 90° rotation.
15 Size operators for smooth and positive operation of devices served, and with sufficient torque capacity to
16 provide tight shutoff against system temperatures and pressure encountered. All electric actuators will be
17 provided with overload protection to prevent motor from damage when stall condition is encountered. Actuator
18 shall use 24VAC power.

19
20 For analog applications, signal input shall be 0-10VDC, 2-10VDC, or 4-20mA to match requirements of the
21 DDC controller. Provide a factory mounted feedback device/ controller that measures the valve position and
22 provides an electronic signal that is linear to the flow of the valve.

23
24 PNEUMATIC CONTROLS:

25 BUTTERFLY DAMPER TERMINAL AIR BOX

26 Actuator shall be furnished with a spring range meeting requirements of the sequence of operation specified in
27 section 23 09 93. The damper actuator shall be arranged so on loss of supply air pressure the damper shall
28 fail open.

29
30 Factory furnished pneumatic reset controller shall have a five-psi reset span regardless of cfm adjustments.
31 Air consumption of the controller shall not exceed 1.0 scfh at 20 psi. Controller shall be field selectable for
32 direct/reverse acting operation and maximum/ minimum cfm setpoints. Controller shall have taps for high- and
33 low-pressure inputs from flow sensor, 20 psi main air, thermostat input, branch output to damper actuator and
34 gauge taps for calibration of unit.

35
36 VENTURI AIR VALVE

37 Two-position Actuation (High Speed): Provide a damper actuator and all required linkages provided and
38 mounted by the manufacturer. Actuator shall be pneumatic high speed with a maximum of a 1.5 second
39 response time for transition from minimum to maximum valve flow positions.

40
41 **ACCESS DOORS**

42 **STANDARD ACCESS DOORS:**

43 Access door to be designed and constructed for the pressure class of the duct in which the door is to be installed.
44 Doors in exposed areas shall be hinged type with cam sash lock. Hinges shall be steel full length continuous
45 piano type. Doors in concealed spaces may be secured in place with cam sash latches. For both hinged and
46 non hinged doors provide sufficient number of camp sash latches to provide air tight seal when door is closed.
47 Do not use hinged doors in concealed spaces if this will restrict access. Use minimum 1" deep 24 gauge
48 galvanized steel double wall access doors with minimum 24 gauge galvanized steel frames. For non-galvanized
49 ductwork, use minimum 1" deep double wall access door with frame that shall use materials of construction
50 identical to adjacent ductwork. Provide double neoprene gasket that shall provide seals from the frame to the
51 door and frame to the duct. When access doors are installed in insulated ductwork or equipment provide
52 insulated doors with insulation equivalent to what is provided for adjacent ductwork or equipment. Access doors
53 constructed with sheet metal screw fasteners will not be accepted.

54
55 **ROUND DUCT ACCESS DOORS:**

56 For duct pressure class positive or negative up to 6 in. wg. Access doors shall be constructed from 16 gauge
57 stainless steel for fume exhaust ducts and 16 gauge galvanized steel for general exhaust or return ducts.
58 Hinges shall be continuous piano style constructed from the same material as the access door. Access doors
59 shall be sealed with ¼" closed cell butyl gasketing permanently bonded on all four sides and no fewer than two
60 draw latches with strike plates. The strike plates shall match the duct/access door material.

61
62 For duct pressure class positive or negative up to 10 in. wg. Access doors shall be the sandwich type and
63 constructed from two layers of stamped 22 gauge stainless steel for fume exhaust ducts and 22 gauge

1 galvanized steel for general or return ducts. Access doors shall be sealed with ¼" butyl gasketing permanently
2 bonded to all four sides of the inside door. The bolts and springs shall be constructed from the same material
3 as the access door. The knobs shall be constructed from polypropylene with threaded metal inserts and able
4 to be fastened without the use of wrenches.

5
6 **INSULATION**

7 Materials or accessories containing asbestos will not be accepted.

8
9 Use composite insulation systems (insulation, jackets, sealants, and adhesives) that have a flame spread rating
10 of 25 or less and smoke developed rating of 50 or less.

11
12 The following two internal insulation options may be utilized.

13
14 **RIGID FIBERGLASS INSULATION:**

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

17
18 Foil-scrim-kraft vapor barrier jacket, factory applied to insulation, maximum permeance of .02 perms. All
19 exposed insulation edges shall be covered with metal nosing.

20
21 **POLYOLEFIN INSULATION:**

22 Flexible closed cell, minimum nominal density of 1.5 lbs. per cu. ft., thermal conductivity of not more than 0.24
23 at 75 degrees F, minimum compressive strength of 5 psi at 25% deformation, maximum water vapor permeability
24 of 0.0 perm inch, maximum water absorption of 0% by weight and volume, rated for service range of -165
25 degrees F to 210 degrees F.

26
27 **PART 3 - EXECUTION**

28
29 **INSTALLATION**

30 Install air terminal units as indicated on project drawings and in accordance with the manufacturer's installation
31 instructions.

32
33 Mount air terminal boxes with a minimum 3 feet of straight ductwork upstream of inlet flow sensor for sizes 12"
34 diameter and below. Provide a minimum of 3X the inlet diameter of straight duct upstream of the inlet flow
35 sensor for inlet sizes above 12" diameter.

36
37 Where hot water reheat coils are provided with air terminal boxes the following two options may be used.

38
39 Field mount coil separate from box with a 12-18" section of duct between the air terminal box and reheat coil.
40 The reheat coil and 12-18" section of duct shall be wrapped with external insulation as indicated in
41 specification section 23 07 00 – HVAC Insulation.

42
43 Factory mount coil in extended supply air terminal unit. The supply air terminal unit shall be extended at the
44 factory 12-18" and internally insulated to match the insulation used for the supply air terminal unit

45
46 Provide at least 24" of clearance on controller side of the air terminal unit. The clearance area shall extend the
47 full length of the supply air terminal unit and the full length (including the access door) of the exhaust/return air
48 terminal unit

49
50 Support air terminal units from building structure using sheet metal straps or trapeze hanger with rods. Do not
51 mount air terminal units off of adjacent ductwork or piping.

52
53 **ACCESS DOORS**

54
55 **DUCT ACCESS DOORS – SQUARE DUCT:**

56 Provide duct access doors in duct or extended supply air terminal unit upstream and downstream of the reheat
57 coil. Duct access doors shall be as large as duct allows with a maximum size of 18"x18". Install heating coils
58 in accordance with Section 23 73 12 - Air Handling Unit Coils.

59
60 **DUCT ACCESS DOORS – ROUND DUCT:**

61 Install round duct access doors on the side of the duct upstream of the return/exhaust terminal unit. At no time
62 shall the access door be installed in the bottom of the duct. Piano hinged style access doors shall be installed

1 with the piano hinges located ½ above the bottom of the duct to allow the access door to swing down toward
2 the floor.

3
4 **INSULATION**

5
6 **RIGID FIBERGLASS INSULATION:**

7 All rigid duct insulation edges shall be covered with metal nosing. Foil scrim face must completely separate the
8 rigid fiberglass duct material from the air stream.

9
10 **POLYOLEFIN INSULATION:**

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

13
14 For supply air terminal units, provide five feet of 1" thick lining immediately downstream from air terminal unit
15 discharge. Where hot water reheat coils are field or factory installed, provide five feet of 1" thick lining in
16 ductwork immediately downstream of reheat coil. Refer to specification section 23 33 00 – Air Duct
17 Accessories for liner specification.

18
19 **ADJUSTING**

20 Coordinate adjustment of air terminal units with section 23 05 93 - Testing, Adjusting and Balancing.

21
22 **CONSTRUCTION VERIFICATION**

23 Contractor is responsible for utilizing the construction verification checklists supplied under specification Section
24 23 08 00 in accordance with the procedures defined for construction verification in Section 01 91 01 or 01 91
25 02.

26
27 **FUNCTIONAL PERFORMANCE TESTING**

28 Contractor is responsible for utilizing the functional performance test forms supplied under specification Section
29 23 08 00 in accordance with the procedures defined for functional performance testing in Section 01 91 01 or 01
30 91 02.

31
32 **AGENCY TRAINING**

33 All training provided for agency shall comply with the format, general content requirements and submission
34 guidelines specified under Section 01 91 01 or 01 91 02.

35
36 **END OF SECTION**

**SECTION 23 37 13
DIFFUSERS, REGISTERS & GRILLES**

PART 1 - GENERAL

SCOPE

This section includes specifications for air terminal equipment. Included are the following topics:

PART 1 - GENERAL

Scope
Related Work
Reference
Reference Standards
Quality Assurance
Submittals
Design Criteria

PART 2 - PRODUCTS

Manufacturers
Linear Slot Diffusers
Linear Bar Diffusers and Grilles
Round Ceiling Diffusers
Perforated Ceiling Diffusers
Square Ceiling Diffusers - High Performance
Square Ceiling Diffusers - Plaque
Square Ceiling Diffusers
Plenum Slot Diffusers - 180 Degree Adjustable
Plenum Slot Diffusers – with Gasketed Blade
Security Grille
Side-Wall Registers and Grilles
Eggcrate Grille
Heavy Duty Sidewall Return/Exhaust Grille
Door Grille
Drum Diffuser
Laboratory Supply Diffuser
Perforated Diffuser
Construction Verification Items

PART 3 - EXECUTION

Installation

RELATED WORK

Section 01 91 01 or 01 91 02 – Commissioning Process
Section 23 08 00 - Commissioning of HVAC
Section 23 31 00 - HVAC Ducts and Casings
Section 23 33 00 - Air Duct Accessories
Section 23 05 93 - Testing, Adjusting and Balancing for HVAC

REFERENCE

Applicable provisions of Division 1 govern work under this section.

REFERENCE STANDARDS

NFPA 90A - Installation of Air Conditioning and Ventilation Systems.
UL 181 - Factory-Made Air Ducts and Connectors.
ARI-ADC Standard 880

QUALITY ASSURANCE

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

SUBMITTALS

Refer to division 1, General Conditions, Submittals.

Furnish submittal information including, but not limited to, the following:
Manufacturer's name and model number

- 1 Identification as referenced in the documents
- 2 Capacities/ratings
- 3 Materials of construction
- 4 Sound ratings
- 5 Dimensions
- 6 Finish
- 7 Color selection charts where applicable
- 8 Manufacturer's installation instructions
- 9 All other appropriate data

10
11 **DESIGN CRITERIA**

12 All performance data shall be based on tests conducted in accordance with Air Diffusion Council (ADC) Test
13 Code 1062 GRD 84.

14
15 **PART 2 - PRODUCTS**

16
17 **MANUFACTURERS**

18 Manufacturers: Carnes, Krueger, Titus, Metal-Aire, and E.H. Price, and United Sheet Metal.

19
20 Acceptable manufacturers for specific products are listed under each item.

21
22 **LINEAR SLOT DIFFUSERS**

23 Titus Series ML, Carnes Series CH, Metal Aire Series 6000, Price Series SDS, Nailor 5000 Series, Shoemaker
24 LSD

25
26 Extruded aluminum with frame type appropriate to installation with diffuser elements being removable from
27 frame. Both air pattern and flow rate adjustment with air pattern having full 180-degree adjustment. Single slot
28 diffuser vanes segmented on 2- or 3-foot centers.

29
30 Diffuser lengths and slot sizes as shown on drawings and/or as scheduled.

31
32 White, baked enamel finish or powder coat finish, unless otherwise indicated. Flat black diffuser vanes and
33 frame interior.

34
35 Provide diffusers with uninsulated galvanized steel plenum. Plenums constructed for specific diffuser frame
36 & border type. Provide round or oval inlet collar designed to fit standard flexible duct sizes.

37
38 **LINEAR BAR DIFFUSERS AND GRILLES**

39 Titus Series CT, Carnes CC, CT or CW, Metal Aire Series 2000, Price series LBP, Nailor 4900 Series,
40 Shoemaker LF, LS, or LC.

41
42 Extruded aluminum with frame type appropriate to side wall, sill or ceiling installation as indicated.

43
44 Diffuser and grille lengths, blade spacing and blankoff strips as shown on drawings and/or as scheduled.

45
46 Where frame and border types allow provide diffusers used for supply air with straightening or equalizing
47 vanes. Fixed blades at 0- or 15-degree deflection as scheduled. Bar support maximum 9" spacing.

48
49 White, anodized aluminum finish unless otherwise indicated

50
51 Provide alignment strips/wires for end-to-end joining of sections for a continuous appearance when scheduled
52 lengths exceed standard manufacturer lengths.

53
54 **ROUND CEILING DIFFUSERS**

55 Titus Series TMRA, Carnes Series SSAA, Metal Aire Series 3100, Price Series RCDA, Nailor RNRA1,
56 Shoemaker RDA

57
58 Spun aluminum or steel with uniform 360° discharge pattern.

59
60 Adjustable inner cones surrounded by a ceiling plate collar designed to reduce ceiling smudges.

61
62 Diffusers as shown on drawings and/or as scheduled.

1 White, baked enamel finish or powder coat finish, unless otherwise indicated.

2
3 **PERFORATED CEILING DIFFUSERS**

4 Titus model PSS, Carne's series SP or SL, Price series PDS, and Metal Aire series 7600, Nailor 4320S,
5 Shoemaker 780

6
7 Aluminum (Steel) unless otherwise indicated and furnished with frame type appropriate to installation.

8
9 Field adjustable pattern controllers accessible through removable or hinged face plate. Pattern controller
10 mounted directly under the neck of the diffuser and fully adjustable for either side blow or corner blow pattern.

11
12 Provide round or square neck duct adapters for each unit for top connection or side connection as appropriate
13 to the space.

14
15 White, baked enamel finish or powder coat finish, unless otherwise indicated. Flat black diffuser vanes and frame
16 interior.

17
18 **SQUARE CEILING DIFFUSERS - High Performance**

19 High performance type diffuser incorporating short throws and low NC levels.

20
21 Titus model TMS, Carne Series, SF, Price model SCD, Metal Aire series 5800, and Krueger series 1400,
22 Nailor RNS, Shoemaker FTD, HVD.

23
24 Diffusers to be aluminum (Steel) unless otherwise indicated, louvered face furnished with frame type appropriate
25 to installation.

26
27 Diffuser shall have throw characteristics of a round diffuser having a 360° horizontal blow pattern.

28
29 Louver cones shall be one-piece construction with no corner joints.

30
31 White, baked enamel finish or powder coat finish, unless otherwise indicated.

32
33 **SQUARE CEILING DIFFUSERS - Plaque**

34 Titus model OMNI, Carnes series SFPA/SHPA, Price model SMDP, Metal Aire series 5750, and Krueger series
35 PLQ/5PLQ, Nailor UNI2, Shoemaker HL.

36
37 Aluminum (Steel) unless otherwise indicated, louvered face furnished with frame type appropriate to installation.

38
39 Directional blow pattern as shown on the drawings and/or as scheduled.

40
41 One-piece removable square face plaque with one-piece backpan.

42
43 White, baked enamel finish or powder coat finish, unless otherwise indicated.

44
45 **SQUARE CEILING DIFFUSERS**

46 Titus model TDC/TDC-AA, Carnes series SK or SE, Price model SMD/AMD, Metal Aire series 5500 or 5500S,
47 and Krueger series S, Nailor 6500/6200, Shoemaker DVD.

48
49 Aluminum (Steel) unless otherwise indicated, louvered face furnished with frame type appropriate to installation.

50
51 Directional blow pattern as shown on the drawings and/or as scheduled.

52
53 One-piece construction louver cones with no corner joints.

54
55 White, baked enamel finish or powder coat finish, unless otherwise indicated.

56
57 **PLENUM SLOT DIFFUSER – 180 degrees adjustable**

58 Titus model TBD-30, Carnes model DA, Price model TBD3, Metal Aire series 6600, and Krueger series
59 PTBA, Raymon-Donco Series SAT/XC, Nailor 5800 Series, Shoemaker LSD.

60
61 Steel, furnished with T-bars compatible with ceiling components. Vane air pattern and flow rate adjustment with
62 air pattern having full 180-degree adjustment.

1 Provide 24 gauge galvanized steel (uninsulated) insulated plenum. Provide round or oval inlet collar designed to
2 fit standard flexible duct sizes.

3
4 Double metal thickness slot face.

5
6 White, baked enamel finish or powder coat finish, unless otherwise indicated. Flat black diffuser vanes and frame
7 interior.

8
9 **PLENUM SLOT DIFFUSER - with Gasketed Blade**

10 Titus model TBD-80, Carnes model DA, Price model TBD4, Metal Aire series PHP, and Krueger series
11 PTBS, Raymon-Donco Series BA/BS, Nailor 5700 Series, Shoemaker LSD.

12
13 Steel, furnished with T-bars compatible with ceiling components. Extruded aluminum pattern with a gasket on
14 top edge to form a seal against the plenum wall or slot divider. Pattern control field adjustable from vertical to
15 horizontal discharge.

16
17 Provide 24 gauge galvanized steel (uninsulated) insulated plenum. Provide round or oval inlet collar designed to
18 fit standard flexible duct sizes.

19
20 Double metal thickness slot face.

21
22 White, baked enamel finish or powder coat finish, unless otherwise indicated. Flat black diffuser vanes and frame
23 interior.

24
25 **SECURITY GRILLE**

26 Titus model SG-PR, Carnes RSPA 25, Metal Aire model SG RP, Krueger model 310, Nailor SG-PR,
27 Shoemaker 1406.

28
29 Steel (304 Stainless Steel) 3/16" face plates with 5/16" diameter holes (maximum) on 7/16" staggered centers.

30
31 Steel (304 Stainless Steel) 3/16" grille sleeve with welded seams. Sleeve length as shown on the drawings
32 and/or as scheduled.

33
34 White, baked enamel finish or powder coat finish, unless otherwise indicated. Flat black diffuser vanes and frame
35 interior.

36
37 **EGGCRATE GRILLE**

38 Titus model 50, Carnes model RAE or RAT, Price model 80, Metal Aire model CC, Krueger model
39 EGC, Nailor 51EC, Shoemaker 600.

40
41 Aluminum construction with frame type appropriate to installation.
42 Grille face 1/2" x 1/2" or 1" x 1" grid pattern 1" deep with a minimum of 85% free area.

43
44 Grille sizes and finishes as shown on drawings and/or as scheduled.

45
46 White, baked enamel finish or powder coat finish, unless otherwise indicated.

47
48 Screw holes on surface counter sunk to accept recessed type screws.

49
50 **DOOR GRILLE**

51 Titus Series 700, Carnes Series RF or RG, Metal Aire Series DG, Price ATG/STG, Nailor 51DGD, Shoemaker
52 4000, 4100

53
54 Aluminum (Steel). Sight tight.

55
56 Grille sizes, frame types, and finishes as shown on drawings and/or as scheduled.

57
58 White, baked enamel finish or powder coat finish, unless otherwise indicated.

59
60 **DRUM DIFFUSER**

61 Krueger series DPL, Metal Aire RH, or Price HCD, Nailor 45DL1

1 Extruded aluminum with adjustable cylindrical drums and deflecting vanes. Minimum 60° angular adjustment of
2 jet centerline rotating drum.

3
4 White, baked enamel finish or powder coat finish, unless otherwise indicated.
5

6 **PART 3 - EXECUTION**

7
8 **INSTALLATION**

9 Install grilles, registers and diffusers as shown on drawings and according to manufacturer's instructions.

10 Furnish diffusers with equalizing grids where it is not possible to maintain minimum 2 duct diameter straight duct
11 into diffuser. Equalizing grids shall consist of individually adjustable vanes designed for equalizing airflow into
12 diffuser neck and providing directional control of airflow.

13
14 Unless otherwise indicated, size ductwork drops to diffusers or grilles to match unit collar size.
15

16 Seal connections between ductwork drops and diffusers/grilles airtight.
17

18 Blank off unused portion of linear slot diffusers and linear bar diffusers and grilles.
19

20 Where diffusers, registers and grilles cannot be installed to avoid seeing inside duct, paint inside of duct with flat
21 black paint to reduce visibility.
22

23 In clean rooms and animal holding rooms, caulk space between diffuser or grille and ceiling or wall to be air and
24 watertight. User clear, non-hardening silicone sealant compatible with ceiling or wall surfaces. Sealant shall be
25 resistant to microbiological growth.
26

27 **CONSTRUCTION VERIFICATION**

28 Contractor is responsible for utilizing the construction verification checklists supplied under specification Section
29 23 08 00 in accordance with the procedures defined for construction verification in Section 01 91 01 or 01 91
30 02.
31

32 **END OF SECTION**

**SECTION 26 05 00
COMMON WORK RESULTS FOR ELECTRICAL**

PART 1 - GENERAL

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. The electrical work included in all other divisions is the responsibility of the contractor performing the division 26 work unless noted otherwise.

RELATED WORK

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

1 **PROTECTION OF FINISHED SURFACES**

2 Furnish one can of touch-up paint for each different color factory finish furnished by the Contractor. Deliver touch-
3 up paint with other "loose and detachable parts" as covered in the General Requirements.
4

5 **APPROVED ELECTRICAL TESTING LABORATORIES**

6 The following laboratories are approved for providing electrical product safety testing and listing services as required
7 in these specifications:
8

9 Underwriters Laboratories Inc.
10 Electrical Testing Laboratories, Inc.
11

12 **SLEEVES AND OPENINGS**

13 Refer to Division 1, General Requirements, Sleeves and Openings.
14

15 **SEALING AND FIRE STOPPING**

16 Sealing and fire stopping of sleeves/openings between conduits, cable trays, wireways, troughs, cablebus, busduct,
17 etc. and the sleeve, structural or partition opening shall be the responsibility of the contractor whose work penetrates
18 the opening. Provide all fire stopping of fire rated penetrations and sealing of smoke rated penetrations in compliance
19 with section 07 84 00 Fire Stopping.
20

21 **INTENT**

22 The Contractor shall furnish and install all the necessary materials, apparatus, and devices to complete the electrical
23 equipment and systems installation herein specified, except such parts as are specifically exempted herein.
24

25 If an item is either called for in the specifications or shown on the plans, it shall be considered sufficient for the
26 inclusion of said item in this contract. If a conflict exists within the Specifications or exists within the Drawings, the
27 Contractor shall furnish the item, system, or workmanship, which is the highest quality, largest, or most closely fits
28 the owner intent (as determined by the owner's Project Manager). Refer to the General Conditions of the Contract
29 for further clarification.
30

31 It must be understood that the details and drawings are diagrammatic. The Contractor shall verify all dimensions at
32 the site and be responsible for their accuracy.
33

34 All sizes as given are minimum except as noted.
35

36 Materials and labor shall be new (unless noted or stated otherwise), first class, and workmanlike, and shall be subject
37 at all times to the owners and/or A/E's inspections, tests and approval from the commencement until the acceptance
38 of the completed work.
39

40 Whenever a particular manufacturer's product is named, it is intended to establish a level of quality and performance
41 requirements unless more explicit restrictions are stated to apply.
42

43 **OMISSIONS**

44 No later than ten (10) days before bid opening, the Contractor shall call the attention of the owner to any materials
45 or apparatus the Contractor believes to be inadequate and to any necessary items of work omitted.
46

47 **SUBMITTALS**

48 Submit for all equipment and systems as indicated in the respective specification sections, marking each submittal
49 with that specification section number. Mark general catalog sheets and drawings to indicate specific items being
50 submitted and proper identification of equipment by name and/or number, as indicated in the contract documents.
51 Failure to do this may result in the submittal(s) being returned to the Contractor for correction and resubmission.
52 Failing to follow these instructions does not relieve the Contractor from the requirement of meeting the project
53 schedule.
54

55 On request from the owner, the successful bidder shall furnish additional drawings, illustrations, catalog data,
56 performance characteristics, etc.
57

58 Submittals shall be grouped to include complete submittals of related systems, products, and accessories in a single
59 submittal. Mark dimensions and values in units to match those specified. Include wiring diagrams of electrically
60 powered equipment.
61

62 The submittals must be approved before fabrication is authorized.
63
64

1 Submit sufficient quantities of submittals to allow the following distribution:

2		
3	Operating and Maintenance Manuals	2 copies
4	User agency	1 copy
5	A/E	1 copy
6	Owner Field Office	1 copy
7		

8 **PROJECT/SITE CONDITIONS**

9 Install Work in locations shown on drawings, unless prevented by project conditions.
10 Prepare drawings showing proposed rearrangement of work to meet project conditions, including changes to work
11 specified in other sections. Obtain permission of owner before proceeding.
12 Tools, materials and equipment shall be confined to areas designated by the owner.

13
14 **WORK SEQUENCE AND SCHEDULING**

15 Install work in phases to accommodate user agency's occupancy requirements. During the construction period
16 coordinate electrical schedule and operations with owner Construction Representative.

17
18 **WORK BY OTHER TRADES**

19 Every attempt has been made to indicate in this trade's specifications and drawings all work required of this
20 Contractor. However, there may be additional specific paragraphs in other trade specifications and addenda, and
21 additional notes on drawings for other trades which pertain to this trade's work, and thus those additional
22 requirements are hereby made a part of these specifications and drawings.

23
24 Electrical details on drawings for equipment to be provided by others are based on preliminary design data only. This
25 Contractor shall lay out the electrical work and shall be responsible for its correctness to match equipment actually
26 provided by others.

27
28 **OFFSITE STORAGE**

29 Prior approval by owner and the A/E will be needed. In general, building wire, conduit, fittings and similar rough-in
30 material will not be accepted for off-site storage. No material will be accepted for off-site storage unless shop
31 drawings for the material have been approved.

32
33 **SALVAGE MATERIALS**

34 No materials removed from this project shall be reused unless specifically noted otherwise. All materials removed
35 shall become the property of and shall be disposed of by the Contractor.

36
37 **CERTIFICATES AND INSPECTIONS**

38 Obtain and pay for all required installation inspections, except those provided by the owner, in accordance with the
39 Wisconsin Administrative Code. Deliver originals of these certificates to the owners Project Representative.

40
41 The Electrical Contractor is responsible for coordination of owner electrical inspections. Prior to the start of significant
42 on-site electrical work, the contractor shall schedule a pre-installation meeting with the owner Electrical Inspector to
43 discuss the inspection requirements and review the contract requirements (also see Article 15 of the General
44 Conditions). The Electrical Contractor shall be present when the owner Electrical Inspector conducts the electrical
45 inspections.

46
47 **OPERATION AND MAINTENANCE DATA**

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

50
51 In addition to the general content specified under GENERAL REQUIREMENTS supply the following additional
52 documentation:

53
54 Manufacturer's wiring diagrams for electrically powered equipment.

55
56 **RECORD DRAWINGS**

57 The Contractor shall maintain at least one copy each of the specifications and drawings on the job site at all times.

58
59 The owner will provide the Contractor with a suitable set of contract drawings on which daily records of changes and
60 deviations from contract shall be recorded. Dimensions and elevations on the record drawings shall locate all buried
61 or concealed piping, conduit, or similar items.

62 The daily record of changes shall be the responsibility of Contractor's field superintendent. No arbitrary mark-ups
63 will be permitted.

1 At completion of the project, the Contractor shall submit the marked-up record drawings to the Architect/Engineer
2 prior to final payment.

3
4 **PART 2 - PRODUCTS**

5
6 **ACCESS PANELS AND DOORS**

7 Lay-in Ceilings:

8 Removable lay-in ceiling tiles in 2 x 2 foot or 2 x 4-foot configuration provided under other divisions are sufficient; no
9 additional access provisions are required unless specifically indicated.

10
11 Concealed Spline Ceilings:

12 Removable sections of ceiling tile held in position with metal slats or tabs compatible with the ceiling system used
13 will be provided under other divisions.

14
15 Metal Pan Ceilings:

16 Removable sections of ceiling tile held in position by pressure fit will be provided under other divisions.

17
18 Plaster Walls and Ceilings:

19 16-gauge frame with not less than a 20-gauge hinged door panel, prime coated steel for general applications,
20 stainless steel for use in toilets, showers and similar wet areas, concealed hinges, screwdriver operated cam latch
21 for general application, key lock for use in public areas, UL listed for use in fire rated partitions if required by the
22 application. Use the largest size access opening possible, consistent with the space and the equipment needing
23 service; minimum size is 12" by 12".

24
25 **IDENTIFICATION**

26 See Electrical section 26 05 53 – Identification for Electrical Systems.

27
28 **SEALING AND FIRE STOPPING**

29 FIRE AND/OR SMOKE RATED PENETRATIONS:

30 Provide all fire stopping of fire rated penetrations and sealing of smoke rated penetrations in compliance with section
31 07 84 00 "Fire Stopping".

32
33 NON-RATED PENETRATIONS:

34 Conduit Penetrations Through Below Grade Walls:

35 In exterior wall openings below grade, use a modular mechanical type seal consisting of interlocking synthetic rubber
36 links shaped to continuously fill the annular space between the uninsulated conduit and the cored opening or water-
37 stop type wall sleeve.

38
39 Conduit and Cable Tray Penetrations:

40 At conduit and cable tray penetrations of non-rated interior partitions, floors and exterior walls above grade, use
41 urethane caulk in annular space between conduit and sleeve, or the core drilled opening.

42
43 **PART 3 - EXECUTION**

44
45 **EXCAVATION AND BACKFILL**

46 Perform all excavation and backfill work to accomplish indicated electrical systems installation unless noted
47 otherwise.

48
49 **CONCRETE WORK**

50 The Division 3 Contractor will perform all cast-in-place concrete unless noted otherwise elsewhere. Provide all layout
51 drawings, anchor bolts, metal shapes, and/or templates required to be cast into concrete or used to form concrete
52 for the support of electrical equipment.

53
54 **CUTTING AND PATCHING**

55 Refer to Division 1, General Requirements, Cutting and Patching.

56
57 **BUILDING ACCESS**

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

61
62 **EQUIPMENT ACCESS**

63 Install all piping, conduit, ductwork, and accessories to permit access to equipment for maintenance. Coordinate the
64 exact location of wall and ceiling access panels and doors with the General Contractor, making sure that access is

1 available for all equipment and specialties. Where access is required in plaster or drywall walls or ceilings, furnish
2 the access doors to the General Contractor and reimburse the General Contractor for installation of those access
3 doors.
4

5 **COORDINATION**

6 The Contractor shall cooperate with other trades and owner in locating work in a proper manner. Should it be
7 necessary to raise or lower or move longitudinally any part of the electrical work to better fit the general installation,
8 such work shall be done at no extra cost to the owner, provided such decision is reached prior to actual installation.
9 The Contractor shall check location of electrical outlets with respect to other installations before installing.

10
11 The Contractor shall verify that all devices are compatible for the surfaces on which they will be used. This includes,
12 but is not limited to light fixtures, panelboards, devices, etc. and recessed or semi-recessed heating units installed
13 in/on architectural surfaces.

14
15 Coordinate all work with other contractors prior to installation. Any installed work that is not coordinated and that
16 interferes with other contractor's work shall be removed or relocated at the installing contractor's expense.

17
18 **SLEEVES AND OPENINGS**

19 Conduit penetrations in existing concrete floors: Core drill openings.

20
21 Conduit penetrations through existing floors located in food service areas that do not require a T rating: Core drill
22 sleeve opening large enough to insert schedule 40 sleeve, extend sleeve 2 inches above the floor and grout area
23 around sleeve with hydraulic setting, non-shrink grout.
24

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

27
28 **SEALING AND FIRE STOPPING**

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

30 Provide all fire stopping of fire rated penetrations and sealing of smoke rated penetrations in compliance with section
31 07 84 00 Fire Stopping.
32

33 **NON-RATED PENETRATIONS:**

34 In exterior wall openings below grade, assemble rubber links of mechanical seal to the proper size for the conduit
35 and tighten in place, in accordance with the manufacturer's instructions. Install so that the bolts used to tighten the
36 seal are accessible from the interior of the building or vault.
37

38 At all interior walls and exterior walls, conduit penetrations are required to be sealed. Apply sealant to both sides of
39 the penetration in such a manner that the annular space between the sleeve or cored opening and the conduit is
40 completely blocked.
41

42 **PENETRATIONS SUBJECT TO WATER INTRUSION:**

43 For penetrations (both rated and non-rated) in floors subject to water intrusion or in rooms housing electrical
44 equipment (but not within walls) provide one of the following:
45

46 Conduit penetration where steel pipe sleeve is used extend steel sleeve 2" above the floor.
47

48 Conduit penetration where cast in place fire stopping device/sleeve is used, extend device/sleeve 2" above the floor
49 (provided it meets the device's UL listing).
50

51 Conduit penetration where there is no steel sleeve or cast in place fire stopping device/sleeve, provide 2"x 2" x 1/8"
52 galvanized steel angles fastened to floor surrounding the penetration or group of penetrations to prevent water from
53 getting to penetration. Provide urethane caulk between angles and floor and fasten angles to floor minimum 8" on
54 center. Seal corners watertight with urethane caulk.
55

56 Floors subject to water intrusion or rooms housing electrical equipment include the following locations:
57

58 Food Service/Kitchen Areas

59 Restrooms

60 Locker/Shower Rooms

61 Janitor Rooms w/ Sinks

62 Mechanical/Plumbing Equipment Rooms

63 Maintenance/Industrial Shops

64 Vehicle Storage and Parking Ramps

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1 Data/Telecommunications Rooms
2 Electrical Equipment Rooms
3 Provide waterproof caulk sealant top coating on fire stopping system (or other approved means to protect the fire
4 stopping system from water) in areas subject to wash down such as Food Service and Dish Washing Areas.
5

6 **HOUSEKEEPING AND CLEAN UP**

7 The Contractor shall clean up and remove from the premises, on a daily basis, all debris and rubbish resulting from
8 its work and shall repair all damage to new and existing equipment resulting from its work. When job is complete,
9 this Contractor shall remove all tools, excess material, and equipment, etc., from the site.
10

11 **OWNER TRAINING**

12 All training provided for the Owner shall comply with the format, general content requirements and submission
13 guidelines specified under Section 01 91 01 or 01 91 02.
14

15

END OF SECTION

**SECTION 26 05 02
ELECTRICAL DEMOLITION FOR REMODELING**

PART 1 - GENERAL

SCOPE

The work under this section includes

RELATED WORK

Applicable provisions of Division 1 govern work under this Section.

PART 2 - PRODUCTS

MATERIALS AND EQUIPMENT

Materials and equipment for patching and extending work as specified in the individual Sections.

PART 3 - EXECUTION

EXAMINATION

Verify field measurements and circuiting arrangements as shown on Drawings.

Verify that abandoned wiring and equipment serve only abandoned facilities.

Verify whether or not PCB ballasts exist in light fixtures which will be disposed of. If PCB light fixture ballasts exist, then follow requirements in **PCB BALLAST HANDLING** and **LAMP AND PCB BALLAST DISPOSAL** below.

Demolition Drawings are based on casual field observation and/or existing record documents. Report discrepancies to the Owner and Architect/Engineer before disturbing existing installation.

Beginning of demolition means installer accepts existing conditions.

PREPARATION

Disconnect electrical systems in walls, floors, and ceilings scheduled for removal.

Coordinate utility service outages with the Owner and Architect/Engineer. Also, if applicable, coordinate utility service outages with the local Utility Company.

Provide temporary wiring and connections to maintain existing systems in service during construction. When work must be performed on energized equipment or circuits, use personnel experienced in such operations and follow the safe working practice requirements of NFPA 70E.

Existing Fire Alarm System: Maintain existing system in service. Disable system only to make switchovers and connections. Obtain permission from the Owner and local Authority Having Jurisdiction at least 48 hours before partially or completely disabling system. Minimize outage duration. If required, make temporary connections to maintain service in areas adjacent to work area.

Existing Communication/Data System: Maintain existing system in service until new system is complete and ready for service. Disable system only to make switchovers and connections. Obtain permission from the Owner and local Telephone Utility. If required, make temporary connections to maintain service in areas adjacent to work area.

DEMOLITION AND EXTENSION OF EXISTING ELECTRICAL WORK

Remove, relocate, and extend existing installations as necessary, to accommodate new construction and to meet all requirements of these specifications. Extend existing installations using materials and methods compatible with existing electrical installations, or as specified.

Remove abandoned wiring to source of supply.

Remove exposed abandoned conduit and abandoned conduit above accessible ceiling finishes, unless noted otherwise on drawings. Cut conduit flush with walls and floors, and patch surfaces. If certain conduits and boxes are abandoned but not scheduled for removal, they shall be shown on the "As Built Drawings".

Disconnect abandoned outlets and remove devices. Remove abandoned outlets if conduit and wiring servicing them is abandoned and removed. Provide blank cover for abandoned outlets which are not removed.

Disconnect and remove abandoned panelboards and distribution equipment.

1 Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.

2
3 Disconnect and remove abandoned luminaires. Remove brackets, stems, hangers, and other accessories.

4
5 Provide revised typed circuit directory in panelboards that have circuits removed.

6
7 Repair adjacent construction and finishes damaged during demolition and extension work.

8
9 Maintain access to existing electrical installations which remain active. Modify installation or provide access panel
10 as appropriate.

11
12 Provide supplemental support for conduits that are routed through demolition area and are to remain. Supplemental
13 support shall be added so that the conduit meets the support requirements of electrical specification section 26 05
14 33.

15
16 **PCB BALLAST HANDLING**

17 Generally, all high-power factor fluorescent light ballasts manufactured before 1978 and some HID ballasts contain
18 polychlorinated biphenyl (PCB) compounds in their capacitors. The Contractor shall inspect all ballasts in all light
19 fixtures and take the actions described below:

20
21 The disposal of all ballasts labeled as "NON-PCBs" or "NO PCBs" shall become the responsibility of the Contractor.
22 If the PCB content is not stated on the ballast label, the ballast shall be handled as a PCB ballast.

23
24 All PCB ballasts shall be removed from the light fixtures and shall have the wires clipped off. However, before
25 removal, all PCB ballasts shall be carefully inspected for leaks. If a ballast appears to be leaking (evidenced by
26 potting compound leaking out or by an oily film on the ballast surface) the ballast must be handled per EPA and
27 DNR PCB regulations. Basically, this means the ballast is to be carefully removed from the fixture and placed in an
28 approved drum. See paragraph below for the drum specifications. The person removing the ballast from the fixture
29 shall wear protective gloves, eye protection, and protective clothing as necessary.

30
31 If the fixture has also been contaminated, it must be cleaned to less than 10 micrograms/100 square centimeters
32 contamination before disposal. This cleaning must be done by an approved PCB contractor and is not considered a
33 part of this contract.

34
35 The PCB ballasts shall then be placed in US DOT approved drums (barrels). The contractor may furnish their own
36 drums or obtain them from Lamp Recyclers Incorporated (800-558-1166). The quantity and size of the drums will be
37 determined by the contractor at the time of construction, 30- and 55-gallon drums are typically available.

38 These PCB drums shall be placed in storage with the cover that came with the barrels, in a location within a
39 building, as designated by the Owner or Construction Manager. The drums are not to be placed outside where they
40 are exposed to weather.

41
42 THESE PCB BALLASTS ARE NOT TO BE REMOVED FROM THE WORK SITE BY THE CONTRACTOR. To do
43 so would be a violation of DNR and DOT hazardous waste regulations and may result in a fine to the Contractor.

44 The Contractor shall label and mark the PCB storage drums with EPA approved PCB labels and the storage area
45 with signs, marks and lines to meet the regulations of Wisconsin Code NR 157 – Management of PCBs and
46 Products Containing PCBs.

47
48 The Contractor shall also provide approved PCB absorbent materials to be stored immediately adjacent to the drum
49 storage area. Do not place loose absorbent material in the drums.

50
51 The Contractor shall provide to the Owner and Construction Manager, in written form, a total count of these ballasts
52 (or their total weight by drum) and where they are stored.

53
54 See Lamp and PCB Ballast Disposal instructions below.

55
56 **LAMP AND PCB BALLAST DISPOSAL**

57 All lamps (fluorescent, incandescent, and HID) contain mercury and/or lead (in the base) as well as other heavy
58 metals and compounds which are regulated by the EPA and DNR during the disposal process. As a result,
59 regulations have been issued covering the handling and disposal of all lamps. Lamps which have been removed
60 from service for disposal shall be handled as follows by the Contractor:

61
62 The Contractor shall very carefully remove all lamps (fluorescent, incandescent, and HID) from light fixtures before
63 removal of the fixture from its mounted position. This is to reduce the likelihood that the lamp(s) will be broken. The

- 1 Contractor will be charged the cost difference between disposal of broken and unbroken lamps, for all lamps broken
- 2 in excess of 1% of the total lamps removed in the project.
- 3
- 4 The contractor shall contact Lamp Recyclers Incorporated (800-558-1166) to coordinate the storage and pickup of
- 5 disposed lamps and PCB ballasts. The contractor may furnish their own containers or obtain them from Lamp
- 6 Recyclers Incorporated. Removed lamps and PCB ballasts shall be placed in containers by the contractor, marked
- 7 with the number and type of lamp and PCB ballast, and placed in storage at a location on the Owner's property.
- 8
- 9 The contractor shall label the area as "Hazardous Material Storage". The contractor shall make arrangements for
- 10 pickup of the lamps and PCB ballasts with Lamp Recyclers Incorporated, shall provide a count of all stored lamps
- 11 and PCB ballasts, and shall fill out any required forms.
- 12
- 13 When making disposal arrangements with Lamp Recyclers Incorporated, the contractor shall make sure to notify
- 14 them of the Construction Manager, for invoicing purposes. Invoicing from Lamp Recyclers Incorporated shall be
- 15 sent to the Construction Manager for direct charge payment from the project.
- 16
- 17 The contractor shall coordinate the lamp and PCB ballast disposal with the Construction Manager.
- 18
- 19

END OF SECTION

**SECTION 26 05 04
CLEANING, INSPECTION, AND TESTING OF ELECTRICAL EQUIPMENT**

PART 1 - GENERAL

SCOPE

The work under this section includes the required cleaning, inspection, adjustment, maintenance, and testing of electrical equipment, as specified herein. This applies only to new electrical and existing electrical equipment being furnished, modified, worked on, or serviced by this contractor for this project.

RELATED WORK

Applicable provisions of Division 1 govern work under this Section.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

GENERAL INSPECTION AND CLEANING OF ALL ELECTRICAL EQUIPMENT

Inspect for physical damage and abnormal mechanical and electrical conditions.

Any item found to be out of tolerance, or in any other way defective as a result of the required inspection or testing, shall be reported to the DFD. Procedure for repair and/or replacement will be outlined. After appropriate corrective action is completed, the item shall be re-tested.

Compare equipment nameplate information with the latest single line diagram and report any discrepancies. Verify proper auxiliary device operation and indicators.

Check tightness of accessible bolted electrical joints. Use torque wrench method.

Make a close examination of equipment and remove any shipping brackets, insulation, packing, etc. that may not have been removed during original installation.

Make a close examination of equipment and remove any dirt or other forms of debris that may have collected in existing equipment or in new equipment during installation.

Clean All Equipment:

Vacuum inside of panelboards, switchboards, switchgear, transformer core and coils, bus ducts, MCC's, fire alarm panels, communication/data panels, security panels, etc.

Loosen attached particles and vacuum them away.

Wipe all insulators with a clean, dry, lint free rag.

Clean insulator grooves.

Re-vacuum inside surfaces as directed by the DFD Construction Representative or Inspector

Inspect equipment anchorage.

Inspect equipment and bus alignment.

Check all heater elements for operation and control.

Lubricate nonelectrical equipment per manufacturer's recommendations.

GROUNDING SYSTEMS

Inspect the ground system for adequate termination at all devices.

LIGHTNING ARRESTERS/SURGE SUPPRESSION

Inspect for physical damage such as chipped or fractured porcelain. Wipe clean.

Perform a ground continuity test to grounding system.

Verify the proper mounting and adequate clearance.

Verify the voltage of the units with system one line diagram. Report any discrepancies.

Verify the electronic surge protection device is connected properly and status lights are normal.

MECHANICAL AND ELECTRICAL INTERLOCK SYSTEM

Physically test each system to insure proper function, operation and sequencing.

Closure attempt shall be made on locked open devices.

Opening attempt shall be made on locked closed devices.

1 Key exchange shall be made with devices operated in off normal positions.
2

3 **PANELBOARDS**

4 Torque all the connections per the manufacturers spec. Verify phase wires, color coding, separate neutral and
5 mechanical bonding. Verify circuit breaker operation. Verify the directory.
6

7 Vacuum clean the panelboard enclosure.
8

9 **MOTOR STARTERS AND MOTOR CONTROL CENTERS**

10 Verify the control circuits. Confirm the fusing and the grounding of the control transformers. Torque all of the
11 connections. Confirm the overload elements and the circuit breakers (fuse) for proper sizing. Verify all grounding.
12 Operate and test each motor starter for proper operation.
13

14 **CABLES**

15 600 Volt cable:

16 Visually inspect cables, lugs, connectors and all other components for physical damage and proper connections.

17 Check all cable connectors for tightness (with a torque wrench) and clearances. Torque test conductor terminations
18 to manufacturer's recommendations.
19

20 Perform a 1000 Vdc megger test on all secondary cables from the substation transformers to the secondary
21 switchboards and on all switchboard feeders.
22

23 **LIGHT FIXTURES**

24 Check the bonding and proper lamping. Verify that recessed fixtures are installed with hold down clips. Confirm
25 operation of the fixture with the proper switch or sensor.
26

27 **OCCUPANCY SENSORS**

28 Confirm operation of the sensor per the manufacturer's specification.
29

30 **BATTERY PACK EMERGENCY LIGHTING**

31 Verify the operation per the manufacturers spec and run all of the diagnostic steps. Confirm proper grounding and
32 location.
33

34 **END OF SECTION**

SECTION 26 05 19
LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

SCOPE

The work under this section includes furnishing and installing required wiring and cabling systems including pulling, terminating, and splicing.

RELATED WORK

Applicable provisions of Division 1 govern work under this Section.

Section 26 05 33 – Raceway and Boxes for Electrical Systems.

Section 26 05 53 – Identification for Electrical Systems.

REFERENCES

SPS 316- Electrical

SUBMITTALS

Submit product data: Provide for each cable assembly type.

Submit factory test reports: Indicate procedures and values obtained.

Submit shop drawings for modular wiring system including layout of distribution devices, branch circuit conduit and cables, circuiting arrangement, and outlet devices.

Submit manufacturer's installation instructions. Indicate application conditions and limitations of use stipulated by product testing agency specified under Regulatory Requirements.

PROJECT CONDITIONS

Verify that field measurements are as shown on Drawings.

Conductor sizes are based on copper.

Wire and cable routing shown on Drawings is approximate unless dimensioned. Route wire and cable as required for project conditions.

Where wire and cable routing is not shown, and destination only is indicated, determine exact routing and lengths required.

PART 2 - PRODUCTS

GENERAL

All wire shall be new, delivered to the site in unbroken cartons and shall be less than one year old out of manufacturer's stock.

All conductors shall be copper.

Insulation shall have a 600-volt rating.

All conductors shall be stranded.

Stranded conductors may only be terminated with UL OR ETL Listed type terminations or methods: e.g., stranded conductors may not be wrapped around a terminal screw but must be terminated with a crimp type device or must be terminated in an approved back wired method.

BUILDING WIRE

Description: Single conductor insulated wire 90-degree C.

Insulation: Type THHN/THWN-2, XHHW-2 insulation.

SERVICE ENTRANCE CONDUCTORS

Description: Single conductor or multi-conductor insulated wire. 90 degree C sized at the 75 degree C table.

Insulation: Type USE-2, XHHW-2 insulation for service entrance conductors routed from exterior source to exterior termination location.

Type XHHW-2 insulation for services entrance conductors routed from exterior source to interior termination location.

VARIABLE FREQUENCY DRIVE (VFD) WIRE

All power wiring from the VFD output to the motor shall be type XHHW-2 insulation, single conductor wire, or VFD cable if required by the VFD manufacturer.

ABOVEGROUND WIRE FOR EXTERIOR WORK

Description: Single conductor insulated wire, 90-degree C.

1 Insulation: Type XHHW-2 insulation.
2

3 **UNDERGROUND WIRE FOR EXTERIOR WORK**

4 Description: Stranded single or multiple conductors insulated wire, 90-degree C.
5

6 Insulation: Type USE-2, XHHW-2, RHW-2 insulation.
7

8 This wiring shall be used in all underground feeder and branch circuit applications, except THHN/THWN-2 is
9 permitted when run in a concrete-encased ductbank.
10

11 **EMERGENCY CIRCUITS (2-HOUR RATED)**

12 Description: Power cable assembly for fire pump circuits and emergency circuits requiring a minimum 2-hour rating.
13

14 Insulation: Type MI mineral insulated cable installed as a listed electrical circuit protective system with a minimum 2-
15 hour fire-resistive cable rating per Factory Mutual testing. UL 2196 and ULC-S139-00 approved.
16

17 Install and support cabling system per manufacturer's requirements.
18

19 **WIRING CONNECTORS**

20 Split Bolt Connectors: Not acceptable.
21

22 Solderless Pressure Connectors: High copper alloy terminal. May be used only for cable termination to equipment
23 terminals. Not approved for splicing.
24

25 Twist Type Wire Connectors: Solderless twist type spring connector (wire-nut) with insulating cover for copper wire
26 splices and taps. Use for conductor sizes 10 AWG and smaller. The manufacturer's wire fill capacity must be
27 followed. Use Silicone filled twist type spring connectors in all wet location areas.
28

29 All wire connectors used in underground or exterior pull boxes or hand holes shall be gel filled twist connectors or a
30 connector designed for damp and wet locations. Gel filled twist type connectors can be used for copper conductor
31 sizes 6 AWG and smaller for site lighting applications. The manufacturer's wire fill capacity must be followed.
32

33 Mechanical Connectors: Bolted type tin-plated; high conductivity copper alloy; spacer between conductors; beveled
34 cable entrances.
35

36 Compression (crimp) Connectors: Long barrel; seamless, tin-plated electrolytic copper tubing; internally beveled
37 barrel ends. Connector shall be clearly marked with the wire size and type and proper number and location of
38 crimps. Connector must be installed with a crimper tool listed for use with the manufacturer and type of compression
39 connector.
40

41 Insulation Piercing Connectors: Molded insulated body, copper teeth, wrench tightened, UL 486B Listed. May be
42 used only for connection of a tap conductor in run and tap type applications when main conductor is 8 AWG and
43 larger.
44

45 **PART 3 - EXECUTION**

46 **GENERAL WIRING METHODS**

47 All wire and cable shall be installed in conduit.
48
49

50 Do not use wire smaller than 12 AWG for power and lighting circuits.
51

52 All phase, neutral and ground conductors shall be sized to prevent excessive voltage drop at rated circuit ampacity.
53 As a minimum use 10 AWG conductors for 20 amperes, 120 volt branch circuit home runs longer than 100 feet (30
54 m), and for 20 ampere, 277 volt branch circuit home runs longer than 200 feet (61 m).
55

56 Ground conductor size shall be increased per NEC 250.122(B) when phase and phase/neutral conductors are
57 increased in size.
58

59 Make conductor lengths for parallel conductors equal.
60

61 Splice only in junction or outlet boxes.
62

63 No conductor less than 10 AWG shall be installed in exterior underground conduit.
64

1 Identify ALL low voltage wire, 600V and lower, per section 26 05 53.

2
3 Neatly train and lace wiring inside boxes, equipment, and panelboards.

4
5 **WIRING INSTALLATION IN RACEWAYS**

6 Pull all conductors into a raceway at the same time. Use Listed water or silicone-based wire pulling lubricant for
7 pulling 4 AWG and larger wires and for other conditions when necessary. Wax based lubricants are not allowed.

8
9 Pulling lubricant is not required for low friction type products where the cable manufacturer recommends that cables
10 be pulled without lube.

11
12 Install wire in raceway after interior of building has been physically protected from the weather and all mechanical
13 work likely to injure conductors has been completed.

14
15 Completely and thoroughly swab raceway system before installing conductors.

16
17 Place all conductors of a given circuit (this includes phase wires, neutral (if any), and ground conductor) in the same
18 raceway. If parallel phase and/or neutral wires are used, then place an equal number of phase and neutral
19 conductors in same raceway or cable.

20
21 VFD Installations: Install VFD input wiring and output wiring in separate conduit systems. Do not mix VFD input power
22 and output power, or control wiring in a common raceway.

23
24 In high ambient spaces, mechanical rooms, utility rooms and exterior exposed conduit, 90 degree C, XHHW-2
25 conductors shall be utilized.

26
27 **WIRING CONNECTIONS AND TERMINATIONS**

28 Splice only in accessible junction boxes.

29
30 Wire splices and taps shall be made firm, and adequate to carry the full current rating of the respective wire without
31 soldering and without perceptible temperature rise.

32
33 All splices shall be so made that they have an electrical resistance not in excess of two feet (600 mm) of the
34 conductor.

35
36 Use solderless twist type spring connectors (wire nuts) with insulating covers for wire splices and taps, 10 AWG and
37 smaller.

38
39 Use mechanical or compression connectors for wire splices and taps, 8 AWG and larger. Tape uninsulated
40 conductors and connectors with electrical tape to 150 percent of the insulation value of the wiring.

41
42 Thoroughly clean wires before installing lugs and connectors.

43
44 At all splices and terminations, leave tails long enough to cut splice out and completely re-splice.

45
46 **FIELD QUALITY CONTROL**

47 Field inspection and testing will be performed under provisions of Section 26 05 04.

48
49 Test procedures shall meet NETA guidelines.

50
51 Test results and report shall be provided to the engineer and included in O&M manual under AL conductors/ tests.
52 Contractor shall correct all deficiencies reported in the test report.

53
54 **WIRE COLOR**

55 General:

56 Solid colored insulation is required for all THHN/THWN-2 wire. For other wire types use colored wire or identify wire
57 with colored tape at all terminals, splices and boxes. Wire shall be colored as indicated below.

58
59 In existing facilities, use existing color scheme.

60
61 In new facilities, use black and red for single phase circuits at 120/240 volts, use Phase A black, Phase B red and
62 Phase C blue for circuits at 120/208 volts single or three phase, and use Phase A brown, Phase B orange and Phase
63 C yellow for circuits at 277/480 volts single or three phase. Note: This includes fixture whips except for Listed whips
64 mounted by the fixture manufacturer on the fixture and Listed as a System.

1 Switch legs shall be the same color as their associated circuit, except for the second switch leg used for dual-level
2 switching. The second switch leg shall be the next phase color, e.g., if the first switch leg is brown (277/480V phase
3 A), the second switch leg shall be orange (277/480V phase B).

4
5 Traveler conductors run between 3- and 4-way switches shall be colored pink or purple.

6
7 Neutral Conductors: White for 120/208V and 120/240V systems, Gray for 277/480V systems. Where there are two or
8 more neutrals in one conduit, each shall be individually identified with a different stripe.

9
10 Branch Circuit Conductors: Three or four wire home runs shall have each phase uniquely color coded.
11 Feeder Circuit Conductors: Each phase shall be uniquely color coded.

12
13 Ground Conductors: Green colored insulation for THHN/THWN-2 wire. For other wire types use green colored wire
14 or identify wire with green tape at both ends and at all access points, such as panelboards, motor starters,
15 disconnects and junction boxes. When isolated grounds are required, contractor shall provide green with yellow
16 tracer.

17
18 **BRANCH CIRCUITS**
19 The use of single-phase, multi-wire branch circuits with a common neutral is not permitted. All single-phase branch
20 circuits shall be furnished and installed with an individual accompanying neutral, sized the same as the phase
21 conductors.

22
23

END OF SECTION

**SECTION 26 05 23
CONTROL-VOLTAGE ELECTRICAL POWER CABLES**

PART 1 - GENERAL

SCOPE

The work under this section includes furnishing and installing cabling for remote-control, signaling and power-limited circuits.

RELATED WORK

Applicable provisions of Division 1 govern work under this Section.

Section 26 05 33 – Raceway and Boxes for Electrical Systems.

Section 26 05 53 – Identification for Electrical Systems.

REFERENCES

NFPA 70 - National Electrical Code.

SUBMITTALS

Submit product data: Provide for each cable assembly type.

Submit manufacturer's installation instructions. Indicate application conditions and limitations of use stipulated by product testing agency.

PROJECT CONDITIONS

Verify that field measurements are as shown on Drawings.

Wire and cable routing shown on Drawings is approximate unless dimensioned. Route wire and cable as required to meet Project Conditions.

Where wire and cable routing is not shown, and destination only is indicated, determine exact routing and lengths required.

PART 2 - PRODUCTS

GENERAL

All wire shall be new, delivered to the site in unbroken cartons and shall be less than one year old out of manufacturer's stock.

All conductors shall be copper.

Insulation shall have a 600-volt rating.

All conductors shall be suitable for the application intended. Conductors #12 and smaller may be solid or stranded with the following requirements or exceptions:

All conductors terminated with crimp type devices shall be stranded.

Stranded conductors shall be terminated with UL OR ETL Listed type terminations or methods: e.g. stranded conductors shall not be wrapped around a terminal screw but shall be terminated with a crimp type device or in an approved back wired method.

REMOTE-CONTROL AND SIGNALING CABLE

Refer to Section 28 31 00 for requirements for cable to be used on fire alarm systems.

Refer to Section 27 10 00 for requirements for cable to be used on communication systems.

All other systems cabling shall meet the requirements of NEC Article 725 and the following:

- Cable for Class 1 Remote-Control, Signaling and Power-Limited Circuits: 600-volt insulation, individual conductors twisted together, shielded, and covered with an overall PVC jacket. Cable shall be Listed, temperature rated, and suitable Type (general purpose, riser, or plenum) for the application as required in the National Electrical Code.

- Cable for Class 2 or Class 3 Remote-Control, Signaling and Power-Limited Circuits shall be Listed, temperature rated, and suitable Type (general purpose, riser or plenum) for the application as required in the National Electrical Code.

WIRING CONNECTORS

Split Bolt Connectors: Not acceptable.

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.

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

GENERAL WIRING METHODS

Control-voltage cables shall be installed in conduit. However, they may be installed free-air (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 cable installation below.

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.

Splice only in junction boxes.

Identify wire per section 26 05 53.

Neatly train and lace wiring inside boxes, and equipment.

WIRING INSTALLATION IN RACEWAYS

Pull all conductors into a raceway at the same time. Use Listed wire pulling lubricant for pulling conditions when necessary.

Install wire in raceway after interior of building has been physically protected from the weather and all mechanical work likely to injure conductors has been completed.

FREE-AIR CABLE INSTALLATION

Cablings shall be neatly run at right angles and be kept clear of other trades work.

Cablings shall be supported at a maximum of 4-foot intervals utilizing "J-Hook" or "Bridal Ring" supports anchored to ceiling concrete, piping supports or structural steel beams. If cable sag at mid-span exceeds 12-inches, another support shall be provided. Cable supports shall be installed to maintain cable bend to larger than the minimum bend radius.

Cablings shall not be attached to or supported by existing cabling, plumbing or steam piping, ductwork, suspended ceiling supports or electrical or communications conduit. Do not place cable directly on the ceiling grid or attach cable in any manner to the ceiling grid wires.

To reduce or eliminate Electro-Magnetic Interference (EMI), the following minimum separation distances for 'Free-Air' cabling installations shall be adhered to:

- Twelve (12) inches from power lines of less than 5kV.
- Five (5) inches from lighting fixtures.
- Thirty-nine (39) inches from transformers and motors.
- A coil of 4 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.
- 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, Kellom type grips may be used to spread the strain over a longer length of cable.
- 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.
- All exposed vertical cable extensions to devices located below the finished ceiling shall be in conduit.
- Use suitable cable fittings and connectors.

- When permitted in exposed ceiling areas as designated on the plan drawings, 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. Provide protection for exposed cables where subject to damage.

WIRING CONNECTIONS AND TERMINATIONS

Splice only in accessible junction boxes (except splices to low voltage occupancy sensor power packs and terminations to temperature control devices).

All splices shall be so made that they have an electrical resistance not in excess of two feet (600 mm) of the conductor.

Use solderless spring type pressure connectors with insulating covers for wire splices and taps, 10 AWG and smaller. Thoroughly clean wires before installing lugs and connectors.

At all splices and terminations, leave tails long enough to cut splice out and completely re-splice.

FIELD QUALITY CONTROL

Field inspection and testing will be performed under provisions of Section 26 05 04.

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.

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.

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 Construction Manager.
- 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.

Test Reports: Indicate overall resistance to ground.

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

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.

1 **MECHANICAL CONNECTORS**

2 The mechanical connector bodies shall be manufactured from high strength, high conductivity cast copper alloy
3 material. Bolts, nuts, washers and lock washers shall be made of Silicon Bronze and supplied as a part of the
4 connector body and shall be of the two-bolt type.

5
6 Split bolt connector types are NOT allowed. Exception: the use of split bolts is acceptable for grounding of wire-
7 basket type cable tray, and for cable shields/straps of medium voltage cable.

8 The connectors shall meet or exceed UL 467 and be clearly marked with the catalog number, conductor size and
9 manufacturer.

10
11 **COMPRESSION CONNECTORS**

- 12 • The compression connectors shall be manufactured from pure wrought copper. The conductivity of this
13 material shall be no less than 99% by IACS standards.
- 14 • Each connector shall be factory filled with an oxide-inhibiting compound.
- 15 • The connectors shall meet or exceed the performance requirements of IEEE 837, latest revision.
- 16 • The connectors shall be clearly marked with the manufacturer, catalog number, conductor size and the
17 required compression tool settings.
- 18 • The installation of the connectors shall be made with a compression tool and die system, as recommended by
19 the manufacturer of the connectors, and shall be irreversible.
- 20 • Pre-crimping of the ground rod is required for all irreversible compression connections to a ground rod.
- 21 • Terminal lug for communication system grounding shall be compression type and conform to the following:
- 22 • Material: Tin Plated Copper (aluminum not permitted).
- 23 • Wire Size: to match conductor
- 24 • Number of Stud Holes: 2
- 25 • Stud Hole Size: 3/8"
- 26 • Bolt Hole Spacing: per TIA-607-C
- 27 • Tongue Angle: Straight

28
29 **EXOTHERMIC CONNECTIONS**

30 As manufactured by Erico Cadweld, Harger Ultraweld or similar.

31
32 **CONDUCTORS**

33 Material: Stranded copper (aluminum not permitted).

34 Grounding Electrode Conductor: Bare seven-strand conductors. Size as shown on drawings, specifications or as
35 required by NFPA 70, whichever is larger.

36
37 Foundation Electrodes: As shown on drawings.

38
39 Primary Manhole, Main Switchgear room and Vault Bonding: No. 4/0 minimum.

40
41 Feeder and Branch Circuit Equipment Ground: Size as shown on drawings, specifications or as required by NFPA
42 70, whichever is larger. Differentiate between the normal ground and the isolated ground when both are used at the
43 same facility.

44
45 Branch Circuit Equipment Ground shall be proportionately increased in size when routed with phase conductors
46 increased in size.

47
48 Conductors for Telecommunications shall be as follows:

- 49 • Telecommunications Bonding Conductor (TMGB to Service Ground): No. 3/0 minimum or as shown on
50 drawings.
- 51 • Telecommunications Bonding Backbone (TBB; TMGB to TGB): No. 3/0 minimum or as shown on drawings.
- 52 • Telecommunications Grounding Equalizer (GE): No. 3/0 minimum or as shown on drawings.

53
54 Bonding Conductors shall be insulated with a Green Jacket or jacket marked with Green Tape or labeled per NEC
55 Guidelines.

56
57 **BUS/BUSBAR**

58 Material: Copper (aluminum not permitted).

59 Size:

- 60 • All Power systems: 1/4" X 2", length as needed (24" minimum).
- 61 • Telecommunications Main Ground Busbar (TMGB): 1/4" x 4" x 20" long (minimum).
- 62 • Telecommunications Grounding Busbar (TGB): 1/4" x 2" x 12" long (minimum).

63 Busbars:

- 64 • 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.

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.

LESS THAN 600 VOLT ELECTRICAL SYSTEM GROUNDING

Supplementary Grounding Electrode: Use driven ground rod on exterior of 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.

1 Provide Telecommunications Bonding Conductor from Telecommunications Main Grounding Busbar (TMGB) at the
2 Communications Entrance Facility to building common grounding electrode system. Attach grounding conductor to
3 building steel as allowed only at the main electrical service entrance. Provide physical protection as required.
4

5 Provide Telecommunications Bonding Backbone (TBB) conductor from the TMGB to Telecommunications Grounding
6 Busbar (TGB) at each Telecommunication Room, Telecommunications Equipment Room and Telecommunications
7 Enclosure.
8

9 TBB shall be continuous and not connected through Telecommunications Grounding Busbars (TGBs).

10 Bond TGBs to TBB via tap off of TBB. Gauge of conductor to be same as TBB.

11 Leave 10 feet slack in conductor from TBB to TGB at TGB location(s).

12 Do not bond TBB or TGB to building steel at TGB location(s).

13 Provide Grounding Equalizer(s) (GE) per project drawings. Connect GE conductor directly to TGBs being
14 interconnected.
15

16
17
18
19
20 **FIELD QUALITY CONTROL**

21 Inspect grounding and bonding system conductors and connections for tightness and proper installation.
22

23 Testing of grounding system resistance is to be witnessed by the Construction Manager. Provide test report of
24 grounding system resistance in final O&M manuals and noted on record drawings.
25

26 Provide resistance test at each electrical and telecommunications Busbar to ground.
27

28 **IDENTIFICATION AND LABELING**

29 Label Grounds at point of termination.

30 Label for TBB connection at TMGB and TGB(s) shall be plastic and include the following:
31

32
33 IF THIS CONNECTOR OR CABLE IS
34 LOOSE OR MUST BE REMOVED,
35 PLEASE CALL THE BUILDING
36 TELECOMMUNICATIONS
37 MANAGER.
38

39 **CONSTRUCTION VERIFICATION**

40 Record locations of all electrical and telecommunications grounding electrodes, busbars and grounding conductors
41 as installed including recorded ground resistance test results.
42

43 **WARRANTY**

44 See Division 1, General Conditions, and General Requirements.
45

46 **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.

RELATED WORK

Applicable provisions of Division 1 govern work under this Section.
Section 26 05 53 – Identification for Electrical Systems

SUBMITTALS

Product Data: Provide data for support channel.

104 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.

1 Nylon anchors

2 Nylon anchors may only be used in limited applications with the pre-approval of the Construction Manager. See Part
3 3 – Execution for examples of applications of where nylon anchors may be allowed.

4
5 Nylon wall plugs shall be designed for 2-way expansion, providing rapid fixing with high pull-out values. Nylon wall
6 plugs shall be molded with protruding side fins which restrict rotation and prevent fall out from overhead holes.
7 Examples of these include Mungo types of MN or MU, or Fischer type S nylon plugs.

8
9 Nylon one-piece self-drilling anchors designed for use in hollow gypsum wallboard for light duty loads. Anchors shall
10 be engineered nylon or Zamac alloy. Examples of these are the Zip-It ® or Zip-It Jr. ® self-drilling anchors.

11
12 Manufacturer's names and catalog numbers are used for quality and performance only. Anchors manufactured by
13 others shall be equally acceptable provided they meet or exceed in performance and quality as specified.

14
15 Threaded Rod: Minimum sized threaded rod for supports shall be 3/8" for trapezes and single conduits 1-1/4" and
16 larger, and 1/4" for single conduits 1" and smaller.

17
18 Hardware: Corrosion resistant, or as noted for each product above.

19
20 **PART 3 - EXECUTION**

21
22 **INSTALLATION**

23 Fasten hanger rods, conduit clamps, and outlet-, junction-, and pull-boxes to building structure using pre-cast insert
24 system, preset inserts, beam clamps, or expansion anchors.

25
26 Use toggle bolts or hollow wall fasteners in hollow masonry, plaster, or gypsum board partitions and walls; expansion
27 anchors or preset inserts in solid masonry walls; self-drilling anchors or expansion anchors on concrete surfaces;
28 sheet metal screws in sheet metal studs and wood screws in wood construction. If nail-in anchors are used, they
29 must be removable type anchors.

30
31 Powder-actuated fasteners are not permitted.

32
33 Do not fasten supports to piping, ductwork, mechanical equipment, cable tray or conduit. Do not fasten to suspended
34 ceiling grid system.

35
36 Do not drill structural steel members unless approved by the Construction Manager.

37
38 In wet locations, mechanical rooms, and electrical rooms, install free-standing electrical equipment on 3.5-inch (89
39 mm) concrete pads.

40
41 Install surface-mounted cabinets and panelboards with a minimum of four anchors. At all cabinet and panelboard
42 locations on concrete or concrete block walls, and at ALL locations below grade, provide steel channel supports to
43 stand cabinet one inch (25 mm) off wall (7/8" Uni-strut or 3/4" painted fire-retardant plywood is acceptable). In above-
44 grade equipment rooms that have drywall walls, the cabinets and panelboards may be mounted to the drywall if
45 backing is provided in the stud walls behind the equipment.

46
47 Bridge studs top and bottom with channels to support flush-mounted cabinets and panelboards in stud walls.
48 Furnish and install all supports as required to fasten all electrical components required for the project, including free
49 standing supports required for those items remotely mounted from the building structure, catwalks, walkways etc.
50 Fabricate supports from galvanized structural steel or steel channel, rigidly welded or bolted to present a neat
51 appearance. Use hexagon head bolts with spring lock washers under all nuts.

52
53 Support Channel

54 Use one of the following types of support channel as appropriate for the installed environment:

55 Indoor: Epoxy Painted Steel, Hot-dipped Galvanized Steel, or as noted on the drawings.

56 Exterior and wet locations: Hot-dipped Galvanized Steel or Stainless Steel, as appropriate for the environment or as
57 noted on the drawings. Type 316 stainless steel shall be used for Food Service type environments. Epoxy painted
58 support channel shall not be used for exterior installations.

59
60 Manholes, steam pits, steam tunnels, or corrosive environments: Stainless Steel Type 316.

61 Field cuts: File and de-bur cut ends of support channel and paint to prevent rusting. For epoxy-painted support
62 channel, paint cut ends to match the original color. For hot-dipped galvanized support channel, spray cut ends with
63 cold galvanized paint.

1 Support Wires

2 Support wires that are installed in addition to the ceiling grid support wires to provide secure support for raceways,
3 cables assemblies, boxes, cabinets, and fittings shall be secured at both ends (e.g. the ceiling structure at the top
4 and the ceiling grid at the bottom) per NEC 300.11(A).

5
6 Compressed-air power-actuated fasteners may ONLY be used for the installation of separate ceiling wires required
7 for support of conduits and aircraft cable hung light fixtures.

8
9 Support wires shall be identified per specification section 26 05 53.

10
11 Spring Steel Clip Conduit Supports

12 Above suspended ceilings: Spring steel clips with snap-close clamps may be used to support conduit from bar joist
13 (steel truss) systems above suspended ceilings.

14
15 Stud wall applications: Spring steel clips with push-in or snap-close conduit clamps may be used to support conduit in
16 interior metal stud wall applications. Use screw fasteners to install conduit clamp onto stud.

17
18 Box/conduit hanger with rod/wire clip (a.k.a. antlers): These may only be used in limited applications with the pre-
19 approval of the Electrical Inspector.

20
21 Nylon anchor applications

22 Nylon anchors may only be used in limited light duty applications with the pre-approval of the Construction Manager.
23 Nylon anchors shall be designed for the construction material in which they are intended to be installed and shall be
24 designed for the weight in which the anchors are intended to support.

25
26 Nylon wall plug applications may include attaching 4" square boxes or conduit straps to plaster-covered clay tile,
27 drywall, or hollow concrete block. Screws used with nylon wall plugs shall be #10 minimum and shall be longer than
28 the anchor.

29
30 Nylon one-piece self-drilling anchor applications may include attaching 4" square boxes or conduit straps to hollow
31 gypsum wallboard for light duty loads. Use No. 8 screws with one-piece self-drilling anchors designed for 3/8" to 1"
32 thick wallboard. Use No. 6 screws with anchors designed for 3/8" to 5/8" wallboard.

33
34 **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.

RELATED WORK

Applicable provisions of Division 1 govern work under this section.
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 conduit covers must be fastened to the conduit body with screws and be of the same manufacture.
- C-condulets shall not be used in lieu of pull boxes.
- All boxes shall be of sufficient size to provide free space for all conductors enclosed in the box and shall comply with NEC requirements.

RIGID METAL CONDUIT (RMC) AND FITTINGS

- Conduit: Heavy wall threaded, galvanized steel, schedule 40.
- Fittings and Conduit Bodies: Use all steel threaded fittings and conduit bodies.
- Expansion Fittings/Expansion Joints: Expansion Fittings shall be Internal Grounding type and shall not rely on external bonding jumpers to maintain grounding continuity between raceway components.

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, threaded.

Fittings and Conduit Bodies: Use all Steel threaded fittings and conduit bodies.

Expansion Fittings/Expansion Joints: Expansion Fittings shall be Internal Grounding type and shall not rely on external bonding jumpers to maintain grounding continuity between raceway components.

1 **ELECTRICAL METALLIC TUBING (EMT) AND FITTINGS**

2 Conduit: Steel, Unthreaded thin wall galvanized tubing.
3 Fittings: All steel, compression or set screw type. No push-on or indenter types permitted.
4 Conduit Bodies: All steel conduit bodies.

5
6 **FLEXIBLE METAL CONDUIT (FMC) AND FITTINGS**

7 Conduit: steel, galvanized, spiral strip.
8 Fittings and Conduit Bodies: All steel, galvanized or malleable iron (except as allowed in specification 26 51 13).

9
10 **LIQUIDTIGHT FLEXIBLE METAL CONDUIT (LFMC) AND FITTINGS**

11 Conduit: flexible, steel, galvanized, spiral strip with an outer Liquidtight, nonmetallic, sunlight-resistant jacket.
12 Fittings and Conduit Bodies: ANSI/NEMA FB 1, compression type. There shall be a metallic cover/insert on the end of
13 the conduit inside the connector housing to seal the cut conduit end.

14
15 **ELECTRICAL NONMETALLIC TUBING (ENT) AND FITTINGS**

16 Conduit: ENT (smurf tube), UL listed, and NEC recognized.
17 Fittings: One piece quick connect fittings for 1/2 inch to 1 inch size and schedule 40 cemented fittings for larger size.
18 When installed in concrete, fittings shall be suitable for damp locations and shall be concrete-tight, stub-ups and stub-
19 downs kits shall meet manufacturer's recommendations.

20
21 **RIGID POLYVINYL CHLORIDE CONDUIT (PVC) AND FITTINGS**

22 Conduit: Rigid non-metallic conduit, Schedule 40 PVC minimum, Listed, sunlight resistant, rated for 90° C conductors.
23 Schedule 80 for locations exposed to physical damage or as required.
24 Fittings and Conduit Bodies: NEMA TC 2, Listed.

25
26 **FIBERGLASS RESIN CONDUIT (RTRC) AND FITTINGS:**

27 Conduit: Reinforced Thermosetting Resin Conduit RTRC, Type AG (Above Ground) and XW (Exposed), and UL 2515
28 AG (Above Ground) or UL 2420 BG (Below Ground) listed.

29
30 The conduit shall be free from defects including delamination's, foreign inclusions, etc. It shall be nominally uniform in
31 color, density, and physical properties. It shall be straight, and the ends shall be cut square to the inside diameter. The
32 resin system shall be epoxy anhydride-cured with no fillers. Glass shall be (E-type or E-CR).

33
34 Joining Methods: Interference Joint – the conduit shall be supplied with an integrally wound tapered bell and machine
35 tapered spigot which shall provide a concrete tight and watertight fit with a minimum pullout strength of 500 lbs. when
36 tested in accordance with ASTM D 2105

37 Fittings: A complete line of fittings, adaptors, and elbows shall be available and shall be manufactured from the same
38 materials and process as the conduit.

39 Sizes: Conduit and fittings shall be manufactured to IPS and ID trade sizes.

40 Flammability: Conduit and fittings shall conform with UL 2515.

41 Hangers and Supports: When supporting or hanging conduit on a wall or structure, the manufacturer supplying the
42 conduit shall also supply the hangers and supports. Third party materials shall not be allowed.

43 Thermal:

44
45 Conduit and fittings shall conform with the following:

46 Heat Deflection Temperature: 312° F per ASTM D 648
47 Continuous Operating Temperature -40° to 250° F (-40° C to 110° C)
48 Maximum Operating Temperature -60° to 260° F (-60° to 130° F)
49 Coefficient of Thermal Expansion 1.25 x 10⁻⁵ in/in/F per ASTM D 696

50
51 Impact Resistance: Conduit and fittings shall conform with minimum impact resistances as required by UL 2515.

52 Compression Resistance: Conduit shall not decrease by more than 25% during testing set forth in UL 2515.

53 Pipe Stiffness: Conduit stiffness shall meet or exceed the standards set forth in ASTM D2412.

54
55 **HIGH DENSITY POLYETHYLENE CONDUIT (HDPE) AND FITTINGS**

56 Conduit: Schedule 80; Continuous length smooth-wall HDPE conduit for electrical applications produced to ASTM
57 F2160. Conduit shall be listed by a Nationally Recognized Testing Laboratory (NRTL) to UL Standard 651-A for
58 smooth-wall duct to be used as electrical conduit for the installation of Listed electrical cables underground.

59
60 The recommended HDPE color for power conduits are black or black with red stripes. Red identifies the conduit as
61 electrical and black provides UV protection for storage and at points where the conduit may exit the ground.

62 The HDPE color for communications conduit shall be orange. Both communications and power HDPE conduits shall
63 be listed by a NRTL per NEC 353.6 and marked per NEC 353.120.

1 Fittings: Threaded Mechanical Fittings: Aluminum reverse-threaded conduit couplers designed for use with HDPE
2 conduit. Compression Fittings and Socket Couplings designed for use with HDPE conduit may also be used.
3

4 **CONDUIT SUPPORTS**

5 See section 26 05 29.
6

7 **CONDUIT WATER SEALANT**

8 Description: Conduit sealant used to prevent water from entering buildings via conduits.
9

10 Sealant shall seal conduits against water and gas intrusion, such as Polywater® FST™-250 Foam Duct Sealant,
11 Raychem RDSS Rayplate Duct Sealing System, or approved alternate. Sealant shall be re-enterable, shall be
12 compatible with the conduit and conductor types being used, and shall comply with NEC 225.27, 230.8, and 300.5(G).
13 Manufacturer names and catalog numbers are used to develop quality and performance requirements only. Products
14 manufactured by others may be acceptable provided they meet or exceed the specifications.
15

16 **PULL AND JUNCTION BOXES**

17 Interior Sheet Metal Boxes: code gauge galvanized steel, screw covers, flanged and spot-welded joints and corners.
18 Interior Sheet Metal Boxes larger than 12 inches (300 mm) in any dimension shall have a hinged cover or a chain
19 installed between box and cover. Boxes 9 square-feet or larger shall have hinged covers and a single cover shall not
20 exceed 10 square-feet.
21

22 Interior Sheet Metal Boxes connected to an exterior underground raceway, shall have a drain fitting located in the
23 bottom.
24

25 Exterior Boxes and Wet Location Installations: Type 4 and Type 6, flat-flanged, surface-mounted junction box, UL listed
26 as rain tight. Galvanized cast iron, Aluminum, or PVC box and cover with ground flange, neoprene gasket, and
27 stainless-steel cover screws.
28

29 Box extensions and adjacent boxes within 48 inches of each other are not allowed for the purpose of creating more
30 wire capacity.
31

32 Junction boxes 6 inch-by-6 inch or larger size shall be without stamped knockouts.
33 Wireways shall not be used in lieu of junction boxes.
34

35 **IN GRADE HANDHOLES AND BOXES**

- 36 • Handholes and Boxes: Fiberglass, HDPE (High Density Polyethylene), or Polymer- Concrete.
- 37 • Handhole and Box Covers: Fiberglass, HDPE (High Density Polyethylene), or Polymer- Concrete.
- 38 • Handhole and box bottoms: Closed.
- 39 • Handholes and boxes for use in underground systems shall be designed and identified as defined in NFPA
40 70, for intended location and application.
- 41 • Handholes and covers shall be listed for the structural load at the identified installation location.
- 42 • Covers: Weatherproof, secured by tamper-resistant locking devices with non-skid finish and labeled
43 "ELECTRIC", "SIGNAL", "CATV" OR "TELEPHONE" dependent on system served.
- 44 • Units shall be designed to prevent frost heaving.
45

46 **OUTLET BOXES**

47 Sheet Metal Outlet Boxes: galvanized steel, with stamped knockouts.

48 Luminaire and Equipment Supporting Boxes: Rated for weight of equipment supported; include 3/8 inch male fixture
49 studs where required.

50 Concrete Ceiling Boxes: Concrete type.

51 Cast Boxes: Cast ferroalloy or aluminum, deep type, gasketed cover, threaded hubs.
52

53 **OUTLET BOX EXTENDERS**

54 Outlet Box Extenders: Non-Metallic, adjustable depth.
55

56 Outlet Box Extenders may only be used in limited applications with the pre-approval of the Electrical Inspector. See
57 Part 3 – Execution for examples of applications of where Outlet Box Extenders may be allowed.
58

59 **FLOOR BOXES**

60 Floor Boxes for Installation in Cast-In-Place Concrete Floors: Fully adjustable, cast iron or formed steel, or as indicated
61 on drawings. Provide boxes with sufficient capacity to house the devices indicated on the plans.

62 Type: Flush or Concealed service as indicated on drawings.
63

1 Floor Box Cover: Solid Aluminum with Brushed Finish, Solid Brass with Brushed Finish, Powder coat painted
2 aluminum, or Polycarbonate. Color to be selected by Architect or as indicated on drawings. Floor plates shall meet
3 and exceed UL scrub water exclusion requirements for concrete, tile, carpet, and wood covered floors.
4 Device Plate: Stainless steel or as available from manufacturer.
5 Configuration: As indicated on drawings.
6

7 **POKE-THROUGH ASSEMBLIES**

- 8 • Description: Assembly comprising of service fitting, poke-through component, fire stops and smoke barriers,
9 and junction box for conduit termination.
- 10 • Fire Rating: Two-hour rated or rated to match existing floor.
- 11 • Type: Pedestal, Flush, or Concealed Service, as indicated on drawings.
- 12 • Floor Plate: Solid Aluminum with Brushed Finish, Solid Brass with Brushed Finish, Powder coat painted
13 aluminum, or Polycarbonate. Color to be selected by Architect or as indicated on drawings. Floor plates shall
14 meet and exceed UL scrub water exclusion requirements for concrete, tile, carpet, and wood covered floors.
- 15 • Device Plate: Stainless steel or as available from manufacturer.
- 16 • Configuration: As indicated on drawings.

17 **2.20 BOXES FOR AUDIO-VIDEO EQUIPMENT**

18 Provide floor, wall, and/or ceiling boxes for Audio-Video (AV) Equipment as indicated on the Electrical and/or Audio-
19 Video drawings.
20

21 **FLAT SCREEN MONITOR BOXES**

22 Provide a recessed wall box for mounting behind flat screen monitors, allowing the screens to sit flush against the wall.
23 These boxes shall provide a neat and secure environment for the audio, video, control, and power connections.
24

25
26 The recessed wall box shall install easily between any two standard studs in the wall. Connections and cable entry can
27 be on the top or the bottom depending on installation preference.
28

29 The recessed wall box shall be provided with one low-voltage conduit entry box and Nationally Recognized Testing
30 Laboratory (NRTL) listed single gang box for AC power.
31

32 The recessed wall box cover shall be provided in white or black and shall be suitable for painting. The cover shall have
33 a cable exit slot for the display connections and the excess cable can easily be hidden inside of the box making the
34 entire installation as clean as possible. The cover screws onto the front of the box once all connections are in place.
35

36 The recessed wall box shall be designed for new or existing construction. Brackets shall be included for mounting to
37 studs in new construction as well as surface mount clips for mounting to sheet rock or plywood in existing construction.
38

39 **BOXES FOR FIRE ALARM AUDIO-VISUAL NOTIFICATION APPLIANCES**

40 Recessed boxes for Fire Alarm audio, visual, and audio-visual notification appliances shall be galvanized steel sheet
41 metal with stamped knockouts. Boxes shall be painted red.
42

43 For surface mounting, use manufacturer supplied back boxes and trim plates, painted red or off white to match device
44 color, and shall contain no visible conduit knockouts. Mark each device with its circuit number.
45

46 **PART 3 - EXECUTION**

47 **CONDUIT SIZING, ARRANGEMENT, AND SUPPORT**

48 EMT is permitted to be used in sizes 4 inch (100 mm) and smaller for power and low-voltage systems. See CONDUIT
49 INSTALLATION SCHEDULE below for other limitations for EMT and other types of conduits.
50

51 Size power conductor raceways for conductor type installed. Conduit size shall be 1/2-inch (16 mm) minimum except
52 all homerun conduits shall be 3/4 inch (21 mm), or as specified elsewhere. Caution: Per the NEC, the allowable
53 conductor ampacity is reduced when more than three current-carrying conductors are installed in a raceway. Contractor
54 must take the NEC ampacity adjustment factors into account when sizing the raceway and wiring system.
55

56
57 Size communications and other low-voltage systems raceways as follows:
58

- 59 • Communications, including Outlet Box: 1 1/4 inch minimum. Conduit used for single device locations (e.g.,
60 Wireless Access Point, Video Surveillance Camera, and Wall mounted telephone) may be 3/4 inch minimum.
- 61 • Control, security, signal, video, and other low-voltage applications: 3/4 inch minimum.
- 62 • Fire Alarm: 1/2 inch minimum.
- 63 • Floor Box and Poke-Through Assemblies:
- 64 • Power: 3/4 inch minimum or as indicated on drawings.

- 1 • Low voltage: 1 inch minimum or as indicated on drawings.
- 2 • Provide one raceway from each communications outlet box to above accessible ceiling or to cable tray (when
- 3 cable tray is used).
- 4 • Arrange conduit to maintain 6'-8" clear headroom and present a neat appearance.
- 5 • Route exposed conduit and conduit above accessible ceilings parallel and perpendicular to walls and adjacent
- 6 piping.
- 7 • Maintain minimum 6 inch (150 mm) clearance between conduit and piping. Maintain 12 inch (300 mm)
- 8 clearance between conduit and heat sources such as flues, steam pipes, and heating appliances.
- 9 • Arrange conduit supports to prevent distortion of alignment by wire pulling operations. Fasten conduit using
- 10 galvanized pipe straps, conduit racks (lay-in adjustable hangers), clevis hangers, or bolted split stamped
- 11 galvanized hangers.
- 12 • Group conduit in parallel runs where practical and use conduit rack (lay-in adjustable hangers) constructed of
- 13 steel channel with conduit straps or clamps. Provide space for 25 percent additional conduit.
- 14 • Do not fasten conduit with wire or perforated pipe straps. Before conductors are pulled, remove all wire used
- 15 for temporary conduit support during construction.
- 16 • Support and fasten metal conduit at a maximum of 8 feet (2.4 m) on center.
- 17 • Supports shall be independent of the installations of other trades, e.g. ceiling support wires, HVAC pipes,
- 18 other conduits, etc., unless so approved or detailed.
- 19 • Conceal all conduits except where noted on the drawings or approved by the Architect/Engineer. Contractor
- 20 shall verify with Architect/Engineer all surface conduit installations except in mechanical rooms.
- 21 • Changes in direction shall be made with symmetrical bends, cast steel boxes, stamped metal boxes or cast
- 22 steel conduit bodies.
- 23 • For indoor conduits, no continuous conduit run shall exceed 100 feet (30 meters) without a junction box.
- 24 • All conduits installed in exposed areas shall be installed with a box offset before entering box.
- 25

26 CONDUIT INSTALLATION

- 27 • Cut conduit square; de-burr cut ends.
- 28 • Conduit shall not be fastened to the corrugated metal roof deck.
- 29 • Bring conduit to the shoulder of fittings and couplings and fasten securely.
- 30 • Use conduit hubs for fastening conduit to cast boxes. Use sealing locknuts or conduit hubs for fastening
- 31 conduit to sheet metal boxes in damp or wet locations.
- 32 • Threads to be coated with approved electrically conductive corrosion compound per NEC 300.6. Coating to
- 33 be listed for installed environment, i.e., food service.
- 34 • Terminate all conduit (except for terminations into conduit bodies) using conduit hubs, or connectors with one
- 35 locknut, or utilize double locknuts (one each side of box wall).
- 36 • Provide bushings for the ends of all conduits not terminated in box walls. Refer to Section 26 05 26 –
- 37 Grounding and Bonding for Electrical Systems for grounding bushing requirements.
- 38 • Provide insulated bushings where raceways contain 4 AWG or larger conductors.
- 39 • Communication and Low Voltage systems conduits shall terminate in horizontal plane.
- 40 • Install no more than the equivalent of:
- 41 • Three 90-degree bends between boxes for electrical systems.
- 42 • Two 90-degree bends between boxes for communications and other low voltage systems. Note: Offsets shall
- 43 be considered 90 degrees.
- 44 • No single bend may exceed 90 degrees.
- 45 • Use hydraulic one-shot conduit bender or factory elbows for bends in conduit larger than 2-inch (50 mm) size
- 46 unless sweep elbows are required.
- 47 • Bend conduit according to manufacturer's recommendations. Torches or open flame shall not be used to aid
- 48 in bending of PVC conduit.
- 49 • Use suitable conduit caps or other approved seals to protect installed conduit against entrance of dirt and
- 50 moisture.
- 51 • Provide 1/8-inch (3 mm) nylon pull string in empty conduit, except sleeves and nipples.
- 52 • Install listed expansion-deflection fitting or other approved means shall be used where a raceway crosses a
- 53 structural joint for expansion, contraction or deflection, used in buildings, bridges, parking garages or other
- 54 structures.
- 55 • Install expansion joints where direct-buried conduit is subject to Earth Movement by settlement or frost per
- 56 NEC 300.5(J), especially where conduit exits the ground exposed and enters a box, cabinet, or enclosure
- 57 attached to a building or structure.
- 58 • Install expansion fitting in exterior PVC conduit runs per NEC table 352.44 utilizing a minimum temperature
- 59 change of 120-degree F.
- 60 • Avoid moisture traps where possible. Where moisture traps are unavoidable, provide junction boxes with drain
- 61 fittings at conduit low points.
- 62 • Where conduit passes between areas of differing temperatures such as into or out of cool rooms, freezers,
- 63 unheated and heated spaces, buildings, etc., provide conduit or box with duct seal or other means to prevent
- 64 the passage of moisture and water vapor through the conduit.

- 1 • Route conduit through roof openings for piping and ductwork where possible.
- 2 • Where communication cabling is to be installed in conduit to the wiring hub (e.g. Telecom Room), multiple
- 3 conduits may be consolidated into fewer, larger conduits. Capacity of shared conduits shall equal the capacity
- 4 of the individual conduits unless otherwise noted.
- 5 • Use NRTL listed metallic grounding clamps when terminating conduit to cable tray.
- 6 • Ground and bond conduit under provisions of Section 26 05 26.
- 7 • Conduit is not permitted in any slab topping of two inches (50 mm) or less.
- 8 • Conduits in Concrete Slab Above Grade: Provide proposed conduit routing and sizing to Structural Engineer
- 9 for approval prior to installation to verify structural integrity and fire rating of concrete slab.
- 10 • Maximum Size Conduit in Concrete Slabs Above Grade: 1 inch (25 mm). Do not route conduits to cross each
- 11 other in slabs above grade. Minimum conduit spacing shall be 6 inches on center.
- 12 • PVC conduit in concrete pole bases shall transition to galvanized rigid metal conduit 12 inches before it enters
- 13 a concrete pole base. Inside the pole base, the elbow shall be galvanized rigid metal conduit. From the elbow,
- 14 the conduit shall transition back to PVC as it continues up and out the top of the concrete pole base.
- 15 • PVC conduit shall transition to galvanized rigid metal conduit before it enters a foundation wall or up through
- 16 a concrete floor.
- 17 • Identify conduit under provisions of Section 26 05 53.
- 18 • All conduit installed underground (exterior to building) shall be buried a minimum of 24 inches below finished
- 19 grade, whether or not the conduit is concrete encased. Install warning tape 12" below finish grade over all
- 20 buried conduits. Underground warning tape shall be detectable, 2" wide minimum, 5 mil thickness, containing
- 21 a foil core. Tape color shall be red and labeled with the words "CAUTION-BURIED ELECTRIC LINE BELOW"
- 22 as manufactured by Presco or similar.
- 23 • Conduits penetrating underground foundation walls: Individual conduits or each conduit as part of a ductbank
- 24 penetrating underground foundation walls (excluding manholes) shall be sealed against water intrusion into
- 25 the building.
- 26 • Clean PVC conduit with solvent, and dry before application of glue. The temperature rating of glue/cement
- 27 shall match weather conditions. Apply full even coat of cement/glue to entire area that will be inserted into
- 28 fitting. The entire installation shall meet manufacturer's recommendations.
- 29

30 CONDUIT INSTALLATION SCHEDULE

- 31 • Conduit other than that specified below for specific applications shall not be used.
- 32 • Horizontal Directional Drilling (Directional Boring) Installations: HDPE conduit.
- 33 • Underground Installations That Penetrate Foundation Walls: Rigid metal conduit within five feet (1.5 m) of the
- 34 foundation wall. Conduit may transition to Fiberglass Resin Conduit (BG) or PVC conduit five feet (1.5 m) from
- 35 the foundation walls.
- 36 • Underground Installations That Do Not Penetrate Foundation Walls: Rigid metal conduit, Fiberglass Resin
- 37 Conduit (BG), or PVC conduit.
- 38 • Underground Installations Emerging from Grade: Buried conduit emerging from grade shall be Rigid metal
- 39 conduit extending from the minimum cover distance of 24 inches below grade to the conduit termination point
- 40 above grade. Refer to owner detail.
- 41 • Underground Installations Under Concrete Slab: Rigid metal conduit or Schedule 40 PVC conduit.
- 42 • Underground Installations Emerging through Concrete Slab: Rigid metal conduit.
- 43 • Concealed in Poured Concrete Walls: Rigid Metal Conduit, PVC conduit, or Electrical Nonmetallic Tubing
- 44 (ENT).
- 45 • Concealed in Concrete Block Walls: Electrical metallic tubing, PVC conduit. Electrical Nonmetallic Tubing
- 46 (ENT).
- 47 • Within Concrete Slab: Rigid Metal conduit or PVC conduit.
- 48 • Emerging from Within Concrete Slab: Rigid Metal conduit.
- 49 • Exposed Outdoor Locations: Rigid Metal conduit, Intermediate Metal conduit.
- 50 • Wet Interior Locations: Exposed: [Rigid metal conduit] [Schedule 80 PVC conduit] [PVC coated Rigid metal
- 51 conduit] [Fiberglass Resin Conduit (XW)].
- 52 • Concealed Dry Interior Locations: Rigid metal conduit, Intermediate metal conduit, Electrical metallic tubing,
- 53 PVC conduit (Ground conductor).
- 54 • Interior Building Grounding Electrode Conductor: Schedule 80 PVC.
- 55 • Exposed Dry Interior Locations: Rigid metal conduit, Intermediate metal conduit, Electrical metallic tubing.
- 56 • Motor and equipment connections: Liquidtight flexible metal conduit (LFMC) in all locations except in
- 57 Mechanical equipment plenum spaces where Flexible Metal Conduit (FMC) shall be utilized. Minimum length
- 58 shall be one foot (300 mm); maximum length shall be three feet (900 mm). Conduit must be installed
- 59 perpendicular to direction of equipment vibration to allow conduit to freely flex.
- 60 • Exposed Dry Interior Locations for HVAC control devices with Conduit Connections: Electrical metallic tubing,
- 61 Flexible Metal Conduit (FMC). For FMC installations, Minimum length shall be one foot (300 mm), Maximum
- 62 length shall be three feet (900 mm). Minimum size FMC of 3/8".
- 63 • Exposed Dry Interior Locations for HVAC control devices without Conduit Connections: Where HVAC
- 64 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.

1 **COORDINATION OF BOX LOCATIONS**

2 Provide electrical boxes as shown on Drawings, and as required for splices, taps, wire pulling, equipment connections,
3 and code compliance.

4
5 Electrical box locations shown on Contract Drawings are approximate unless dimensioned. Verify location of floor boxes
6 and outlets in offices and work areas prior to rough-in.

7
8 No outlet, junction, or pull boxes shall be located where it will be obstructed by other equipment, piping, lockers,
9 benches, counters, etc.

10
11 Conduit and boxes shall not be fastened to the metal roof deck. If conduit and boxes are required to be located and
12 installed on roof decks, the conduit and boxes are required to be spaced minimum 1-5/8 inch off the lowest part of the
13 metal roof decking material, per NEC 300.4 (E).

14
15 It shall be the Contractor's responsibility to study drawings pertaining to other trades, to discuss location of outlets with
16 workmen installing other piping and equipment and to fit all electrical outlets to job conditions.

17
18 In case of any question or argument over the location of an outlet, the Contractor shall refer the matter to the
19 Architect/Engineer and install outlet as instructed by the Architect/Engineer.

20
21 The proper location of each outlet is considered a part of this contract and no additional compensation will be paid to
22 the Contractor for moving outlets which were improperly located.

23
24 Locate and install boxes to allow access to them. Where installation is inaccessible, coordinate locations and provide
25 18 inch (450 mm) by 24 inch (600 mm) access doors. Boxes must be installed within 12" from edge of the access door.
26 Locate and install to maintain headroom and to present a neat appearance.

27
28 Install boxes to preserve fire resistance rating of partitions and other elements, using approved materials and methods.
29 Boxes installed in the building envelop shall be sealed with caulking materials or closed with gasketing systems
30 compatible with the construction materials and locations per IEC 502.4.3.

31
32 **PULL AND JUNCTION BOX INSTALLATION**

33 Pull boxes and junction boxes shall be minimum 4 inches square (100 mm) by 2 1/8 inches (54 mm) deep for use with
34 1 inch (25 mm) conduit and smaller. On conduit systems using 1 1/4-inch (31.75 mm) conduit, minimum junction box
35 size shall be 4 11/16 inches square by 2 1/8 inches deep.

36
37 Where used with raceway(s) containing conductors of 4 AWG or larger, pull box shall be sized as required unless
38 otherwise noted on the drawings.

39
40 Where used with raceway(s) containing conductors on systems over 600V, size pull box per NEC 314 Part IV unless
41 otherwise noted as larger on the drawings.

42
43 Size pull boxes for communications per ANSI/TIA-568-C

44
45 Locate pull boxes and junction boxes above accessible ceilings, in unfinished areas or furnish and install -approved
46 access panels in non-accessible ceilings where boxes are installed. All boxes are to be readily accessible.

47
48 Provide Pull and Junction boxes for communications and other low voltage applications (a) in any section of conduit
49 longer than 100 feet, (b) where there are bends totaling more than 180 degrees between pull points or pull boxes and
50 (c) wherever there is a reverse bend in run. Locate boxes on straight section of raceway (e.g., do not use boxes in
51 place of raceway bends).

52
53 Support pull and junction boxes independent of conduit.

54
55 **GRADE HANDHOLES AND BOXES**

56 Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to
57 minimize bends and deflections required for proper entrances.

58
59 Unless otherwise indicated and detailed, support units on a level bed of crushed stone or gravel, graded from 1/2-
60 inch (12.5 mm) sieve to No. 4 (4.25 mm) sieve and compacted to same density as adjacent undisturbed earth.
61 Elevation: In finished areas, set so cover surface will be flush with finished grade.

1 Unless approved by the Construction Manager, handholes and boxes shall NOT be installed in paved or concrete
2 drives or walks.

3
4 Units shall be selected with depth sufficient to allow for conductor bending/ wire management and allow sufficient
5 conduit elevation above compacted bed to prevent water infiltration in conduit.

6
7 Provide conduit sealant to seal conduits against water and gas intrusion, such as Polywater® FST™-250 Foam Duct
8 Sealant, Raychem RDSS Rayplate Duct Sealing System, or approved alternate. Sealant shall be re-enterable, shall be
9 compatible with the conduit and conductor types being used, and shall comply with NEC 225.27, 230.8, and 300.5(G).

10 **OUTLET BOX INSTALLATION**

11 Do not install boxes back-to-back in walls. Provide minimum 6-inch (150 mm) separation, except provide minimum 24-
12 inch (600 mm) separation in acoustic-rated walls.

13 **Power:**

- 14 • Recessed (1/4 inch maximum) outlet boxes in masonry, concrete, tile construction, or drywall shall be
15 minimum 4-inch square, with device rings. Device covers shall be square cut except rounded corner plaster
16 rings are allowed in drywall applications. Angle cut plaster rings are not permitted. Coordinate masonry cutting
17 to achieve neat openings for boxes. A single gang box can be used in drywall and masonry, for a single device
18 location, when a single conduit enters box.
- 19 • Shallow 4-inch square by 1 1/2-inch-deep boxes can be used as device boxes for power provided the box and
20 plaster ring is sized for installed device and conductors.

21 **Low Voltage:**

- 22 • Recessed (1/4 inch maximum) outlet boxes in masonry, concrete, tile construction or drywall shall be minimum
23 4 11/16-inch square by 2 1/8 inch deep with single gang device ring (unless noted otherwise on drawings).
24 Device covers shall be square cut except rounded corner plaster rings are allowed in drywall applications.
25 Angle cut plaster rings are not permitted. Coordinate masonry cutting to achieve neat openings for boxes.
- 26 • Provide one conduit from each communications outlet box. Conduit runs between outlet boxes for
27 communications are not allowed. Terminate conduit above accessible ceiling or on cable tray (when cable
28 tray is used).
- 29 • Provide knockout closures for unused openings.
- 30 • Support boxes independently of conduit except for cast boxes that are connected to two rigid metal conduits,
31 both supported within 12 inches (300 mm) of box.
- 32 • Use multiple-gang boxes where more than one device are mounted together; do not use sectional boxes.
33 Sectional boxes may only be used with the pre-approval from the Construction Manager for remodeling
34 applications where it is impractical to install multi-gang boxes. Provide non-metallic barriers to separate wiring
35 of different voltage systems.
- 36 • Install boxes in walls without damaging wall insulation.
- 37 • Coordinate mounting heights and locations of outlets mounted above counters, benches, and backsplashes.
- 38 • Ceiling outlets shall be 4-inch square, minimum 2 1/8 inch (54 mm) deep except that concrete boxes and
39 plates will be approved where applicable. Position outlets to locate luminaires as shown on reflected ceiling
40 plans.
- 41 • In inaccessible ceiling areas, position outlets and junction boxes within 6 inches (150 mm) of recessed
42 luminaire, to be accessible through luminaire ceiling opening.
- 43 • Provide recessed outlet boxes in finished areas; secure boxes to interior wall and partition studs, accurately
44 positioning to allow for surface finish thickness. Use stamped steel stud bridges for flush outlets in hollow stud
45 wall, and adjustable steel channel fasteners for flush ceiling outlet boxes.
- 46 • Align wall-mounted outlet boxes for switches, thermostats, and similar devices.
- 47 • Provide cast ferrous or aluminum outlet boxes in exterior and wet locations.
- 48 • Surface wall outlets shall be 4 inch (100 mm) square with raised covers for one and two gang requirements.
49 For three gang or larger requirements, use gang boxes with non-overlapping covers.

50 **Outlet Box Extender applications:**

- 51 • Outlet Box Extenders may only be used in limited applications with the pre-approval from the Construction
52 Manager.
- 53 • Provide box extenders for boxes that are set too far back in the wall due to un-anticipated wall finishes. Outlet
54 Box Extenders will NOT be allowed for installations where the EC has not accommodated for wall finishes that
55 were expected prior to installation. Place the box extender over the existing box face to make the box face
56 flush with the wall finish.

57 **FLOOR BOX INSTALLATION**

58 Set boxes level and flush with finish flooring material.

59 Floor boxes for communications shall each be served by conduit(s) dedicated to that box. Conduit runs between floor
60 boxes for communications are not allowed. Conduit shall be part of path that allows for cable to be terminated at wiring
61 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 dB μ	20 Hz to 20 kHz
B	Line level AV circuits, Communication Circuits (Intercom)	-30 dB μ to +24 dB μ	20 Hz to 20 kHz
C	Speaker level AV circuits, including low- and high-impedance types (70V)	Greater than +24 dB μ	20 Hz to 20 kHz
D	Control Circuits Data Circuits	0-28 volt into <50k ohm 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.

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.

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

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 each service disconnect indicating "Service Disconnect", per NEC 230.70(B).

1
2 **BOX IDENTIFICATION**

3 The following junction and pull boxes shall be identified utilizing spray painted covers:

4
5

<u>System</u>	<u>Color(s)</u>
6 Secondary Power – 208Y/120V, 240/120V	White
7 Fire Alarm (see below)	Red
8 Temperature Control	Green
9 Door Access Control	Orange
10 Sound and Intercom Systems	Gray
11 Video Surveillance System	Yellow
12 Communications	Blue

13

14 All boxes with power wiring shall be further identified with circuit numbers and source panel designation as follows:

- 15 • All outlet and device boxes shall use machine-generated adhesive labels, or neatly hand-written permanent marker.
- 16 • 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.
- 17 • All junction and pull boxes located above an accessible ceiling shall utilize machine-generated adhesive labels, or neatly hand-written permanent marker.

18 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.
19 Non-factory device boxes shall also be painted red.

20
21
22 Other system boxes shall be further identified as shown on drawing details or approved shop drawings.

23
24
25
26
27 **COMMUNICATIONS CONDUIT LABELING**

28 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.

29
30
31 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.

32
33
34
35 **POWER, CONTROL AND SIGNALING WIRE IDENTIFICATION**

36 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.

37
38
39 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.

40
41
42
43 **WIRING DEVICE IDENTIFICATION**

44 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.

45
46
47
48
49 **SUPPORT WIRE IDENTIFICATION**

50 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.

51
52
53
54
55 **NAMEPLATE ENGRAVING FOR ELECTRICAL EQUIPMENT**

- 56 • Provide nameplates of minimum letter height as scheduled below.
 - 57 • 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. Both panels in a double tub application shall be labeled.
 - 58 • 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.
 - 59 • Individual Circuit Breakers, Disconnect Switches, Enclosed Switches, and Motor Starters: ½ inch (13 mm); identify source and load served.
- 60
61
62
63
64

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30 NOVEMBER 2022

- 1 **PANELBOARD DIRECTORIES**
- 2 Typed directories for panelboards shall be covered with clear plastic and have a metal frame. Room number on
- 3 directories shall be Owner's numbers, not Plan numbers unless Owner so specifies.
- 4
- 5

END OF SECTION

**SECTION 26 27 02
EQUIPMENT WIRING SYSTEMS**

PART 1 - GENERAL

SCOPE

The work under this section includes electrical connections to equipment specified under other Divisions and/or Sections, or furnished by Owner, including, but not limited to:

- Misc. Equipment
- HVAC and Plumbing motors, VFDs, and panels
- Elevators

RELATED WORK

Applicable provisions of Division 1 govern work under this Section.

- Section 26 05 19 – Low-Voltage Electrical Power Conductors and Cables
- Section 26 05 33 – Raceway and Boxes for Electrical Systems
- Section 26 27 29 - Elevator Distribution Equipment

SUBMITTALS

Product Data: Provide data for cord and wiring devices.

COORDINATION

Coordinate all equipment requirements with the various contractors and the Owner. Review the complete set of drawings and specifications to determine the extent of wiring, starters, devices, etc., required.

PART 2 - PRODUCTS

CORDS AND CAPS

- Straight-blade Attachment Plug: NEMA WD 1.
- Locking-blade Attachment Plug: NEMA WD 5.
- Attachment Plug Configuration: Match receptacle configuration at outlet provided for equipment.
- Cord Construction: Oil-resistant thermoset insulated multi-conductor flexible cord with identified equipment grounding conductor, suitable for hard usage in damp locations.
- Cord Size: Suitable for connected load of equipment and rating of branch circuit overcurrent protection.

OTHER PRODUCTS

Refer to related sections for other product requirements.

PART 3 - EXECUTION

INSPECTION

Verify that equipment is ready for electrical connection, wiring, and energizing.

PREPARATION

Review equipment submittals prior to installation and electrical rough-in. Verify location, size, and type of connections. Coordinate details of equipment connections with supplier and installer.

INSTALLATION

- Use wire and cable with insulation suitable for temperatures encountered in heat-producing equipment.
- Provide a green equipment ground conductor for all installed equipment wiring.
- Make conduit connections to equipment using flexible PVC-coated metal conduit.
- Requirements of NEC Article 300.22 shall apply for boxes, conduit, conduit connections to equipment, devices and fixtures located in Mechanical Plenum spaces.
- Install pre-finished cord set where connection with attachment plug is indicated or specified, or use attachment plug with suitable strain-relief clamps.
- Provide suitable strain-relief clamps for cord connections to outlet boxes and equipment connection boxes.
- Make wiring connections in control panel or in wiring compartment of pre-wired equipment in accordance with manufacturer's instructions. Provide interconnecting wiring where indicated.
- Install disconnect switches, controllers, control stations, and control devices such as limit switches and temperature switches as indicated. Connect with conduit and wiring as indicated.

MISCELLANEOUS CONNECTIONS

Hand Dryers: Provide handle lock on source circuit breaker to serve as required lock open disconnect.

1 Drinking Fountains and Bottle Fill Fountains: Provide GFCI source circuit breaker to serve receptacle at fountain.
2

3 **HVAC AND PLUMBING CONNECTIONS**

- 4 • Provide all power wiring including all circuitry carrying electrical energy from panelboard or other source
5 through starters, variable frequency drives (VFDs), and disconnects to motors or to packaged control panels.
6 Packaged control panels may include disconnects and starters and overcurrent protection. Provide all wiring
7 between packaged control panels and motors.
8 • Contractor shall verify with mechanical contractor the electrical requirements including voltages, horsepower,
9 disconnecting means, starters and variable frequency drives for motors and equipment prior to ordering circuit
10 breakers, disconnects and starters.
11 • VFD Installations: Install VFD input wiring and output wiring in separate conduit systems. Do not mix VFD
12 input power and output power, or control wiring in a common raceway.
13 • Provide 120 volts to each temperature control panel. Coordinate quantity and exact locations with HVAC/DDC
14 contractors.
15 • Unless otherwise specified, all electrical control devices such as aqua-stats, float and pressure switches, fan
16 powered VAV boxes, switches, electro-pneumatic switches, solenoid valves and damper motors requiring
17 mechanical connections shall be furnished and installed and wired by the Contractor supplying the devices.
18 • Provide 120V, single phase 15 ampere circuit and switching means to serve factory installed interior lighting
19 within each HVAC unit.
20 • Each motor terminal box shall be connected with a minimum 12", maximum 36" piece of flexible PVC-coated
21 metal conduit to a fixed junction box. When connections are located in Mechanical Plenum spaces located
22 within Mechanical equipment, flexible metal conduit shall be utilized. Conduit must be installed perpendicular
23 to direction of equipment vibration to allow conduit to freely flex.
24 • Provide local disconnect within each walk-in HVAC units to serve as line-of-site local motor disconnect.
25 Disconnect enclosure shall be NEMA 4X stainless steel.
26 • Check for proper rotation of each motor.
27 • All heating, air conditioning and refrigeration equipment installed on the exterior of the building or rooftop shall
28 have a 120V, single phase, 20 ampere rated outlet at an accessible location within 25 feet of the equipment.
29

30 **ELEVATOR CONNECTIONS**

31 Disconnect Switch (Power Module) - Fused Elevator Shunt Trip

- 32 • Description: Provide shunt-trip fused disconnect switch with necessary relay(s), control transformer and other
33 options, as required per specification Section 26 27 29.

34 Connections

- 35 • Provide all power wiring from source through disconnect to elevator controller to motor.
36 • Provide all ground connections and wiring from building ground bus to elevator controller sized per NEC 250.
37

38 Provide single means of disconnect; manual starter, enclosed circuit breaker or disconnect, labeled "elevator cab lights"
39 located in equipment room Per NEC 620.22. The means of disconnect shall be capable of being locked in the open
40 position. Extend 120 volt circuit from source through lockable switch to controller. Provide one lockable switch and
41 120 volt circuit per unit. The overcurrent device protecting the branch circuit shall be located in the elevator machine
42 room.
43

44 Provide 120V, 20 ampere separate branch circuit to serve machine room lighting and receptacle(s) per NEC 620.23.
45 Provide light switch and duplex receptacle(s). A GFCI receptacle shall be located adjacent to elevator motor. The
46 lighting shall not be connected to load side of GFCI.
47

48 Provide 120V, 20 ampere separate branch circuit to serve elevator pit lighting and receptacle(s) per NEC 620.24. The
49 lighting shall not be connected to load side of GFCI. Electrical installation in elevator pit shall be suitable for wet
50 locations when the pit contains a fire protection sprinkler.
51

52 Provide 120V, 20 ampere separate branch circuit to serve elevator pit sump pump. Dedicated circuit shall not be GFCI
53 protected. Electrical installation in elevator pit shall be suitable for wet locations when the pit contains a fire protection
54 sprinkler.
55

56 Provide 120V, 20 ampere separate branch circuits for additional circuits supplying utilization equipment not identified
57 in NEC 620.22, 620.23 and 620.4 but limited to loads per 620.1. Coordinate with elevator manufacturer's requirements.
58 Overcurrent devices protecting these additional loads shall be located in the elevator equipment room.
59

60 Provide 120V, 20 ampere separate branch circuit to serve hoistway receptacles. Locate receptacles on every other
61 floor above lowest level.
62
63

1 Lighting

- 2 • Provide minimum of two (2) luminaires in the elevator pit. Electrical installation in elevator pit shall be suitable
- 3 for wet locations when the pit contains a fire protection sprinkler.
- 4 • Provide switch adjacent to pit access ladder, 36" above door sill.
- 5 • Provide luminaires as required to maintain a minimum of 10 FC throughout the elevator pit.
- 6 • Provide luminaires as required to maintain a minimum of 19 FC throughout the elevator equipment room or
- 7 required working clearance around equipment in room-less equipment locations (equipment integral with
- 8 elevator car).
- 9 • Provide elevator lobby lighting to provide minimum 10 FC at elevator door (s) with the door (s) closed.

10
11 **Lighting – Hoistways**

- 12 • Provide lighting on every floor above lowest level as required to maintain a minimum of 1 FC throughout the
- 13 hoistway. Provide 3-way and 4-way switches.

14
15 **Misc. connections**

- 16 • Provide all wiring for and mount exterior alarm bell. Feed from emergency source.
- 17 • Provide smoke detector in each elevator equipment room or space. Connect main alarm contacts to fire alarm
- 18 system and auxiliary contacts to the controller.
- 19 • Provide smoke detector in each elevator lobby. Connect main alarm contacts to fire alarm system and
- 20 auxiliary contacts to elevator controller.
- 21 • All traveling cables, control stations, control station wiring and final control connections at the controller shall
- 22 be furnished and installed under Division 14 Elevator Work.
- 23 • All elevator wiring from elevator controller shall be installed with raceway connectors. Hoistway cabling shall
- 24 utilize raceway connectors or bushings at entrance to equipment enclosure.
- 25 • Provide 3/4" conduit from controller to nearest telephone wiring closet (IDF) with four pair UTP Cat. -5e or
- 26 better cable.
- 27 • Coordinate entire installation with Division 14 Contractor prior to rough-in.
- 28 • Coordinate entire installation with Division 27 contractor prior to rough-in for communication and security
- 29 requirements.

30
31 **EQUIPMENT CONNECTION SCHEDULE**

32 As indicated on the drawings.

33
34 **END OF SECTION**

**SECTION 26 27 26
WIRING DEVICES**

PART 1 - GENERAL

SCOPE

This section describes the products and execution requirements relating to furnishing and installing wiring devices and related systems for the project.

RELATED WORK

Applicable provisions of Division 1 govern work under this Section.

SUBMITTALS

Provide product data showing model numbers, configurations, finishes, dimensions, and manufacturer's instructions.

For occupancy sensor shop drawings, the manufacturer's actual layout of occupancy sensors and the wiring diagrams shall be provided.

OPERATION AND MAINTENANCE DATA

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

PART 2 - PRODUCTS

MODULARLY CONNECTED (MODULAR) DEVICES:

Modularly connected devices are allowed, but not required.

Modular Pigtailed Connector: Polarized connector with minimum six-inch stranded copper wire leads, polycarbonate right-angle housing, UL498 listed, with finger-safe connector housing which provides insulation from conductive surfaces. Contacts shall be brass. Connector shall be manufactured so that it provides a secure connection such that it will maintain contact with the device until the device is removed for replacement. Modular connectors shall be provided with covers which protect the contacts from paint, drywall mud, and construction dust and debris. Connectors shall be Hubbell SNAPConnect, Leviton Lev-Lok, Pass & Seymour PlugTail, or approved equal.

WALL SWITCHES

General: Heavy duty use toggle switch, rated 20 amperes and 120/277 volts AC. Switches shall be UL20 Listed and meet Federal Specification WS-896. All switches shall be heavy duty Specification Grade.

Handle: Ivory made of nylon or high impact resistant material.

Wall Switches for Lighting Circuits and Motor Loads Under 1/2 HP: All switches shall be back and side wired, screw clamp type, suitable for solid or stranded wire up to #10 AWG, with separate green ground screw. Switches shall be as follows:

- Hubbell 1221*,
- Leviton 1221-S*,
- Pass & Seymour CSB20AC1-*,
- or approved equal. (* indicates color selection).

Modular Wall Switches for Lighting Circuits and Motor Loads Under 1/2 HP: Switches shall be as follows:

- Hubbell SNAP1221*NA,
- Leviton M1221-*,
- Pass & Seymour PT20AC1-*,
- or approved equal. (* indicates color selection).

RECEPTACLES

General Requirements: NEMA Type 5-20R, ivory nylon or high impact resistant face. Receptacles shall be UL498 Listed and meet Federal Specification WC-596. All duplex receptacles shall be heavy duty Specification Grade, 20 amp rated.

Generally, all receptacles shall be duplex convenience type unless otherwise noted.

All receptacles designated as isolated ground shall have an isolated ground triangle imprint on the face of the receptacle.

1 All receptacles installed in bathrooms, kitchens, and within 6 feet of the outside edge of sinks shall be GFCI type.

2
3 All receptacles installed in outdoor locations, garages, rooftops, and in other damp or wet locations shall be GFCI
4 type with a weather resistant (WR) rating.

5
6 **Convenience and Straight-blade Receptacles:** All receptacles shall be back, and side wired, screw clamp type,
7 suitable for solid or stranded wire up to #10 AWG, with a separate green ground screw. Receptacles shall be as
8 follows:

- 9 • Hubbell 5362*,
- 10 • Leviton 5362-*,
- 11 • Pass & Seymour PS5362*,
- 12 • or approved equal. (* indicates color selection).

13
14 **GFCI Receptacles:** Duplex convenience receptacle with integral ground fault current interrupter meeting the
15 requirements of UL standard 943 Class A, including self-test functionality and reverse line-load misfire function
16 repeatability. GFCI receptacles shall be as follows:

- 17 • Hubbell GFR5362SG*,
- 18 • Leviton GFNT2-*,
- 19 • Pass & Seymour 2097*,
- 20 • or approved equal. (* indicates color selection).

21
22 **GFCI Receptacles with a weather-resistant (WR) rating:** Weather-Resistant duplex convenience receptacle with
23 integral ground fault current interrupter meeting the requirements of UL standard 943 Class-A, including self-test
24 functionality and reverse line-load misfire function repeatability. WR GFCI receptacles shall be as follows:

- 25 • Hubbell GFR5362SG*,
- 26 • Leviton GFWR2-*,
- 27 • Pass & Seymour 2097TRWR*,
- 28 • or approved equal. (* indicates color selection).

29
30 **USB Charger and Duplex Tamper-Resistant Receptacles:** Do not use combination duplex receptacles with USB
31 chargers. Use duplex receptacles as required for the application and as specified herein. Use separate 4-port USB
32 charging devices.

33
34 **USB Charging Devices:** Single-gang 4-port USB charging station. USB ports shall meet UL94 for 5V flammability
35 rating and shall comply with battery charging specification USB BC1.2. USB ports shall be compatible with USB
36 1.1/2.0/3.0 devices, including Apple products. USB ports shall be rated 5VDC, 4.2A minimum. Devices shall be as
37 follows:

- 38 • Hubbell USB4*,
- 39 • Leviton USB4P-*,
- 40 • Pass & Seymour TM8USB4*CC6,
- 41 • or approved equal. (* indicates color selection).

42 **Locking-Blade Receptacles:** As indicated on drawings.

43
44 **Specific-use Receptacle Configuration:** As indicated on drawings.

45
46 **Modular Convenience and Straight-blade Receptacles:** Receptacles shall be as follows:

- 47 • Hubbell SNAP5362*A,
- 48 • Leviton M5362-*,
- 49 • Pass & Seymour PT5362*,
- 50 • or approved equal. (* indicates color selection).

51
52 **Modular GFCI Receptacles:** Duplex convenience receptacle with integral ground fault current interrupter meeting
53 the requirements of UL standard 943 Class A, including self-test functionality and reverse line-load misfire function
54 repeatability. GFCI receptacles shall be as follows:

- 55 • Hubbell GFRST83SNAP*,
- 56 • Leviton MGFN2-*,
- 57 • Pass & Seymour PT2097*,
- 58 • or approved equal. (* indicates color selection).

59
60 **Modular GFCI Receptacles with a weather-resistant (WR) rating:** Use back and side wired devices in lieu of
61 modular weather-resistant rated GFCI receptacles.

1 **TAMPER-RESISTANT RECEPTACLES**

2
3 **Tamper-Resistant Convenience and Straight-blade Receptacles:** Tamper-resistant receptacles shall be back and
4 side wired, screw clamp type, suitable for solid or stranded wire up to #10 AWG, with a separate green ground screw.
5 Receptacles shall be as follows:

- 6 • Hubbell 8300*TR,
- 7 • Leviton 5362-SG*,
- 8 • Pass & Seymour TR5362*
- 9 • or approved equal. (* indicates color selection).

10
11 **Tamper-Resistant Arc-Fault Receptacles:** Tamper-resistant duplex convenience receptacle with integral arc fault
12 current interrupter meeting the requirements of UL standard 1699A. Device shall include an LED indicator.
13 Receptacles shall be as follows:

- 14 • Hubbell AFR20TR*
- 15 • Leviton AFTR2-*
- 16 • Pass & Seymour AF20TR*
- 17 • or approved equal. (* indicates color selection).

18
19 **Tamper-Resistant GFCI Receptacles:** Tamper-Resistant duplex convenience receptacle with integral ground fault
20 current interrupter meeting the requirements of UL standard 943 Class A, including self-test functionality and reverse
21 line-load misfire function repeatability. Receptacles shall be as follows:

- 22 • Hubbell GFR5362SG*,
- 23 • Leviton GFTR2-*,
- 24 • Pass & Seymour 2097TR*,
- 25 • or approved equal. (* indicates color selection).

26
27 **Tamper-Resistant GFCI Receptacles with a weather-resistant (WR) rating:** Tamper-Resistant and weather-
28 resistant duplex convenience receptacle with integral ground fault current interrupter meeting the requirements of UL
29 standard 943 Class A, including self-test functionality and reverse line-load misfire function repeatability. Receptacles
30 shall be as follows:

- 31 • Hubbell GFR5362SG*,
- 32 • Leviton GFWT2-*
- 33 • Pass & Seymour 2097TRWR*,
- 34 • or approved equal. (* indicates color selection).

35
36 **Modular Tamper-Resistant Convenience and Straight-blade Receptacles:** Tamper-resistant receptacles shall be
37 as follows:

- 38 • Hubbell SNAP5362*TR,
- 39 • Leviton M5362-SG*,
- 40 • Pass & Seymour PTTR5362*,
- 41 • or approved equal. (* indicates color selection).

42
43 **Modular Tamper-Resistant GFCI Receptacles:** Tamper-resistant duplex convenience receptacle with integral
44 ground fault current interrupter meeting the requirements of UL standard 943 Class A, including self-test functionality
45 and reverse line-load misfire function repeatability. Receptacles shall be as follows:

- 46 • Hubbell GFTWRST83SNAP*,
- 47 • Leviton MGFT2-*,
- 48 • Pass & Seymour PT2097TR*,
- 49 • or approved equal. (* indicates color selection).

50
51 **OCCUPANCY SENSORS**

52 **General Requirements:**

- 53 1. All occupancy sensors shall be hardwired type; battery type shall not be permitted.
- 54 2. Sensors shall use either passive infrared, or if dual technology, passive infrared and passive acoustic
55 sensing or passive infrared and ultrasonic sensing for detecting room occupancy.
- 56 3. Sensitivity shall be user adjustable or self-adjusting type.
- 57 4. The delay timer shall be adjusted within a range of 6 to 30 minutes by the contractor in the field. The sensor
58 shall have a test mode for performance testing.
- 59 5. The test LED shall indicate motion.
- 60 6. Line voltage sensors are acceptable, especially in exposed ceiling areas where all wiring shall be installed in
61 conduit, including low voltage cabling if power packs are used. Provide power pack as required for low
62 voltage sensors.
- 63 7. See drawings for actual types of sensors.
- 64 8. Occupancy sensors and power packs shall have five-year warranties.

1 **Wall Mounted (Wall Switch Type):** The unit shall fit in/on a standard single gang switch box

- 2 1. Rated capacity: 600 watts minimum at 120 volts, 60 Hz; 1000 watts minimum at 277 volts, 60 Hz.
- 3 2. The sensor shall have two switches where dual-level lighting is required. The switch shall have manual
- 4 override for positive OFF and automatic ON.
- 5 3. The area of coverage shall be approximately 180 degrees by 35-40 feet.

6
7 **Ceiling Mounted:** The unit shall fit in/on a standard octagon box. All ceiling mounted sensors shall be installed to a
8 box with ring and box support.

- 9 1. The coverage area shall be 360 degrees by approximately 15 feet radius when mounted at 9-foot height.
10 The sensor shall have provisions, such as masking, to block out problem areas.

11
12 **Ceiling/Corner Mounted:** The unit shall fit in/on a standard octagon box. All ceiling mounted sensors shall be
13 installed to a box with ring and box support.

- 14 1. The coverage area shall be 90 degrees or greater by approximately 40 feet radius when mounted at 9-foot
15 height. The sensor shall have provisions, such as masking, to block out problem areas.

16
17 **Power Packs:** Provide power packs as required for low voltage sensors. Rated capacity shall be 20 amps at 120 or
18 277 volts for fluorescent lamps.

- 19 1. The unit shall fit on a standard octagon box. All power packs shall be installed onto a supported box.
- 20 2. Low voltage cabling shall be plenum rated or installed in conduit in plenum-rated areas.

21
22 **Auxiliary Contacts for HVAC Interlock:** Provide auxiliary dry contacts for HVAC BAS interlock when required. Refer
23 to the "Occ Sensor Interlock" column in the Air Terminal Schedule(s) on the HVAC drawings. When required, provide
24 auxiliary contacts regardless if the occupancy sensors are line or low voltage.

- 25 1. The occupancy sensors and auxiliary contacts shall be wired such that the sensor still detects occupancy
26 and controls the auxiliary contacts regardless if the light switch(es) are in the OFF position (e.g. the
27 occupant has turned the lights OFF because there is enough daylight, but the occupant is still occupying the
28 space, and the occupancy sensor senses the occupant and closes the auxiliary contacts for BAS input).
- 29 2. The BAS wiring to the auxiliary contacts shall be by the Division 23 contractor.

30 31 **EMERGENCY LIGHTING CONTROL UNITS**

32 **General Requirements:** The Emergency Lighting Control Unit (ELCU) shall automatically illuminate connected
33 emergency lighting upon utility power interruption, regardless of room switch position or occupancy sensor state.

- 34 1. The ELCU shall be UL 924 listed.
- 35 2. Warranty shall be 5-year replacement warranty.
- 36 3. Local room switch or lighting control shall turn both normal and emergency luminaires ON at the same time
37 (no dedicated emergency room switch required).
- 38 4. The ELCU shall have a minimum load rating of 20 Amps at 120V or 277V, 1800W Tungsten at 120V,
- 39 5. 1500W Tungsten at 277V, 1 HP, or general use 20 Amp circuits.
- 40 6. The ELCU shall accept 120V or 277V, 60Hz Input & Output (voltage tolerance +/- 15%).
- 41 7. The ELCU shall include emergency power and normal power indicator LEDs, and a manual test switch.
- 42 8. The ELCU shall accept separate phases on the constant hot and switched hot inputs.
- 43 9. The ELCU shall include high voltage input surge protection up to 50,000V.
- 44 10. Load contacts shall be able to withstand 10 direct shorts while connected to a 20 Amp breaker without
45 permanent damage.
- 46 11. The ELCU shall not generate any objectionable electrical or mechanical noise.
- 47 12. The ELCU shall have UL 94-VO or UL 94-5VA flame rating and be approved for installation above the
48 suspended ceiling.

49
50 **Dimming Applications:** The ELCU shall automatically illuminate connected emergency lighting to full brightness
51 upon utility power interruption, regardless of dimmer or switch position or occupancy sensor state.

- 52 1. The ELCU shall be compatible with 2-wire, 3-wire, 0-10V, and DALI dimming systems and ballasts.
- 53 2. The same local room switch, dimmer, or lighting control shall dim both normal and emergency luminaires at
54 the same level during normal operation.

55 56 **WALL DIMMERS**

57 **General:**

- 58 1. Compatible with the voltage of the circuit being controlled: 120V or 277V.
- 59 2. Compatible with the load being dimmed.
- 60 3. Linear full-range slide control.
- 61 4. Separate ON/OFF switch: single-pole, 3-way, or multiple-location operation as indicated on the drawings.
- 62 5. No derating required in multi-gang applications.
- 63 6. Polycarbonate construction.
- 64 7. Color to match receptacles and/or standard toggle switches.

1 Line-voltage LED Dimmer:

- 2 1. Forward or reverse phase dimming control as required for the application.
3

4 0-10 V Dimmers:

- 5 1. Ratings: 30 mA sink current.
6 2. Adjustable dial allows users to trim the low-end dimming range.
7

8 **DEVICE PLATES AND BOX COVERS**

9 **Decorative Cover Plate:** Ivory smooth thermoplastic nylon.

10
11 **Weatherproof Cover:** All receptacles installed in wet locations shall have an enclosure that is weatherproof whether
12 or not the attachment plug is inserted. Covers shall be gasketed metal with hinged "in-use" device covers, powder
13 coat painted. Non-metallic covers are not allowed. Covers shall be latching type and shall be lockable. Covers shall
14 be identified as "extra-duty" type per NEC 406.9(B)(1).
15

16 **Damp Location Cover:** All receptacles installed outdoors in a location protected from the weather or in other damp
17 locations shall have an enclosure that is weatherproof when the receptacle is covered (attachment plug not inserted
18 and receptacle covers closed). Covers shall be gasketed metal with hinged device covers, powder coat painted. Non-
19 metallic covers are not allowed.
20

21 **Surface Cover Plate:** Raised galvanized steel.
22

23 **PHOTOCELLS**

- 24 A. The controller shall be rated 2000 watts tungsten at 120, 240 or 277 volts. The cell shall be cadmium sulfide,
25 1" diameter.
26 B. The enclosure shall be die cast zinc, gasketed for maximum weather proofing.
27 C. The enclosure shall include the positioning lug on the top of the enclosure.
28 D. The unit shall have a delay of up to two minutes to prevent false switching. ON/Off adjustment shall be done
29 by moving a light selector with a range from 2 to 50 foot-candles.
30 E. Mounting shall be for a 1/2" conduit nipple.
31 F. The unit shall have a 5-year warranty.
32 G. The contacts shall be SPST normally closed.
33 H. The operational temperature range shall be -40 to 140 degrees F (-40 to +60 degrees C).
34

35 **TIME CLOCKS**

- 36 A. Unit shall be a multi-purpose, 7-day, 365-day advance single and skip a day, combination 2-channel
37 electronic time clock with a SPDT switching configuration and astronomic dial.
38 B. The contacts shall be rated 10 amp resistive at 120/250 VAC, 7.5 amps inductive at 120/250 VAC, 5 amps
39 inductive at 30 VDC and up to 1/2 HP at 250 VAC. The unit shall be rate for 30 VDC, 120 VAC, 250 VAC
40 and 277 VAC.
41 C. The controller shall be capable of programming in the AM/PM or 24-hour format by jumper selection, in one
42 minute resolution, using 2 buttons only for all basic settings.
43 D. Display shall be LED type.
44 E. The unit shall have 365 day and or holiday selection capabilities, with 16 single date and 5 holiday selection
45 options and user selectable daylight savings/standard time functions.
46 F. The unit shall have 72 hour memory backup with rechargeable battery and charger.
47 G. The unit shall be capable of manual override, ON and OFF to the next scheduled event, using 1 button for
48 each channel.
49 H. The enclosure shall be rated for indoor or outdoor installation.
50

51 **TIME SWITCH**

- 52 A. The switch shall be programmed to automatically turn lights off after a preset time.
53 B. The delay timer shall be adjustable with a range of 5 minutes to 12 hours.
54 C. Switch shall be rated for 120/277V, 1200W load.
55 D. The switch shall beep warning every 5 seconds during the last minute of countdown. Also, the switch shall
56 flash lights (for warning) at one minute before timer expires.
57 E. Time scrolling shall be provided to override preset time by pressing the ON/OFF switch for four seconds.
58 F. LCD provided to show count down time.
59 G. The switch shall have zero crossing circuitry.
60

61 **PART 3 - EXECUTION**

62 **INSTALLATION**

- 63 A. See plans for device mounting heights.
64

- 1 B. Install wall switches with OFF position down.
- 2 C. Wall dimmers: de-rate ganged dimmers as instructed by manufacturer; do not use common neutral.
- 3 D. Install convenience receptacles with grounding pole on bottom.
- 4 E. Install box for information outlet at the same height as adjacent convenience receptacles. Locate boxes for
- 5 information outlet as close as practical to duplex power outlet, approximately 2-inches apart.
- 6 F. Install box for telephone jack for wall telephone at 46-inches to center above finished floor.
- 7 G. Install specific-use receptacles at heights shown on Contract Drawings.
- 8 H. Install decorative plates on switch, receptacle, and blank outlets in finished areas.
- 9 I. Install galvanized steel plates on outlet boxes and junction boxes in unfinished areas, above accessible
- 10 ceilings, and on surface-mounted outlets.
- 11 J. Install devices and wall plates flush and level.
- 12 K. Receptacles shall have a bonding conductor from grounding terminal to the metal conduit system. Self-
- 13 grounding receptacles using mounting screws as bonding means are not approved.
- 14

15 FIELD QUALITY CONTROL

- 16 A. Inspect each wiring device for defects.
- 17 B. Operate each wall switch and sensor with circuit energized and verify proper operation.
- 18 C. Verify operation of each ELCU by turning off the normal power circuit breaker at the panelboard.
- 19 D. Verify that each receptacle device is energized.
- 20 E. Test each receptacle device for proper polarity.
- 21 F. Test each GFCI receptacle device for proper operation.
- 22 G. The user agency and owner personnel reserve the right to be present at all tests.
- 23

24 OCCUPANCY SENSORS

- 25 A. Power packs used in return air plenum ceiling areas shall be installed in an approved enclosure or UL listed
- 26 for return air plenum.
- 27 B. Provide a minimum of 4' of coiled cable for ceiling-mounted sensors.
- 28 C. Occupancy sensors shall be installed at locations indicated on the manufacturer's submittal layout drawings.
- 29 Sensors shall be located to prevent false "ON" tripping of the lights.
- 30 D. Sensitivity Test: After the sensor has been energized for at least 15 minutes, walk to the middle of the room
- 31 (if conference room) or sit at the normal desk position (if an office). Make no motion for 20 seconds. Move
- 32 one arm up and down slowly. The test LED should blink.
- 33 E. Time Delay Test: Set the time delay for 10 minutes. Walk into the room to activate the sensor then leave
- 34 room. Sensor must turn lights off at approximately 10 minutes. Walk into the room again to reactivate the
- 35 lights. Lights should activate within 1 second.
- 36 F. For lights on emergency power *without* an emergency lighting control unit (ELCU), use the *emergency* circuit
- 37 to energize the occupancy sensor's power pack. Route the emergency circuit through the occupancy
- 38 sensor's power pack relay to the light fixtures. Route any non-emergency circuits controlled by the same
- 39 occupancy sensor through separate auxiliary relay packs.
- 40 G. For lights on emergency power *with* an ELCU, route the *normal* power through the switches and occupancy
- 41 sensor relay to the ELCU, then to the normal power lighting fixtures. Connect the emergency circuit to the
- 42 ELCU's emergency power terminals, then to the emergency lighting fixtures. The ELCU will control the
- 43 emergency lighting along with the normal lighting controls but will turn the emergency lights ON in a power
- 44 outage, regardless of the position of the switches or relays.
- 45

46 ADJUSTING

- 47 A. Adjust devices and wall plates to be flush and level.
- 48 B. Mark all conductors with the panel and circuit number serving the device with a machine generated label, at
- 49 the device, and on the back of the device cover.
- 50

51 END OF SECTION

SECTION 26 28 16
ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

SCOPE

The work under this section includes enclosed molded case circuit breakers.

RELATED WORK

Applicable provisions of Division 1 govern work under this Section.

REFERENCES

NEMA AB 1 - Molded Case Circuit Breakers
NEMA KS 1 - Enclosed Switches

SUBMITTALS

Include circuit breaker ratings, withstand ratings, frame size, time-current and let-through current curves, outline dimensions, and terminal lug sizes.

OPERATION AND MAINTENANCE DATA

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

REGULATORY REQUIREMENTS

Circuit breakers listed by Underwriter's Laboratories, Inc., and suitable for specific application.

DELIVERY, STORAGE, AND HANDLING

Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

PART 2 - PRODUCTS

CIRCUIT BREAKERS

Molded Case Circuit Breakers: Inverse time with integral thermal and instantaneous magnetic trip elements in each pole.

Electronic Trip Circuit Breaker: As scheduled on the drawings, electronic circuit breakers shall have, at a minimum, adjustments for long time trip, short time trip and instantaneous trip. Provide integral ground fault sensing with adjustable ground fault trip where indicated on the drawings.

RATINGS

Ratings as shown on the Drawings.

ENCLOSURE

Enclosure:

1. Indoor: NEMA Type -1 code gauge steel with rust inhibiting primer and baked gray enamel finish.
2. Outdoor: NEMA 3R code gauge zinc coated steel with baked gray enamel finish [NEMA 4X stainless steel with brushed finish].
3. Corrosive Areas, Kitchen/Food service areas, Therapeutic/Pool spaces and Damp/Wet locations: NEMA type 4X, 304 stainless steel with brushed finish.

ACCESSORIES

1. Provide accessories as scheduled or indicated on drawings, to NEMA AB 1.
2. Shunt Trip Device: 120 volts, AC. Electrically operated solenoid for remote opening of circuit breaker main contacts.
3. Auxiliary Switch: 120 volts, 5 amps. One set of normally open and one set of normally closed contacts. Contacts signal the status of CB main contacts independent of the method used to open or close CB.
4. Alarm Switch: 120 volts, 5 amps. One set of normally open and one set of normally closed contacts. Contact activation upon any trip function of the CB or external trip device.
5. Electric Operator: 120 volts, 5 amps.
6. Handle Lock: Include provisions for padlocking.

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PART 3 - EXECUTION

INSTALLATION

1. Install enclosed circuit breakers where shown on Drawings, in accordance with manufacturer's instructions.
2. Install free standing enclosed circuit breakers on a 3.5-inch-high concrete equipment pad.
3. Install 90 degree C insulated conductors based on ampacity of 75 degree C conductors when utilizing 100% rated OCPD's. Consult manufacturer's requirements for specific devices.

ADJUSTING

1. Adjust all operating mechanisms for free mechanical movement.
2. Adjust trip and time delay settings to values as recommended in coordination study or as instructed by the A/E. Include a copy of the coordination study and recommended circuit breaker set points in the O&M manual

FIELD QUALITY CONTROL

1. Inspect completed installation for physical damage, proper alignment, anchorage, and grounding.
2. Check tightness of accessible bolted bus joints using a calibrated torque wrench. Tightness shall be in accordance with manufacturer's recommended values.
3. Touch up scratched or marred surfaces to match original finish.
4. Inspect visually and perform several mechanical ON-OFF operations on each device.

END OF SECTION

SECTION 26 29 00
LOW-VOLTAGE CONTROLLERS

PART 1 - GENERAL

SCOPE

The work under this section includes Low-Voltage Controllers (starters) for motors: Manual motor starters, magnetic motor starters, combination magnetic motor starters, and/or motor control centers.

RELATED WORK

Applicable provisions of Division 1 shall govern work under this Section.
Section 26 05 29 – Hangers and Supports for Electrical Systems

REFERENCES

- ANSI/NEMA ICS 6 – Industrial Control and Systems: Enclosures.
- ANSI/UL 248-8 – Low-Voltage Fuses – Part 8: Class J Fuses.
- NEMA AB 1 – Molded-case Circuit Breakers, Molded Case Switches, and Circuit-breaker Enclosures.
- NEMA ICS 2 – Industrial Control and Systems Controllers, Contactors, and Overload Relays Rated 600 Volts.
- NEMA ICS 18 – Motor Control Centers.
- NEMA KS 1 – Enclosed and Miscellaneous Distribution Equipment Switches.
- NEMA PB 1 – Panelboards.
- NEMA PB 1.1 – General Instructions for Proper Installation, Operation, and Maintenance of Panelboards Rated 600 Volts or Less.

SUBMITTALS

Indicate on shop drawings, front and side views of motor control center enclosures with overall dimensions. Include conduit entrance locations and requirements; nameplate legends; size and number of bus bars per phase, neutral and ground; electrical characteristics including voltage, frame size and trip ratings, withstand ratings, and time-current curves of all equipment and components.

Provide product data on motor starters and combination motor starters, relays, pilot devices, and switching and overcurrent protective devices.

OPERATION AND MAINTENANCE DATA

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

COORDINATION WITH OTHER TRADES

Motors: In general, all electric motors required for this installation will be supplied with equipment, apparatus and/or appliances covered under other sections of the specifications.

For the sake of consistency and conformity of manufacturer, design and construction, all motors shall conform to the following description unless otherwise noted or required.

- Motors 1/3 HP and smaller shall be wound for operation on single phase, 60 Hz. service unless otherwise noted.
- Motors 1/2 HP and above shall be wound for operation on 3 phase, 60 Hz service unless otherwise noted.
- Refer to drawings in each case in order to verify voltage characteristics required.

Equipment:

- All building utility motors such as fans, pumps, overhead doors, etc., together with certain "controlling equipment" for same, except motor starters and related apparatus, will be furnished under other sections of the specifications and delivered to the building site unless specifically noted otherwise. The above mentioned "controlling equipment" pertains to electrical thermostats, electro-pneumatic and pneumatic-electric and detection devices, or any other device not purely electrically operating in nature.
- The starters for these motors shall be furnished and installed by the Electrical Trade unless noted otherwise (See Motor Schedule on Drawings).
- The Electrical Trade shall set and connect all specified starting equipment, install all power conduits and wiring and shall furnish and make all connections from starting equipment to motors as required to leave the apparatus in running condition.

Wiring Connections:

- Furnish branch circuits for all motors to the starting equipment and then to the motors, complete with all control wiring for automatic and remote control where required or noted. Conduits to motors shall terminate

1 in the conduit fittings on the motors, the final connection being made with flexible, PVC-coated metal
2 conduit.

- 3 • Provide all necessary labor and material to completely connect all electrical motors and controls (where
4 required) in connection with the building utility equipment, including fans, pumps, overhead door operators,
5 etc.
- 6 • All conduits and wiring required for control work from the holding coil circuit of the starter, including the
7 furnishing and installation of control devices such as auxiliary contacts, control relays, time delay relays, pilot
8 lights, selector switches, alternators, etc., shall be provided and installed by other trades unless otherwise
9 indicated.

10 **Power Branch Circuits:**

- 11 • Wire sizes for branch circuits not specifically called for on drawings or in specifications shall be based on
12 125 percent of the full load current of the motor unless the voltage drop of motor branch circuits exceeds 1-
13 1/2 percent from the distribution panel to the motor; in which case, voltage drop shall govern wire sizes. A
14 power factor of 80 percent shall be used for motors in such calculations.

15
16 **DELIVERY, STORAGE, AND HANDLING**

17 Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to
18 protect units from dirt, water, construction debris, and traffic.

19
20 Handle in accordance with manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle
21 carefully to avoid damage to components, enclosure, and finish.

22
23 **SPARE PARTS**

- 24 • Keys: Furnish two (2) each to Owner.
- 25 • **Provide three (3) spares of each size and type fuse used. Provide enclosure for spare fuses.**
- 26 • Fuse Pullers: Furnish one fuse puller to Owner.

27
28 **PART 2 - PRODUCTS**

29
30 **MANUAL MOTOR STARTERS**

31 Single-phase Manual Motor Starter: Provide a motor-rated wall switch for motor loads under 1/2 HP. Provide switch
32 with a toggle handle operator and with an optional handle guard in a NEMA Type 1 enclosure to prevent accidental
33 operation of the toggle operator, and to allow the toggle operator to be padlocked in either the On or Off position.

34
35 Three-phase Manual Motor Starter: NEMA ICS 2; size as shown on Drawings. AC general-purpose Class A manually
36 operated full-voltage controller for induction motors rated in horsepower, with overload protection, red pilot light and
37 toggle operator.

38
39 Enclosure: NEMA Type 1, or as indicated on the drawings.

40
41 Provide manufacturer's equipment grounding kit in all starter enclosures.

42
43 **MAGNETIC MOTOR STARTERS**

- 44 • Magnetic Motor Starters: NEMA ICS 2; AC general-purpose Class A magnetic controller for induction motors
45 rated in horsepower; size 0 minimum.
- 46 • Full Voltage Starting: Non-reversing type.
- 47 • Size: NEMA ICS 2; size as shown on Drawings, size 0 minimum.
- 48 • Coil Operating Voltage: 120 volts, 60 Hz.
- 49 • Overload Protection: The overload shall be solid-state, self-powered, provide phase loss and phase
50 unbalance protection, have a permanent tamper guard, and be ambient insensitive. The overload shall have
51 a mechanical test function.
- 52 • Enclosure: NEMA Type 1, or as indicated on the drawings.
- 53 • Provide manufacturer's equipment ground kit in all starter enclosures.
- 54 • Auxiliary Contacts: NEMA ICS 2, two (2) field convertible contacts in addition to seal-in contact.
- 55 • Selector Switches: NEMA ICS 2, HAND-OFF-AUTO in front cover.
- 56 • Indicating Lights: NEMA ICS 2; red "RUN" LED Push-to-test type in front cover.
- 57 • Control Power Transformers: Each magnetic starter shall have a fused primary and a fused 120Vsecondary
58 control transformer, sized for the load, 50 VA minimum. Additionally, the X2 terminal of the control
59 transformer shall be grounded.
- 60 • Combination Motor Starters: Combine motor starters with fusible switch disconnect in common enclosure.

1 **CONTROLLER OVERCURRENT PROTECTION AND DISCONNECTING MEANS**

2 Fusible Switch Assemblies: NEMA KS 1; quick-make, quick-break, load interrupter enclosed knife switch with
3 externally operable handle. Provide interlock to prevent opening front cover with switch in ON position. Handle
4 lockable in OFF position. Fuse Clips: Designed to accommodate Class J fuses.

5
6 **FUSES**

7 Fuses 600 Amperes and Less: Dual element, time delay, 250 or 600 volt (as appropriate), UL Class J. Interrupting
8 Rating: 200,000 rms amperes.

9
10 **PART 3 - EXECUTION**

11
12 **INSTALLATION**

- 13
- 14 • Install motor control equipment in accordance with manufacturer's instructions.
 - 15 • Set overload protection in motor starters to match installed motor characteristics.
 - 16 • Motor Data: Provide neatly typed label inside each motor starter enclosure door identifying motor served,
17 nameplate horsepower, full load amperes, code letter, service factor, and voltage/phase rating.
- 18

END OF SECTION

**SECTION 26 51 13
INTERIOR LIGHTING FIXTURES, LAMPS, AND BALLASTS**

PART 1 – GENERAL

SCOPE

The work under this section includes interior luminaires and accessories, exit signs, and building-mounted exterior lighting

RELATED WORK

Applicable provisions of Division 1 govern work under this Section.
Section 26 27 26 – Wiring Devices

REFERENCE STANDARDS

RoHS – Restriction of Hazardous Substances. Council of the European Union (EC) Directive 2002/95/EC on the restriction of the use of certain hazardous substances in electrical and electronic equipment.

LM-79-08 (or latest) – IES Approved Method for the Electrical and Photometric Measurements of Solid-State Lighting Products.

LM-80-08 (or latest) – IES Approved Method for Measuring Lumen Maintenance of LED Light Sources.

TM-21-11 (or latest) – IES Technical Memorandum on Projecting Long Term Lumen Maintenance of LED Light Sources.

NEMA SSL 1-2010 (or latest) – Electronic Drivers for LED Devices, Arrays, or Systems.

SUBMITTALS

Include outline drawings, lamp and ballast data, support points, weights, accessory information and performance data for each luminaire type.

For each luminaire type, submit luminaire information including catalog cuts with highlighted catalog numbers and required accessories:

1. Luminaire:
 - i. Manufacturer and catalog number,
 - ii. Type (identification) as indicated on the plans and schedule,
 - iii. Delivered lumens,
 - iv. Input watts,
 - v. Efficacy,
 - vi. Color rendering index.
2. Driver:
 - i. Manufacturer and catalog number,
 - ii. Type (Non-Dimming, Step-dimming, Continuous dimming, etc.),
 - iii. Power Factor, Crest Factor, THD, etc.

OPERATION AND MAINTENANCE DATA

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

EXTRA MATERIALS

Provide three (3) percent of each lamp type, but not less than one (1) of each type.

Provide one (1) of each type of LED module, light bar, or array (if applicable). If the LED's are integrated into the luminaire and are not separate components, provide one (1) of each of these types of luminaires.

Provide one (1) LED driver or ballast of each type.

DEFINITIONS

Driver: The power supply used to power LED luminaires, modules, or arrays.

L70, L₇₀, or L_{70%}: The reported life of an LED component or system to reach 70% lumen maintenance, or 70% of the LED's original light output. This test is being developed by the IES and is currently described by TM-21-11.

1 LED's: Broadly defined as complete luminaire with light emitting diode (LED) packages, modules, light bars or arrays,
2 complete with driver.

3
4 LED luminaire failure: Negligible light output from more than 10 percent of the LED's constitutes luminaire failure.

5
6 **PART 2 - PRODUCTS**

7
8 **INTERIOR LUMINAIRES AND ACCESSORIES**

9 See the Luminaire Schedule on the drawings for type of luminaires and catalog numbers. Catalog numbers are
10 shown on the drawings for quality and performance requirements only. Installation and mounting options and
11 accessories shall be provided as necessary to accommodate installation location and construction. Luminaires
12 manufactured by others are equally acceptable provided they meet or exceed the performance of the indicated
13 luminaires and meet the intent of the design.

14
15 Luminaire shall be certified by a Nationally Recognized Testing Laboratory (UL, ETL, or IEC).

16
17 Provide luminaires with quick-connect disconnecting means, similar to Thomas & Betts Sta-Kon.

18
19 **GENERAL USE LAMPS**

20 General Use Incandescent Lamps and Incandescent Reflector Lamps are prohibited. Use LED retrofit lamps or LED
21 luminaires in lieu of incandescent or halogen luminaires. LED retrofit lamps shall be:

- 22 1. Rated for the voltage of the incandescent lamp/luminaire they are replacing.
- 23 2. Dimmable where required as indicated on the plans.
- 24 3. Rated for the luminaire in which they are being installed. Verify whether the luminaire is enclosed and
25 whether the LED retrofit lamp is rated for enclosed luminaires and the temperatures that will be
26 encountered.
- 27 4. LED lamps/luminaires shall provide delivered footcandles equal to or greater than the footcandles provided
28 by an equivalent incandescent lamp/luminaire.
- 29 5. LED retrofit lamps shall have an average rated life of 25,000 hours, minimum.
- 30 6. Lamp color temperature shall be nearly equal to the incandescent lamp it is replacing.
- 31 B. All lamps shall be new.

32
33 **LED LUMINAIRES**

34 LED Luminaires shall meet all DesignLights Consortium® (DesignLights.org) Product Qualification Criteria. This does
35 not require that the luminaire be listed on the DesignLights Consortium's® Qualified Products List, but they must
36 meet the Product Qualification Criteria. The technical requirements that the luminaire shall meet for each Application
37 Category are:

- 38 1. Minimum Light Output.
- 39 2. Zonal Lumen Requirements.
- 40 3. Minimum Luminaire Efficacy.
- 41 4. Minimum CRI.
- 42 5. L70 Lumen Maintenance.
- 43 6. Minimum Luminaire Warranty of 5 years (not pro-rated) to include LED driver and all LED components.

44
45 *Additional requirements:*

- 46 1. Color Temperature of 3000K-4100K for interior luminaires as listed in the Luminaire Schedule on the plans.
47 The color temperature of exterior LED luminaires should not exceed 4100K (nominal).
- 48 2. Color Consistency: LED manufacturer shall use a maximum 3-step MacAdam Ellipse binning process to
49 achieve consistent luminaire-to-luminaire color for interior luminaires. Exterior luminaires shall use a
50 maximum 5-step MacAdam Ellipse binning process.
- 51 3. Glare Control: Exterior luminaires shall meet DesignLights Consortium's® criteria for Zonal Lumen
52 Distribution requirements or Backlight-Uplight-Glare (BUG) standards for exterior luminaires.
- 53 4. Luminaire shall be mercury-free, lead-free, and RoHS compliant.
- 54 5. Luminaire shall comply with FCC 47 CFR part 15 non-consumer RFI/EMI standards.
- 55 6. Light output of the LED system shall be measured using the absolute photometry method following IES LM-
56 79 and IES LM-80 requirements and guidelines.
- 57 7. Luminaire shall maintain 70% lumen output (L70) for a minimum of 50,000 hours.
- 58 8. Lumen output shall not depreciate more than 20% after 10,000 hours of use.
- 59 9. Luminaire and driver shall be furnished from a single manufacturer to ensure compatibility.
- 60 10. Luminaire Color Rendering Index (CRI) shall be a minimum of 80 for interior luminaires, and a minimum of
61 70 for exterior luminaires.
- 62 11. LED luminaire shall be thermally designed as to not exceed the maximum junction temperature of the LED
63 for the ambient temperature of the location the luminaire is to be installed. Rated case temperature shall be

- 1 suitable for operation in the ambient temperatures typically found for the intended installation. Exterior
2 luminaires to operate in ambient temperatures of -20°F to 122°F (-29°C to 50°C).
- 3 12. Luminaire shall operate normally for input voltage fluctuations of plus or minus 10 percent.
- 4 13. Luminaire shall have a maximum Total Harmonic Distortion (THD) of $\leq 20\%$ at full input power and across
5 specified voltage range.
- 6 14. All connections to luminaires shall be reverse polarity protected and provide high voltage protection in the
7 event connections are reversed or shorted during the installation process.
- 8 15. All luminaires shall be provided with knockouts for conduit connections.
- 9 16. The LED luminaire shall carry a limited 5-year warranty minimum for LED light engine(s)/board array, and
10 driver(s).
- 11 17. Provide all of the following data on submittals:
- 12 i. Delivered lumens
- 13 ii. Input watts
- 14 iii. Efficacy
- 15 iv. Color rendering index.
- 16

17 *LED Luminaires used for Emergency Egress Lighting:*

- 18 • The failure of one LED shall not affect the operation of the remaining LEDs.
- 19

20 *Emergency LED Luminaire Compatibility with Inverters:*

- 21 • Emergency Inverters shall be sinewave type, or have written confirmation from the luminaire manufacturer
22 that the luminaire will function with a square-wave inverter.
- 23

24 **LED DRIVERS**

25 **General:**

- 26 1. Provide driver type (non-dimmed, step-dimmed, continuous-dimming, etc.) as indicated on the luminaire
27 schedule on the drawings.
- 28 2. Minimum Warranty of 5 years (not pro-rated) to include LED driver and all LED components.
- 29 3. Driver shall have a rated life of 50,000 hours, minimum.
- 30 4. Driver and LEDs shall be furnished from a single manufacturer to ensure compatibility.
- 31 5. Driver shall have a minimum power factor (pf) of 0.9 and a maximum crest factor (cf) of 1.5 at full input
32 power and across specified voltage range.
- 33 6. Driver shall operate normally for input voltage fluctuations of plus or minus 10 percent.
- 34 7. Driver shall have a maximum Total Harmonic Distortion (THD) of $\leq 20\%$ at full input power and across
35 specified voltage range.
- 36 8. Wiring connections to LED drivers shall utilize polarized quick-disconnects for field maintenance.
- 37 9. Fuse Protections: All luminaires shall have built-in fuse protection. All power supply outputs shall be either
38 fuse protected or be Polymeric Positive Temperature Coefficient (PTC)-protected as per Class 2 UL listing.
- 39 10. Provide all of the following data on submittals:
- 40 i. Input watts
- 41 ii. Power Factor (pf)
- 42 iii. Crest Factor (cf) at full input power
- 43 iv. Total Harmonic Distortion (THD).

44 **Dimming Drivers:**

- 45 11. LED driver shall be compatible with dimming controls where dimming is indicated on the plans. Dimmable
46 drivers shall use Dimming Constant Current (DCC), Constant Voltage, or Pulse Width Modulation (PWM)
47 operation.
- 48 12. Step-Dimming Drivers: Easily switched from 0% to 50% to 100% output power. Both switch-leg inputs shall
49 control 50% of the luminaire's light output equally.
- 50 13. Continuous Dimming Drivers: LED luminaires shall dim to (10%, 1%, or 0.1%) as specified in the Luminaire
51 Schedule on the plans without visible flicker or "popcorn effect". "Popcorn effect" is defined as the luminaire
52 being on a pre-set dimmed level (less than 100%), and going to 100% prior to returning to the pre-set level
53 when power is returned to the luminaire. Continuous Dimming Drivers shall use 0-10V control.
- 54

55 **PART 3 - EXECUTION**

56 **INSTALLATION**

57 Verify ceiling types with Architectural plans or with existing ceilings. Verify specified luminaires are compatible with
58 specified ceiling type(s) prior to ordering luminaires.

59 Install in accordance with manufacturer's instructions.

60

61 Install suspended luminaires using aircraft cable, or pendants supported from swivel hangers. Heavy duty chain
62 supports may be used where indicated on the luminaire schedule. Provide aircraft cable, pendants, or chain lengths

63

64

- 1 required to suspend luminaire at indicated height. All aircraft cables or pendant supported luminaires shall have an
2 independent support to structure at all cable or pendant support locations. When chain is used, tie-wrap the luminaire
3 wiring method to the chain.
4
- 5 Support luminaires larger than 2 x 4-foot (600 x 1200 mm) size independent of ceiling framing.
6
- 7 Provide independent support for all luminaires over 50 lbs.
8
- 9 Locate ceiling luminaires as indicated on reflected ceiling plan.
10
- 11 Install surface mounted luminaires and exit signs plumb and adjust to align with building lines and with each other.
12 Secure to prohibit movement.
13
- 14 The Contractor shall install luminaire supports as required. Luminaire installations with luminaires supported only by
15 insecure boxes will be rejected. It shall be the Contractor's responsibility to support all luminaires adequately,
16 providing extra steel work for the support of luminaires if required. Any components necessary for mounting
17 luminaires shall be provided by the Contractor. No plastic, composition or wood type anchors shall be used.
18
- 19 Exposed Grid Ceilings: Support surface mounted luminaires on grid ceiling directly from building structure; or Provide
20 auxiliary members spanning ceiling Ts to support surface mounted luminaires; or Fasten surface mounted luminaires
21 to ceiling T using bolts, screws, rivets, or suitable clips].
22
- 23 Install recessed luminaires to permit removal from below.
24
- 25 Install recessed luminaires using accessories and firestopping materials to meet regulatory requirements for fire
26 rating.
27
- 28 Install code required hardware to secure recessed grid-supported luminaires in place.
29
- 30 Install wall mounted luminaires and exit signs at height as scheduled. Use pendants supported from swivel hangers in
31 exposed ceiling/structure locations where necessary to mount exit signs at the specified height.
32
- 33 Install accessories furnished with each luminaire.
34
- 35 Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within
36 luminaire.
37
- 38 Bond luminaires and metal accessories to branch circuit equipment grounding conductor.
39
- 40 Install specified lamps in each luminaire and exit sign.
41
- 42 High-Bay or Low-Bay Luminaires: Use power hook hangers rated 500 pounds (225 kg) minimum and provide safety
43 chain between ballast and structure. Also provide safety chain between reflector and ballast.
44
- 45 Dimmed luminaire circuits shall have separate neutrals.
46
- 47 Dimmed LED luminaires shall have a positive OFF, which requires turning off the circuit to the luminaire so that the
48 luminaires don't "glow" at the lowest dimmed setting.
49
- 50 All lamps shall be delivered to the job in sealed cartons and protected from dirt and dust during storage on the
51 project. Lamps shall be taken directly from the cartons and installed in the luminaire with special care so that they do
52 not become dusty and are not soiled in the operation.
53
- 54 All new lamps shall be operational at the Substantial Completion of the project.
55
- 56 **ADJUSTING AND CLEANING**
- 57 Align luminaires and clean lenses and diffusers at completion of Work. Clean paint splatters, dirt, and debris from
58 installed luminaires.
59
- 60 Aim and adjust luminaires as indicated on Drawings or as directed by the A/E.
61
- 62 Touch up luminaire finish at completion of work.
63
64

1 **INTERFACE WITH OTHER PRODUCTS**

2 Interface with air handling accessories furnished and installed under Division 23.

3
4 Provide controls as indicated on the plans. Refer to section 26 27 26 - Wiring Devices. Controls shall be compatible
5 with the luminaires/ballasts/drivers being installed.

6
7 **ZERO-TO-10V DIMMING CONTROL WIRING INSTALLATION**

- 8 A. Zero-to-10V dimming control conductors are classified by the NEC as Class 2 conductors and shall be kept
9 separate from line-voltage conductors per NEC 725.136(A). Matching the insulation rating of Conductors of
10 Different Systems does not apply to Class 2 conductors per NEC 300.3(C)(1), Informational Note No.1.
- 11 B. Wall box dimmers will typically have two conduits: One conduit for line-voltage power, and one conduit or
12 conduit stub for the 0-10V control wiring.
- 13 C. At each luminaire, separate openings (either manufactured knock-outs or punched openings) shall be used
14 for the line-voltage power and the 0-10V wiring. The EC shall use a cable connector at the opening for the 0-
15 10V wiring. Zero-to-10V conductors entering and within a luminaire enclosure shall maintain a minimum
16 separation of 6 mm (0.25 in.) per NEC 725.136(D).
- 17 D. Exposed 0-10V cables shall be installed in separate conduits from line-voltage conductors.
- 18 E. The 0-10V cables may be routed in free air where concealed above accessible ceilings. Cables routed in
19 free air shall observe the following installation requirements:
- 20 1. The 0-10V cables may be tie-wrapped to the outside of the luminaire power raceway where allowed
21 by NEC 300.11(B)(2). Tie-wraps shall be UL listed for UV resistance. Care should be taken in the
22 use of cable ties to secure and anchor the cabling. Ties shall not be over tightened as to compress
23 the cable jacket. No sharp burrs shall remain where excess length of the cable tie has been cut.
 - 24 2. Cabling shall be neatly run at right angles and be kept clear of other trades work.
 - 25 3. Cabling shall be secured within twelve (12) inches of direction change or termination.
 - 26 4. Cabling shall be supported at a maximum of 5-foot intervals utilizing "J-Hook" or "Bridle Ring"
27 supports anchored to ceiling concrete, piping supports or structural steel beams. If cable sag at
28 mid-span exceeds 12-inches, another support shall be provided. Cable supports shall be installed
29 to maintain cable bend to larger than the minimum bend radius.
 - 30 5. Cabling shall not be attached to or supported by existing cabling, plumbing or steam piping,
31 ductwork, suspended ceiling supports or electrical or communications conduit. Do not place cable
32 directly on the ceiling grid or attach cable in any manner to the ceiling grid wires.
 - 33 6. All cables shall be free of tension at both ends. Nylon strain relief connectors shall be provided at
34 each device and junction box where cables enter. In cases where the cable must bear some
35 stress, Kellem type grips may be used to spread the strain over a longer length of cable.
 - 36 7. Cable manufacturer's minimum bend radius shall be observed in all instances.
 - 37 8. Use suitable cable fittings and connectors.

38
39 **FIELD QUALITY CONTROL**

40 Operate each luminaire after installation and connection. Inspect for proper connection and operation.

41
42 **LUMINAIRE CONNECTIONS**

43 **METAL-CLAD (MC) CABLE**

- 44 • Metal-Clad (MC) type cable that combines power and Class 2 circuits into a single cable may be used for
45 the luminaire wiring where 0-10V dimming control wiring is required. Examples of such products are Encore
46 Wire® MC-LED™ or Southwire® MC-PCS Duo™. Manufacturer's names and catalog numbers are used for
47 quality and performance only. MC Cables manufactured by others shall be equally acceptable provided they
48 meet or exceed in performance and quality as specified.

49
50 Recessed, including Master-Satellite connections:

- 51 • Use a luminaire fixture whip from a J-box for recessed lay-in luminaires. Luminaire fixture whips shall be
52 aluminum or steel AC Cable (Armored Cable) or Flexible Metal Conduit (FMC). Metal Clad (MC) cable that
53 combines power and Class 2 circuits (for 0-10V dimming control) into a single cable may be used as a whip
54 for luminaires that are dimmed.
- 55 • Cable/Conduit whips shall be 3/8" (10 mm) minimum diameter, six feet (1.8 m) maximum length.
- 56 • Flexible whips or pre-wired systems between master and satellite luminaires may be supported by the
57 ceiling grid wires.
- 58 • The flexible connectors shall be steel, galvanized, clamp type with locknut, snap-in type with locknut, or
59 snap-in connector type, including those used on the master-satellite units.

60
61 Chain or Cable Hung (unfinished spaces):

- 62 • Use manufacturer's SO cord or a luminaire fixture whip from a J-box. Luminaire fixture whips shall be
63 aluminum or steel AC Cable (Armored Cable) or Flexible Metal Conduit (FMC). Metal Clad (MC) cable that

- 1 combines power and Class 2 circuits (for 0-10V dimming control) into a single cable may be used as a whip
2 for luminaires that are dimmed.
3 • Conduit whips shall be 3/8" (10 mm) minimum diameter. Conduit whip or SO cord shall be cut to length (six
4 feet (1.8 m) maximum) and shall allow movement of the chain/cable/luminaire, but shall not be long enough
5 to "loop" and shall present a neat and workmanlike appearance.
6 • Luminaire field wired flexible cord installations shall be connected per NEC 410.62.
7 • The flexible connectors shall be steel, galvanized, clamp type with locknut, snap-in type with locknut, or
8 snap-in connector type, including those used on the master-satellite units.
9 • Conduit whip slack shall be tie-wrapped to the chain supports. Tie-wraps shall be UL listed for UV
10 resistance.

11
12 Cable Hung (finished spaces):

- 13 • Use manufacturer's SO cord from luminaire to a J-box.
14 • SO cord shall be cut to length (six feet (1.8 m) maximum) and shall allow movement of the cable/luminaire,
15 but shall not be long enough to "loop" and shall present a neat and workmanlike appearance.
16 • SO cord slack may be tie-wrapped to the cable supports. Tie-wraps shall be UL listed for UV resistance.
17 • Luminaire field wired flexible cord installations shall be connected per NEC 410.62.

18
19 Surface Mounted (unfinished spaces):

- 20 • Provide direct conduit and box connection.

21
22 Surface Mounted (finished spaces):

- 23 • Provide direct conduit and box connection. Use surface metal raceway where indicated on drawings.
24 Conceal box and conduit where appropriate. Flexible metal conduit shall not be used where the conduit is
25 exposed.

26
27 **OWNER TRAINING**

28 All training provided for the Owner shall comply with the format, general content requirements and submission
29 guidelines specified under Section 01 91 01 or 01 91 02.

30
31 **END OF SECTION**

**SECTION 28 10 00
ACCESS CONTROL SYSTEM**

PART 1 - GENERAL

SCOPE

This specification section describes the products and execution requirements relating to the furnishing, installation, testing, and commissioning of a complete Access Control System and placing it into satisfactory operation.

This system is an extension of the existing Access Control System.

In general, work consists of installation of new access control field devices and all associated cabling as part of this project.

Included are the following topics:

PART 1 - GENERAL

- Scope
- Related Work
- Quality Assurance
- References
- Submittals

PART 2 - PRODUCTS

- General
- Control Panel (Controller)
- Credential Readers and Keypads
- Miscellaneous Field Devices
- Cabling

PART 3 - EXECUTION

- General
- Coordination
- Continuity of Existing Services and Systems
- Installation
- Identification and Labeling
- Acceptance Testing
- Documentation
- Warranty

Major features of the Access Control System and responsibilities to furnish and/or install equipment, install cabling, and terminate cabling are as follows:

Division 08 contractor-furnished, Division 08 contractor-installed

- ADA Door Operators
- ADA Door Operator Pushbuttons
- Electric Latches and Strikes
- Push-bars with integrated request-to-exit switches
- Power-transfer Door Hinges

Division 28 contractor-furnished, Division 28 contractor installed

- Cabling:
 - ADA door operators to ADA door operator pushbuttons
 - Field Device to Controller (incl. signal and power)
 - Network Cabling (Controller to Network Switch)
 - Cable Termination at Field Devices
 - Cable Termination at Controller
- Credential Readers and/or Keypads
- Door lock Power Supplies
- Request-to-Exit Devices (PIR)
- Door Release Pushbuttons, if required
- Local Locking/Unlocking Switch, if required
- Door-Position Switches, if required

1 All raceways and pull boxes, conduit and cables supports, grounding hardware, and bonding as required for a full
2 and functioning system shall be installed and documented by this Division 28 Contractor, as detailed in this and
3 related section(s).
4

5 **RELATED WORK**

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

8 Section 08 71 00 – Door Hardware
9 Section 26 05 26 – Grounding and Bonding for Electrical Systems
10 Section 26 05 29 – Hangers and Supports for Electrical Systems
11 Section 26 05 33 – Raceway and Boxes for Electrical Systems
12 Section 26 05 53 – Identification for Electrical Systems
13

14 **QUALITY ASSURANCE**

15 **Bidder Qualifications**

16 The intent of these quality assurance requirements is to ensure that the installing contractor has the capabilities
17 to engineer, install, and commission the devices as specified under this section.
18
19

20 Installing contractor must be a firm specializing and experienced in Access Control system installation for no less
21 than 3 years.
22

23 Installing contractor must be a branch office or an authorized representative of the manufacturer of the existing
24 Access Control System identified in the above article "SCOPE". Such authorization must have been in effect for
25 a period of not less than three years at the time of Bidding and remain so throughout project.
26

27 Installation of equipment and cabling shall be done by qualified staff in the direct employ or directly
28 subcontracted and under the supervision of the manufacturer or Authorized Representative.
29

30 **REFERENCES**

31 All materials shall be listed by UL and shall bear the UL label. If UL has no published standards for a particular
32 item, then other national independent testing standards shall apply, and such items shall bear those labels.
33 Where UL has an applicable system listing and label, the entire system shall be so labeled.
34

35 Other applicable standards are as follows:

36 ANSI/IEEE C2 - National Electrical Safety Code
37 SPS Chapter 316 – Wisconsin Dept. of Safety and Professional Services Electrical Code
38 FCC Part 15 as applicable to the equipment type(s) included
39 UL 294 Standard for Access Control System Units
40

41 **SUBMITTALS**

42 **General**

43 Under the provisions of Division 1, prior to the start of work, submit:

- 44 • Bidder Qualifications
 - 45 • Shop Drawings
- 46
47

48 Group Submittals to include complete documentation of related systems, products, and accessories in a single
49 submittal.
50

51 Submittals shall be original catalog sheets, photocopies, or electronic format (ADOBE Portable Document format
52 ".pdf") thereof. Facsimile (fax) sheets shall not be accepted.
53

54 **Bidder Qualifications**

55 Furnish documentation of contractor capabilities as identified under "Quality Assurance / Bidder Qualifications"
56 above.
57

58 Where installing contractor is an authorized representative of the Card Access System manufacturer, submit
59 written confirmation of such authorization from the manufacturer. Indicate in letter of authorization that installing
60 contractor has successfully completed all necessary training required for engineering, installation, and
61 commissioning of equipment. Letter should indicate the start date of such authorization.
62

63 **Shop Drawings**

- 64 • Product data for all equipment, hardware cabling and miscellaneous components proposed.

- 1 • Schematic drawings - specific to project - of all circuits from the field devices to the required connection
2 points. The diagrams shall show schematic wiring of equipment and all connections to be made to devices.
3 Terminal connections in the equipment shall be numbered to correspond to the diagrams for use in making
4 connections. Wiring diagrams shall be coordinated so that terminal numbering, circuit designation and
5 equipment or device designations are the same on all drawings. All drawings must be submitted and
6 approved by the Engineer before installation starts, but such approval will not waive specification
7 requirements unless specifically stated.
8

9 Mark submittal package with specification section number. Do not mix sections in a single submittal.

10 Work shall not proceed without Engineer approval of the submitted items.

11 No substituted materials shall be installed except by written approval from the Engineer.
12

13 **PART 2 - PRODUCTS**

14 **GENERAL**

15 All contractor-furnished items shall be compatible with the existing system as identified above.
16

17 New system devices installed as part of this project will integrate into the existing campus-wide system. No
18 substitutions will be allowed unless otherwise noted.
19

20 Licensing where applicable will be provided by the owner.
21

22 **CREDENTIAL READERS AND KEYPADS**

23 **Proximity Card Reader**

24 Match Existing
25

26 **Keypad**

27 Match Existing
28

29 **MISCELLANEOUS FIELD DEVICES**

30 **Request-to-Exit (REX)**

31 Match Existing
32

33 **Door Release Pushbuttons**

34 Code required exit pushbuttons shall be wired to directly remove power to the lock at the door location and not
35 through the electronic card key control panel.
36

37 Time delay to relock shall be adjusted for 30 second
38

39 Match Existing, or Schlage Cat. No. 631-AL-EX or approved equal.
40

41 **Local Locking/Unlocking Switch**

42 Local switch for locking/unlocking door(s) shall be a DPDT toggle switch with indicator LED.
43

44 **Door Position Switches**

45 Match Existing
46

47 **CABLING**

48 **General**

49 All cables shall be suitable for installation in the environment defined.
50

51 Any cabling installed unenclosed shall meet a CM, CMP, or CMR rating, as appropriate (or approved substitutes
52 as defined by the referenced NEC).
53

54 All cabling exiting a building underground in conduit shall be UL listed for direct burial.
55

56 Cables shall be Underwriters Laboratory (UL) listed and comply with Article 800 (Communications Circuits) of the
57 National Electrical Code.
58
59
60
61
62
63
64

1 **Field Device to Controller**

2 Per manufacturer's recommendations.

3
4 **Horizontal (Telecom) Cabling**

5 Match Existing

6
7 **PART 3 - EXECUTION**

8
9 **GENERAL**

10 The complete installation shall be done in a neat, workmanlike manner in accordance with Division 26 of these
11 documents and manufacturer's recommendations.

12
13 **COORDINATION**

14 Coordinate with the Division 08 contractor regarding the doorframes and hardware equipment which is
15 associated with the Access Control System. Verify rough-in and installation requirements for all door frame
16 mounted and/or door mounted control and monitoring equipment.

17
18 Prior to start of construction, confirm installation requirements with the Construction Manager. The coordination
19 shall include, but not be limited to, hardware, cabling and wiring requirements including types, sizes, color-coding
20 schemes, labeling, wire way requirements, termination responsibilities, and cable identification requirements.

21
22 Prior to the start of system installation, schedule and facilitate a pre-installation meeting with the pertinent
23 hardware, lock, exit device, and door closer manufacturers' representative(s), and related trades to coordinate
24 materials, techniques, and to sequence complex hardware items and system installation. Proper installation and
25 adjustment of hardware is to be reviewed. Convene at least one week prior to commencement of access control
26 installation. Provide written documentation of the meeting including: date, attendee/participant list and minutes.
27 Distribute to A/E and Construction Manager within seven (7) days of the meeting date.

28
29 Coordinate with Division 26 installer to confirm required cabling pathways, device rough-ins, and line-voltage
30 power requirements.

31
32 Coordinate hardware placement, cabling, and interface requirements relating to elevator cab-mounted credential
33 readers (if applicable) with the elevator contractor.

34
35 **CONTINUITY OF EXISTING SERVICES AND SYSTEMS**

36 No outages shall be permitted on existing systems except at the time and during the interval specified by
37 Construction Manag4er and site representatives. Obtain written approval for any outages.

38
39 Any outage must be scheduled when the interruption causes the least interference with normal site schedules
40 and business routines. No extra costs will be paid to the Contractor for such outages which must occur outside
41 of regular weekly working hours.

42
43 This Contractor shall restore any service interrupted as a result of this work to proper operation as soon as
44 possible.

45
46 **INSTALLATION**

47
48 **General**

49 Receive, store, and install Access Control System equipment and cabling as specified.

50
51 Comply with the manufacturer's instructions and recommendations for installation of all products.

52
53 Provide all system wiring between all components in accordance with manufacturer's guidelines. Each cable for
54 each device shall be home run. No splices are allowed unless otherwise noted.

55
56 Intermediate termination points within a wire run would be considered a splice. If intermediate termination points
57 are allowed, with prior approval of the Construction Manager and the Engineer, provide pull boxes and terminal
58 strips permanently labeled with the numbering scheme per Construction Manager's requirements.

59
60 Mount all credential readers where shown on plans. Placement shall be in accordance with Americans with
61 Disabilities Act (ADA) requirements.

1 Locate all request-to-exit motion detectors directly above the door frame, centered on the door opening (as
2 applicable). Adjust sensitivity to permit operation on motion of persons within 2'-0" of door. Avoid false activation
3 by persons passing by where possible.
4

5 Provide wiring to request-to-exit devices located in electrified door hardware.
6

7 **Controller Installation - General**

8 Install, wire, and power per manufacturer's recommendations and matching existing cabling.
9

10 **Cable Installation - General**

11 Field Device cables shall be installed in a raceway unless otherwise noted.
12

13 Where cables are to be installed unenclosed (without raceway) the cable shall meet NEC requirements for the
14 application and installation environment. See Cable Installation - Unenclosed below.
15

16 Route system cabling to equipment per the Access Control System installation diagrams. Provide all
17 interconnecting cabling from the head-end, between controllers, and between peripheral devices.
18

19 Install and terminate cable as required at each door location.
20

21 **Cable Installation - Unenclosed**

22 Cabling shall be neatly run at right angles and be kept clear of other trades work.
23

24 Support cabling at a maximum of 4-foot intervals utilizing "J-Hook" or "Bridle Ring" supports anchored to
25 structure. Cable sag at mid-span shall not exceed 6-inches. Install supports to maintain cable bend to larger than
26 the minimum bend radius.
27

28 Do not attach-to or support cabling from existing cabling, plumbing or steam piping, ductwork, suspended ceiling
29 supports, or electrical or communications conduit. Do not place cable directly on the ceiling grid or attach cable
30 in any manner to the ceiling grid wires.
31

32 Provide 4-feet slack in each cable in accessible ceiling at each device location. Secure cable slack—coiled from
33 100% to 200% of the cable recommended minimum bend radius— (wire tied) at the last cable support before the
34 cable reaches the device and shall be.
35

36 All cable shall be free of tension at both ends. Provide strain relief connectors at each device and junction box
37 where cables enter.
38

39 Cable manufacturers minimum bend radius shall be observed in all instances. Care should be taken in the use
40 of cable ties to secure and anchor the station cabling. Ties should not be over tightened as to compress the
41 cable jacket. No sharp burrs should remain where excess length of the cable tie has been cut.
42

43 All exposed vertical cable extensions to devices located below the finished ceiling shall be in conduit.
44

45 Use suitable cable fittings and connectors.
46

47 When permitted in exposed ceiling areas as designated on the plan drawings, Free-Air wiring runs shall avoid
48 areas of high traffic (i.e., aisle way), shall be run as close as possible to outlining walls and shall be a minimum of
49 ten (10) feet above finished floor. Provide protection for exposed cables where subject to damage.
50

51 **Field Device Installation**

52 Field devices are shown on the drawing locations diagrammatically and shall not be used for dimensioning of
53 final location. The exact location of door control devices shall be determined by the Division 28 contractor and
54 verified with the General and Division 08 contractors.
55

56 Multiple devices (i.e., intercoms, card readers, etc.) at door locations shall be mounted adjacent to each other.
57

58 Mount Credential Readers at 42" AFF to center unless noted otherwise on drawings.
59

60 Card reader stations shall not be mounted back-to-back on a common wall. Maintain separation to eliminate one
61 card reader reading through the wall to a card reader on the opposite side.
62

63 The Division 26 contractor shall make all 120-volt connections to access control panels, and at remote and local
64 door power supply locations as indicated on the drawings.

1 **Door Control Interface Wiring**

2 Obtain from the Division 08 contractor all necessary cut sheets, wiring diagrams, and manufacturer's installation
3 instructions.

4
5 Install door control wiring at each door location according to manufacturer's wiring instructions and as provided
6 by the hardware supplier, including standard locations and all special function controls for interlocking doors and
7 fire release door locations.

8
9 **Emergency Door Release**

10 There are two types of emergency door release events:

- 11 • Condition 1 – Emergency Fire Alarm
12 Doors that receive their lock power from centralized power supplies adjacent to the access control panels:
13 This door type, which, when scheduled to be unlocked in a Condition 1 - Emergency Fire Alarm condition,
14 shall unlock from a fire alarm interface control module at the centralized power supply. When activated, the
15 fire alarm interface control module removes power to the power supply that feeds the locks.

16
17 Doors that are associated with crash bars and rim mounted electric locks: The electrical in-rush current of
18 these devices makes it necessary to control these locks from a local power supply provided with the device.
19 This door type, which, when scheduled to be unlocked in a Condition 1 - Emergency Fire Alarm condition,
20 shall unlock from a fire alarm interface control module located at the door's local power supply.

- 21
22 • Condition 2 – Emergency Response
23 Doors that receive their lock power from centralized power supplies adjacent to the access control panels:
24 This door type, which, when scheduled to be unlocked in a Condition 2 - Emergency Response condition,
25 shall unlock from the key switch control located per the drawings at the fire alarm control panel located in the
26 lobby. When activated, the key switch removes power to the power supply that feeds the locks.

27
28 Doors that are associated with crash bars and rim mounted electric locks: The electrical in-rush current of
29 these devices makes it necessary to control these locks from a local power supply provided with the device.
30 This door type, which, when scheduled to be unlocked in a Condition 2 - Emergency Response condition,
31 shall unlock from the same key switch control as noted above. When activated, the key switch removes
32 power to the power supply that feeds the locks.

33
34 **IDENTIFICATION AND LABELING**

35 Label all installed electronic access control cabling and equipment. Match existing labeling scheme and
36 methods.

37
38 Prior to installation, the Contractor shall provide samples of all label types planned for the project. These
39 samples shall include examples of the lettering to be used.

40
41 Label cables with the architectural door number for the opening served, the room number the opening is located
42 in, the type of door device they serve ("reader", "REX", "lock", etc.), a unique numerical identification number for
43 the control panel it originates in, and the room number the control panel is located in, on both ends of the cable.
44 Example: "DOOR 1234A / RM 1234 / READER / CP 1 / RM B123".

45
46 All system wiring shall be color coded as required by Agency. Maintain color coding and labeling throughout the
47 system at all accessible locations to the cabling.

48
49 **ACCEPTANCE TESTING**

50
51 **General**

52 Conduct acceptance testing according to a schedule coordinated with the Owner and Construction Manager.

53
54 Prior to testing, provide a summary of the proposed test plan. Test plan shall include – at minimum – proposed
55 schedule, list of tests to be performed, equipment to be used, set-up, expected results and documentation
56 format.

57
58 Testing shall not proceed without approval by the Engineer.

59
60 Schedule shall allow time for correction of defects and remedial work.

61
62 Representatives of the Owner may be in attendance to witness the test procedures. Provide a minimum of one
63 (1) week advance notice to allow for such participation.
64

1 Supply all equipment and personnel necessary to conduct the acceptance tests.

2
3 Perform tests related to connected equipment of others only with the permission and presence of Contractor
4 responsible for that equipment.

5
6 Document all tests. Refer to the Article "DOCUMENTATION" below which details requirements.

7
8 **Cable Testing**

9 Visually inspect all cabling and termination points to ensure that they are complete and conform to the wiring
10 pattern defined herein. Provide the Engineer with written certification that this inspection has been made.

11
12 Test all cables for continuity, ground faults or line-to-line short circuits.

13
14 Test Field Device cables as applicable to verify resistance in both door-open and door-closed conditions.
15 Document results on a chart that lists each door and the measured resistance of each conductor pair.

16
17 **System Testing**

18 At minimum, verify the following are properly wired and labeled:

- 19
 - Field Devices
 - Associated equipment such as Power Supplies.

20
21
22 Prior to the commencement of the Acceptance Tests, verify the installation and configuration of software related
23 to the operation and control of the Access Control System.

24
25 Assist Construction Manager in testing overall functionality of the Access Control System. The tests shall include
26 verification of the following:

- 27
 - The functional operation of each controlled access door and circuit.
 - Demonstrate normal and abnormal modes of operation and required responses to each.

28
29
30 **DOCUMENTATION**

31
32 **General**

33 Upon completion of the installation, provide project documentation to the Engineer for review.

34
35 Documentation shall include the items detailed in the sub-sections below. Provide approved test results and
36 documentation in Operating and Maintenance Manuals.

37
38 At the request of any of the parties listed above, provide copies of the original test results.

39
40 Provide chart listing test results (resistance) for each controlled door.

41
42 All documentation, including hard copy and electronic forms shall become the property of the State.

43
44 **Operation and Maintenance Manuals**

45 Submit quantities required by Division 1 and Section 26 05 00.

46
47 Provide documents in electronic format (Adobe Acrobat .pdf) and (when requested) hard copy.

48
49 At minimum, O&M Manuals shall include:

- 50
 - Drawings annotated to show as-installed field device locations, cable routes, and major equipment locations
 - Cabling Schematics
 - Approved Submittals
 - Test plan and test report sheets

51
52
53
54 **WARRANTY**

55 This Contractor shall guarantee the following for a period of two (2) years from date of substantial completion of
56 this work:

- 57
 - All provided materials and equipment
 - Installation of all equipment, hardware, cabling, and related components.

58
59 Warranties shall include labor, materials, and travel time.

60
61
62 See Division 1, GENERAL CONDITIONS, and GENERAL REQUIREMENTS - Guarantee Documents and the
63 individual technical sections for further requirements.
64

ICA
30 NOVEMBER 2022

1 If while fulfilling requirements of this warranty, the Contractor disturbs other work, the Contractor shall arrange for
2 such disturbed work to be restored to its original condition by the responsible Contractor. This shall be at no cost
3 to the State.
4
5

END OF SECTION

**SECTION 28 31 00
FIRE DETECTION AND ALARM**

Included are the following topics:

PART 1 - GENERAL

Scope
Related Work
Description of Work
Regulatory Requirements
Manufacturer Provided Services
Quality Assurance
Qualifications
Submittals
Department of Safety & Professional Services Plan Review
Project Record Drawings
Operation and Maintenance Data
Product Delivery, Storage and Handling
Supervision
Power Requirements

PART 2 - PRODUCTS

Enclosures
Fire Alarm Control Panel
Operation - Fire Alarm System
Central Monitoring
One Way Voice Communication Sub System
Remote Annunciator Panel
NAC Booster Panels
Multiplex/Intelligent Peripheral devices
Conventional Peripheral Devices
Audio Visual Notification Appliances
Printers
Special Devices

PART 3 - EXECUTION

General
Raceways
Free Air Wiring
Conductors
Device Mounting
Identifications
Testing
Warranty
Training
Special Considerations

PART 1 - GENERAL

SCOPE

The work covered by this section of the specifications includes the furnishing of all labor, equipment, materials, and performance of all operations associated with the installation of the new Fire Alarm System as shown on the drawings and as herein specified.

RELATED WORK

The work covered by this section of the specifications shall be coordinated with the related work as specified elsewhere under the following project sections:

Section 07 84 00 - Fire Stopping
Section 26 05 00 - Common Work Results for Electrical
Section 26 05 02 - Electrical Demolition
Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cable
Section 26 05 26 - Grounding and Bonding for Electrical Systems
Section 26 05 29 - Hangers and Supports for Electrical Systems
Section 26 05 33 - Raceway and Boxes for Electrical Systems
Section 26 05 53 - Identifications for Electrical Systems

1 Section 26 27 26 – Wiring Devices

2
3 **DESCRIPTION OF WORK**

4 Add devices and wiring to the existing fire alarm system as shown on the plans. New devices shall be of the
5 same manufacture and models as existing and be compatible with the existing system.

6
7 The complete installation shall be done in a neat, workmanlike manner in accordance with the applicable
8 requirements of NFPA 70 - Article 760 and the manufacturer's recommendations.

9
10 **REGULATORY REQUIREMENTS**

11 The complete installation shall conform to the applicable sections of the latest edition of the following Codes
12 and Standards:

13
14 NATIONAL FIRE PROTECTION ASSOCIATION (NFPA):

15 NFPA-70	National Electrical Code (NEC) Generally, and Article 760 in particular
16 NFPA-72	National Fire Alarm Code
17 NFPA 101	Life Safety Code
18 IBC	International Building Code
19 IFC	International Fire Code
20 IMC	International Mechanical Code

21
22 STATE OF WISCONSIN – DEPARTMENT OF SAFETY AND PROFESSIONAL SERVICES (DSPS)

23 SPS 361.30	Plan Review Approval
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24
25 NATIONAL ELECTRICAL MANUFACTURER'S ASSOCIATION (NEMA)

26
27 UNDERWRITERS' LABORATORIES, INC. (UL)

28 UL-864	Control Units for Fire Protective Signaling Systems
29 UL-268	Smoke Detector for Fire Protective Signaling Systems
30 UL-217	Smoke Detectors for Single and Multiple Station
31 UL-521	Heat Detectors for Fire Protective Signaling Systems
32 UL-464	Audible Signaling Appliances
33 UL-1971	Visual Signaling Appliances
34 UL-38	Manually Actuated Signaling Boxes
35 UL-1481	Power Supplies for Fire Protective Signaling Systems

36
37 **MANUFACTURER PROVIDED SERVICES**

38 A manufacturer-trained service technician shall provide the following installation supervision. This Techni-
39 cian shall be certified by the equipment manufacturer and shall have had a minimum of two (2) years of
40 service experience in the fire alarm industry.

41
42 The technician's name shall appear on equipment submittals and a letter of certification from the fire alarm
43 manufacturer shall be sent to the project engineer. The manufacturer's service technician shall be
44 responsible for the following items:

- 45 • Pre-installation visit to the job site to review equipment submittals and verify method by which
46 the system should be wired.
- 47
- 48 • Periodic job site visits to verify installation and wiring of system, and to perform any partial
49 system programming – required to permit portions of the existing system to be removed.
- 50
- 51 • Upon completion of wiring, final connections shall be made under the supervision of this
52 technician, and final checkout and certification of the system.
- 53
- 54 • At the time of final checkout, technician shall give operational instructions to the Owner and/or
55 his representative on the system.
- 56
- 57 • All job site visits shall be dated and documented in writing and signed by the Electrical
58 Contractor. Any discrepancy shall be noted on this document and a copy kept in the system
59 job folder that shall be available to the Project Engineer any time during the project.
- 60

61 **QUALITY ASSURANCE**

62 Unless specifically stated otherwise, each and all items of the fire alarm system shall be listed as a product
63 of a SINGLE fire alarm system manufacturer under the appropriate category by Underwriters' Laboratories,
64 Inc. (UL), and shall bear the UL label.

1 Notification Appliances may be products of a single, different manufacturer – provided that the Primary
2 Equipment Provider or Manufacturer provides written documentation of compatibility and agrees to assume
3 any and all responsibility for compatibility with the Control Equipment.
4

5 In addition to previously listed UL standards, all control equipment shall be listed under the following UL
6 Standards:

7 UOJZ UL category UOJZ as a single control unit. Partial listing shall NOT be acceptable.
8 UL 864 Transient protection
9 UL 497B Isolated Loop Circuit Protectors. Where fire alarm circuits leave the building, additional
10 Transient protection must be provided for each circuit.
11 UL 1481 Power Limited Applications.
12

13 **QUALIFICATIONS**

14 All equipment shall be supplied by a firm, which specializes in fire alarm and smoke detection systems with
15 a minimum of five (5) years-documented experience. The company shall be an authorized distributor of the
16 proposed equipment
17

18 All work shall be performed by a licensed contractor, who is regularly engaged in the installation and
19 servicing of fire alarm systems. Proof of five (5) years documented experience and of factory authorization
20 to furnish and install the equipment proposed shall be furnished prior to contract award, if required by
21 Division of Facilities Development.
22

23 Contractor shall be located within three (3) hours of travel time or less from the site of this project.
24

25 **SUBMITTALS**

26 Under the provisions of Section 26 05 00 and Division 1, submit the following for approval prior to ordering
27 any equipment in accordance with requirements of Division 1, General Conditions. Provide information
28 detailed below only as applicable for the added, removed, or revised devices and wiring.
29

30 Copies of CAD Files (AutoCAD, latest version) for the Fire Alarm floor plans will be made available to the
31 successful bidder for preparation of the required shop drawings and as-builts
32

33 **REQUIRED SUBMITTAL MATERIALS**

34 The following items, and any additional items required per Section 26 05 00, shall be included within the
35 submittal package:
36

37 Although they may be submitted under separate cover, Submittal Brochures / Booklets / Binders and
38 Shop Drawings shall be submitted together, and shall be treated as a complete set.
39

40 **COVER SHEET:**

41 The submittals shall contain a cover sheet, which shall include the following information:
42

43 Submittal Date
44 Specification Section(s)
45 Electrical Contractor (Contact Name, name, address, and telephone number)
46 Project Name, Project City, Project State, and Project Address.
47

48 **TABS AND TABLE OF CONTENTS:**

49 The Table of Contents shall appear immediately behind the Cover Sheet, and shall contain a complete
50 listing of all of the tabs contained within the binder / booklet.
51

52 Tabbed index sheets shall be inserted into each of the binders, such that each binder is clearly sub-
53 divided into sections. Tabbed sections shall be provided, at minimum, for the following:
54

- 55 • One section for each building – All submittal data, which applies to any particular building, shall
56 be located within the tabbed section for the corresponding building. All submittal data within
57 each “building” section shall appear in the same order.
58

59 One section for manufacturer’s data sheets – divided into sub-sections for the following:
60

- 61 • Panel Equipment (Panels, Panel Components / Modules, Printers, Annunciators, etc.)
- 62 • Addressable Field Devices (Initiating and Control / Monitoring / Isolation)
- 63 • Non-Addressable Field Devices (Initiating Devices, relays, etc.)
- 64 • Notification Appliances

- Fire-Fighter Communications Equipment if applicable

EQUIPMENT LIST:

A complete equipment list of all components, including the following: Quantity, Manufacturer, Part Number, and Description. If the supplier uses different part numbers from those of the actual manufacturer, the actual manufacturer and part numbers as they appear – marked on the shipping box / packages, shall also be identified on this list.

Each Equipment List shall include a complete listing of the modules, components, and software included for each modular FIRE Alarm Control Panel, Network Panel, Transponder, Outboard Gear Panel or Annunciator. Such items shall be listed in a manner that clearly indicates that such items are parts of / components of a larger unit. Simply stating a single part number and description for such panels shall be unacceptable.

A separate list shall be included for each section, with items grouped by system.

For projects involving multiple systems, separate equipment lists shall be provided - one for each system.

Spare Parts shall also be listed separately, and shall be identified clearly as "Spare Equipment".

PRODUCT DATA:

Manufacturer's product data sheets, and equipment description of all system components. These data sheets shall be highlighted or suitably marked, so that included items and options are indicated. On data sheets that include multiple products, products that are not used shall be crossed out.

Product Data Sheets shall be organized, in order, corresponding to the first occurrence of the corresponding item on the equipment list

SEQUENCE OF OPERATION:

Complete sequence of operations of all functions of the system. This sequence of operation shall be custom created for this particular job.

In order to satisfy this submittal requirement, it shall be acceptable to include copies of the "Operation" portions of the specifications, including any applicable schedules / other supplementary information. Copied specification pages shall be marked and highlighted, where the programmed operation will differ from the specified operation. Copied specification pages shall be marked "no changes", where no significant deviation will occur. Other acceptable alternatives shall include written narratives, organized in a logical manner, and Matrix Charts.

Where Matrix Charts are provided, such charts shall be organized and labeled clearly, and shall incorporate suitable levels of detail (refer to NFPA-72 (2007) **A.10.6.2.3(9)** for an example of an acceptable matrix chart). The Leftmost column of the Matrix Chart shall include groupings of initiating devices and other function switches. The Topmost Row shall include groupings of notification appliances and output devices.

BATTERY CALCULATIONS:

These calculations shall clearly illustrate both the Standby and Alarm loads, due to the various field devices and panel components / modules. It is generally recommended to submit such calculations in a "spreadsheet" format. These calculations shall include any reserve / additional capacity, as required elsewhere within these specifications. Final results shall indicate both the minimum battery capacity required and the capacity actually provided.

AMPLIFIER CAPACITY CALCULATIONS

For all speakers plus all required spare capacity.

ADDRESSABLE DEVICE / DESCRIPTOR LIST - Prior to programming the system, submit a chart or printout, listing every system address provided for purposes of alarm initiation, status monitoring, supervised signaling, and auxiliary controls. This printout shall include the corresponding device type and field programmable "custom labels", as they will be displayed on the System – at the FACP and Local Annunciator. The addresses listed within this document shall directly correspond to the addresses marked on the submitted floor plan drawings. This list will be modified as needed by the Owner and returned to the contractor for final programming into the system.

1 **NAC WIRE DROP CALCULATIONS:**

2 Calculations shall be provided for all Notification Appliance Circuits (NAC) in the building. It is
3 recommended that this calculation should follow a “spreadsheet” format, and should clearly indicate the
4 following:

- 5
- 6 • The name of the circuit
- 7 • Point of origin of the circuit
- 8 • Complete list of all devices served by the circuit, including location and type of each device
- 9 • Alarm Current Draw for each device, at the applied voltage
- 10 • Applied Voltage (Based on anticipated battery voltage after specified stand-by & alarm
11 operation)
- 12 • Acceptable Operating Voltage for each type of device on circuit
- 13 • Calculated Voltage at each device on circuit
- 14

15 These calculations should mathematically prove that all Notification Appliances on the circuit will receive
16 acceptable power for proper operation, under “worst-case-scenario” conditions.

17

18 **SHOP DRAWINGS:**

19 All submitted drawings shall be created using AutoCAD, and shall be coordinated so that terminal
20 numbering, circuit designation and equipment or device designations are the same on all drawings. All
21 drawings must be submitted and approved by the engineer before ordering or fabrication starts, but
22 such approval will not waive any specification requirements unless specifically stated. The Architect
23 and/or Engineer shall provide copies of the floor plan drawings, in AutoCAD, to the successful bidder.

24

25 Each and every sheet of the Shop Drawings shall be clearly and prominently identified as “SHOP
26 DRAWINGS – PREPARED BY: (insert name of contractor firm preparing the shop drawings)”. The
27 name and company logo for the Electrical Contractor should be added to the title block in each sheet,
28 and a revision date shall be inserted on each sheet.

29

30 The submitted Shop Drawings shall include the following types of drawings:

31

32 **PROJECT-SPECIFIC DRAWINGS:**

33 Project-Specific Drawings. These drawings shall include the following:

34

35 **SYSTEM RISER DRAWING:**

36 A separate riser drawing shall be furnished for each system. Each System Riser shall illustrate all
37 fire alarm circuits, which serve the facility, and shall incorporate the following information, in a clear,
38 concise format:

- 39
- 40 • Point of origin of each circuit (usually a Panel, or a Module within a panel)
- 41 • Circuit type and labeling
- 42 • Area served by each circuit
- 43 • Wire / cable type and size
- 44 • Locations of Panelboards where primary system power is obtained
- 45

46 The following information for each Field Device:

- 47 • Device Type
- 48 • Circuit(s) to which device is connected
- 49 • Locations of any End-Of-Line Resistor (EOLR)
- 50 • (and the circuit terminated by any such EOLR)
- 51

52 **BLOCK DIAGRAMS:**

53 Showing layout and operation of the entire system.

54

55 **FLOOR PLANS:**

56 These drawings shall consist of edited versions of the Contract Documents, which shall include the
57 following information:

- 58
- 59 • Fire Department Response Location(s)
- 60 • Annunciator Location(s)
- 61 • Panel Location(s)
- 62 • Device Addresses - The addresses shown on these drawings shall directly correspond to
63 the chart or printout, as specified previously, which spells out specific information about
64 each device, including the field programmable “custom label”.

1
2 **TYPICAL DEVICE / MODULE WIRING DETAILS:**

3 Component and module wiring diagrams – intended to illustrate terminations and wiring connections to each
4 typical Field Device (Detectors, Notification Appliances, etc.), and each typical panel component / module
5 utilized within the system. This set of drawings shall only include diagrams for modules and components,
6 which are actually used in the provided system(s).

7
8 These drawings shall incorporate clear labeling / nomenclature, which shall clearly indicate the
9 corresponding field device or module, to which it corresponds.

10
11 OMISSION OF ANY OF THE ABOVE MATERIALS FROM THE SUBMITTALS SHALL RESULT IN AN
12 IMMEDIATE REJECTION OF THE SUBMITTALS FOR THIS PROJECT. If the Contractor has any
13 questions concerning the preparation of these materials, please contact the Engineer.

14
15 **DEPARTMENT OF SAFETY AND PROFESSIONAL SERVICES PLAN REVIEW**
16 **REQUIRED DOCUMENTS** (per building)

17
18 If this project requires a submittal to the Department of Safety and Professional Services for review and
19 approval. The following details the requirements of the contractor and the A/E with regard to the fire alarm
20 Department of Safety and Professional Services submittal.

21
22 **CONTRACTOR'S RESPONSIBILITY**

- 23 a) Department of Safety and Professional Services approval is required prior to the start of fire alarm
24 system construction. The contractor shall prepare and submit the required documents in a timely
25 fashion to meet this requirement. If the contractor starts fire alarm system construction before
26 approval is given by the Department of Safety and Professional Services, the contractor is
27 responsible for all additional fees required by the Department of Safety and Professional Services.
- 28 b) Initially, prepare one set of the Department of Safety and Professional Services fire alarm submittals
29 and send it to the A/E for approval before proceeding with actual submittal to DSPS.
- 30 c) Contractor shall follow DFD's AutoCAD standards when preparing fire alarm shop drawings, using
31 information consistent with the project's construction drawings.
- 32 d) After obtaining A/E approval to proceed with the Department of Safety and Professional Services
33 fire alarm submittal, prepare four (4) sets of the fire alarm shop drawings as approved by the A/E
34 that will be sent to the Department of Safety and Professional Services by the contractor. These
35 shop drawings shall be stamped, signed and dated by a Wisconsin registered architect,
36 professional engineer or electrical designer taking responsibility for the shop drawings. Signing
37 and sealing shall comply with SPS 361.31(1). Note that each shop drawing copy must be stamped,
38 signed and dated unless there is a drawing index sheet, in which case only the four index sheets
39 need to be stamped, signed and dated. Where the submitter is both the designer and installer of
40 the fire alarm system, a signature only will suffice [ch. 443.14(6), Stats.]. It shall be an original
41 signature and date.
- 42 e) Prepare one bound booklet of the fire alarm system device cut sheets and all calculations
43 (indicating device power calculations, voltage drop calculations and battery calculations). These
44 booklets do not need to be stamped, signed or dated.
- 45 f) Prepare a letter of transmittal listing all items being sent to the Department of Safety and
46 Professional Services. Copy the A/E on the letter of transmittal only.
- 47 g) Complete the Application for Review, Buildings, HVAC, Fire and Components – SBD-118 form.
- 48 h) Calculate the SDB-118 submittal fee; write a check for the appropriate amount, payable to Safety
49 and Professional Services.
- 50 i) Schedule a plan review date with Department of Safety and Professional Services, Division of
51 Safety and Buildings by visiting this website and completing the online request form.
52 http://apps2.commerce.wi.gov/SB_PlanReviewApp/Bldg/TaskList?ptid=0&action=new
- 53 j) Assemble the submittal and send the documents described in items (d), (e), (f), (g) and (h) above
54 to the Department of Safety and Professional Services at the appropriate address shown on at the
55 bottom of DBS-118.
- 56 k) If requested by DFD, A/E, Department of Safety and Professional Services or its authorized
57 representative, additional data pertaining to the construction, materials and equipment shall be
58 submitted to the A/E to substantiate conformance to SPS 361 code.

59
60 **PLAN REVIEW FEES**

61 Fees shall be determined in accordance with Table 302.31-1 or Table 302.31-2 found in Chapter SPS 302 of
62 the Wisconsin Administrative Code.

1 Reduced plan review fees (Table 302.31-2) may be utilized for projects in municipalities that perform
2 inspections as an agent of the Division of Safety & Buildings.

3
4 Reduced fees (Table 302.31-2) do **not** apply to State-owned buildings.

5
6 In addition to the plan review fee, a plan entry fee of \$100 shall be included with each submittal.

7
8 Per SPS 302.10, plan review fees shall be **doubled** for projects where the installation, erection or
9 construction was initiated without the required Departmental approval.

10
11 **WHAT TO SUBMIT**

12 a) Four (4) sets of properly signed/sealed fire alarm plans.

13 In an effort to limit handling and mailing costs, the submitter may opt to submit one (1) complete set of plans
14 and three (3) index sheets. The plan set will be retained. A copy of the approval letter will be attached to
15 the index sheets and returned. It shall then be the responsibility of the submitter to properly attach the
16 approval and index page to plans matching the copy on file with the Department.

17 A maximum of five (5) plan sets may be submitted. Additional plan sets (in excess of 5) will incur a \$25/set
18 fee.

19 b) One (1) set of battery calculations.

20 b) One (1) set of voltage-drop calculations for each notification circuit.

21 d) One (1) copy of applicable material data sheets.

22 e) A detailed, project-specific 'Sequence of Operation' which clearly identifies all functions of the fire
23 alarm system, including the transmission of alarm, supervisory and trouble signals to an approved
24 supervising station.

25 f) A completed SBD-118 application form. The application must identify the Transaction ID No.
26 related to the parent building review approval. Fire alarm submittals for new construction, building
27 additions or building alterations cannot be reviewed prior to building plan approval.

28 The original supervising professional's signature for the building project is applicable to fire alarm
29 submittals and a separate signature is not required. Standalone fire alarm system submittals do not
30 require a supervising professional.

31 g) Plan review fee.

32
33 **FORMS**

34 SBD-118 (R11/11) can be downloaded from: <http://dsps.wi.gov/sb/docs/sb-Form118App.pdf> (PDF) or
35 <http://dsps.wi.gov/sb/docs/SB-Form118App.doc> (Word)

36
37 Visit Department of Safety and Professional Services, Division of Safety and Buildings Commercial Buildings
38 Plan Review info website for additional information:

39 <http://dsps.wi.gov/Plan-Review>

40
41 For scheduling of building, HVAC, and fire plans, use the electronic online request for commercial building
42 plan appointments: http://apps2.commerce.wi.gov/SB_PlanReviewApp/Bldg/TaskList?ptid=0&action=new

43
44 Once approved, Safety and Buildings will retain one of the sets, and will return three sets, which shall be
45 distributed as follows:

46
47 (1) Copy shall be retained by the Electrical Contractor on-site, and shall be used as a reference
48 / made available to any Department of Safety and Professional Services inspectors, who may make
49 periodic inspection visits to the site.

50
51 (1) Copy shall be forwarded to the Owner for their records.

52
53 (1) Copy shall be kept on site, at or near to the FIRE Alarm Control Panel.

54
55 **PROJECT RECORD DRAWINGS**

56 Installing Electrical Contractor shall submit to the Architect/Engineer for approval the as-built drawings for
57 the entire work done under this project prior to final payment.

58
59 Work shall be done on AutoCAD using the contract drawings provided to the Contractor by the Architect or
60 Engineer in the form of AutoCAD files. A hard copy of same shall also be submitted.

1 These drawings shall show:

- 2 • Locations and addresses of Initiation Devices, Notification Appliances, isolation devices, status-
3 monitoring devices, supervised signaling devices, and auxiliary control devices. All these devices
4 shall be shown as connected to system wiring.
- 5 • Circuit and Address information for each field device listed above.
- 6 • Conduit layout.
- 7 • Number/size/type of conductors in each conduit run
- 8 • Riser diagrams
- 9 • Location of end-of-line devices

10
11 Riser diagrams shall be specific for this project, and shall include location of emergency 120VAC panel,
12 panel designation and circuit number used to feed each fire alarm panel. Also, indicate if panel is backed up
13 by an emergency generator.

14
15 Riser diagrams shall include locations (room or area number) of notification, initiating, end-of-line devices
16 and addresses for all addressable field devices.

17
18 Also see requirements in Division 1, General Conditions.

19
20 **OPERATION AND MAINTENANCE DATA**

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

23
24 In addition to the general content specified under GENERAL REQUIREMENTS supply the following
25 additional documentation:

- 26 1. A material guide, which shall contain the replacement part numbers and description of all
27 components used. If this information is included in an instruction section for any of the equipment,
28 it will not be necessary to duplicate the list. In either case, the parts list shall be associated with its
29 respective chassis, modules or kit wherein it is found. A total listing of parts without such grouping
30 will not be acceptable.
- 31 2. Catalog data or literature
- 32 3. Manufacturer's operating instructions.
- 33 4. Manufacturer's maintenance instructions
- 34 5. Installation instructions
- 35 6. Name, address and telephone number of source for parts (i.e. keys, guards, etc) not supplied by
36 the Fire Alarm Manufacturer
- 37 7. Copies of all approved shop drawings
- 38 8. An updated copy of the submitted sequence of operation, revised to reflect any implemented
39 changes

40
41 **PRODUCT DELIVERY, STORAGE AND HANDLING**

42 Receive equipment at job site; verify applicable components and quantity delivered.

43
44 Handle equipment to prevent internal components' damage and breakage, as well as denting and scoring of
45 enclosure finish.

46
47 Do not install damaged equipment.

48
49 Store equipment in a clean, dry space and protect from dirt, fumes, water, and construction debris and
50 physical damage. Make arrangements with the Owner at the pre-construction meeting for storage of
51 equipment on the premises

52
53 **SUPERVISION**

54 The system shall report a TROUBLE condition when any supervised circuit becomes disarranged,
55 disconnected, or is manually disabled or overridden. Each supervised circuit shall be independently
56 protected for short-circuit conditions, and shall be arranged so that faults on any one circuit do not prevent
57 the proper operation of any other circuit in the system.

58
59 The following devices/circuits shall be supervised, as a minimum:

- 60 • ALL communications links.
- 61 • ALL Signaling Line Circuits
- 62 • ALL Initiating Device Circuits.
- 63 • All sprinkler flow and tamper switches..
- 64 • ALL Notification Appliance Circuits.

- 1 • Auxiliary manual control circuits.
- 2 • Manual control switches for off normal position
- 3 • Remote Control Relays / Control Modules.
- 4 • Primary, AC Incoming power to the system.
- 5 • The system's batteries.
- 6 • System Expansion Modules
- 7 • Auxiliary module LED's.

8
9 The system shall have provisions for disabling and enabling all circuits individually for maintenance or
10 testing purposes.

11
12 **POWER REQUIREMENTS**

13 Primary 120 VAC power, to all Fire Alarm equipment shall consist of dedicated branch circuits. These
14 circuits shall be of a 3-conductor type, including a suitably sized green ground wire – SHARED NEUTRALS
15 AND CONDUIT GROUNDS SHALL BE UNACCEPTABLE.

16
17 The fire alarm equipment shall receive 120 VAC power via a branch circuit from the specified designated
18 panel. The branch circuit shall supply no other loads. The location of the branch circuit overcurrent
19 protective device shall be permanently identified at the fire alarm equipment. The branch circuit shall be
20 permitted to be secured in the "ON" position to prevent accidentally de-energizing the power to the fire alarm
21 equipment. The circuit disconnecting means shall have red identification, shall be accessible only to
22 qualified personal and shall be identified as "FIRE ALARM CIRCUIT". The red identification shall not
23 damage the overcurrent protective device or obscure the manufacturer's markings. The branch circuit shall
24 not be supplied through ground-fault circuit-interrupters or arc-fault circuit-interrupters.

25
26 All fire alarm power supplies, as well as any other supplemental power supplies, shall be installed in
27 compliance with NFPA-70 – National Electrical Code (Latest Edition).

28
29 Where the new control panel is to remain at same location as the existing panel, the contractor may re-use
30 the existing branch circuit, if it meets the previously stated requirements stated above.

31
32 The control panel shall include 120 VAC electrical power surge and transient protection. If problems are
33 anticipated, due to electrical transients associated with periodic generator testing, then the fire alarm
34 equipment supplier shall provide suitable power filtering / suppression equipment, as recommended by the
35 equipment manufacturer.

36
37 The system shall include sufficient back-up battery capacity to operate the entire system as follows, upon
38 loss of normal 120 VAC power

39 For panels, which are not connected to Dedicated Emergency Power (no Generator) Branch Circuits:

- 40 • The Panel and associated devices shall operate in a normal (non-Alarm) mode for a period of 24
41 Hours. After the 24-Hour normal period has expired, sufficient capacity shall remain, such that the
42 panel and associated devices shall operate in an Alarm mode (All Speakers EVAC) for a period of
43 15 minutes.

44
45 The panel shall include a power-limited, filtered and regulated battery charger. The charger shall charge a
46 fully discharged battery to 70% in 12 hours. The panel shall monitor for AC fail / disconnect, low/no battery
47 and high battery and shall distinctly display or annunciator any abnormality. The main panel power supply
48 shall include sufficient power to power all connected field devices and an additional 25% spare power for
49 future additions without the need to add additional boards or booster power supplies. The charger shall be
50 designed specifically for, or shall be properly configured for the provided batteries, which shall be of one of
51 the following types:

- 52 • Sealed, Immobilized Electrolyte Lead-Acid type ("Gel-Cells") – Types which require fluid level
53 maintenance, or which vent significant amounts of Hydrogen shall be unacceptable.
54 Nickel-Cadmium (Ni-Cad) batteries.

55
56 All batteries used in conjunction with the fire alarm system shall be installed in accordance with NFPA-70 –
57 National Electrical Code (Latest Edition).

58
59 If these batteries are not located within or immediately adjacent to the fire alarm equipment, the location of
60 such batteries shall be clearly indicated within the fire alarm equipment served by them, and the batteries
61 and their enclosure shall be clearly marked as "FIRE ALARM"

62
63 All external circuits requiring system-operating power shall be 24VDC and shall be individually supervised
64 and fused at the control panel.

1 **PART 2 - PRODUCTS**

2
3 **ENCLOSURES**

4 All panels and peripheral devices shall be the standard product of a single manufacturer and shall display
5 the manufacturer's name on each component.

6
7 Cabinet shall be equipped with locks and transparent door panel providing tamper proof enclosure yet
8 allowing full view of the various lights and controls as required above.

9
10 **FIRE ALARM CONTROL PANEL (FACP):**

11 Utilize the existing Fire Alarm Control Panel and NAC Panels.

12
13 **OPERATION: FIRE ALARM SYSTEM**

14 The functions and operation of the existing Fire Alarm System do not require revisions. The system shall
15 continue to operate as installed. If conflicts are discovered, coordinate resolution with the Architect and
16 Engineer.

17
18 **CENTRAL MONITORING**

19 Maintain the existing Central Monitoring method/system.

20
21 **ONE-WAY VOICE COMMUNICATION SUB-SYSTEM**

22 If existing, maintain the FACP's existing Integrated, One-way Emergency Voice Communications (EVAC)
23 sub-system.

24 **REMOTE ANNUNCIATOR - FAAP**

25 If installed, an existing FAAP shall remain unmodified, except if new, added devices require annunciation.

26
27 **NAC BOOSTER PANELS (Remote Power Supplies):**

28 Where they are used, "NAC Power Booster Panels" shall be individually supervised. Interconnecting NAC
29 Booster Panels in a manner, which prevents identification of individual panel TROUBLE conditions, shall not
30 be approved. NAC Booster Panels shall be wired to dedicated Emergency Power Branch Circuits where
31 available.

32
33 If NAC Booster Panels are needed at locations other than those identified on the construction drawings, the
34 Electrical Contractor shall obtain approval for their proposed installation locations. At such locations, the EC
35 shall provide any required circuit breakers, associated power wiring, and local smoke detection at the
36 approved location. Power shall be obtained from the nearest available emergency panel. The cost of such
37 equipment and installation shall be included within the base Electrical Bid.

38
39 **MULTIPLEX/INTELLIGENT PERIPHERAL DEVICES**

40 All devices shall be supervised for trouble conditions. The system control panel shall be capable of
41 displaying the type of trouble condition (open, short, device missing/failed). Failure of a device shall not
42 hinder the operation of other system devices.

43
44 **DEVICE IDENTIFICATION**

45 Each intelligent device must be uniquely identified by an address code entered on each device at time of
46 installation. The use of jumpers to set address shall not be acceptable.

47
48 Device addressing schemes which use permanently imbedded, electronically identifiable "serial number"
49 which is similar to the address imbedded within Personal Computer Network Interface Cards shall be
50 acceptable.

51
52 Fire Alarm Systems utilizing hand-held or briefcase-style programming tools, which are used to electronically
53 assign addresses and/or programming parameters to devices shall be acceptable. However, one such
54 programmer tool shall be provided to the Owner at no additional cost.

55
56 The address along with the loop number and end-of-line device if present shall be indicated, and be visible
57 from the ground, on the device in the field using machine generated marking. Contractor shall provide a
58 sample of such labeling scheme before using it.

59
60 End-of Line devices shall also be identified by means of permanent, machine generated label, affixed to the
61 device.

62
63 Device identification schemes that do not use uniquely set addresses but rely on electrical position along the
64 communication channel are unacceptable. These systems cannot accommodate tapping and the addition

1 of an intelligent device between existing devices requires re-programming all existing devices beyond added
2 device.

3
4 The system must verify that proper type device is in place and matches the desired software configuration.

5
6 **INTELLIGENT DETECTORS - GENERAL**

7 Smoke and heat detectors must be approved by the State Engineer prior to installation.

8
9 Each detector shall incorporate the following features:

- 10 • LED(s), which shall flash to indicate communication with the Fire Alarm System, and which also
11 illuminate in a steady manner when the detector is in an alarm status
- 12 • A means to allow field function testing of the detector
- 13 • A low-profile design / shape
- 14 • An insect screen
- 15 • Voltage and RF transient suppression techniques, in order to minimize false alarms

16
17 Smoke detectors shall communicate the actual smoke chamber values to the system control panel.

18
19 Smoke detectors shall be listed for sensitivity testing from the control panel. Sensitivity test results shall be
20 logged and downloaded to a printer.

21
22 The detectors shall be plug-in units, which mount to a common base, and shall be UL 268 approved.

23
24 Each detector shall be compatible with the fire alarm panel and shall obtain its operating power from the
25 SLC, to which it is connected. (Where relay or sounder-equipped bases are used, it shall be acceptable to
26 require a separate 24 VDC or NAC connection.) Each detector shall be reset by actuating the control panel
27 reset switch.

28
29 If field conditions so require the smoke detection devices shall not be installed until the construction is
30 completed.

31
32 **INTELLIGENT DETECTOR BASES**

33 Bases shall be suitable for either smoke or heat detector mounting.

34
35 Either the base or the head shall contain electronic circuits that communicate the detector's status (normal,
36 alarm, sensitivity status, trouble, etc.) to the control panel over two wires. The same two wires shall also
37 provide power to the base and detector. Contacts between the base and head shall be of the bifurcated
38 type using spring-type, self-wiping contacts.

39
40 The base shall be lockable. The locking feature must be field-removable when not required.

41
42 Upon removal of the detector's head, a trouble signal shall be transmitted to the control panel.

43
44 The detector base shall be sealed against rear airflow entry.

45
46 Each detector's base or head shall contain LED(s), which shall flash when the detector is being scanned by
47 the control panel. The LED(s) shall turn on steady when the detector is in an alarm condition.

48
49 **INTELLIGENT PHOTOELECTRIC SMOKE DETECTORS**

50 The detectors shall contain no radioactive material.

51
52 Detectors shall be of the solid state photoelectric type and shall operate on the light scattering photodiode
53 principle using a pulsed infrared LED light.

54
55 **INTELLIGENT THERMAL DETECTORS**

56 The detectors shall be a combination rate-of-rise and fixed temperature 135 F unless noted.

57
58 Detectors shall sense within a temperature range of 32 F to 158 F. The control panel shall be capable of
59 sensing either a set point of 135 F, or a rate-of-rise of 15 degrees F per minute for fire sensing.

60
61 **MULTI-CRITERIA DETECTORS**

62 The Intelligent multi-criteria detector shall have advanced software to continuously sample the air in an
63 environment and adjust its detection parameters and alarm threshold accordingly. It shall do this
64 automatically, without user intervention.

1 Detector shall incorporate either thermal and photoelectric technologies or thermal, photoelectric and carbon
2 monoxide technologies.

3
4 Detector shall have on-board microprocessor and advanced software that focuses on rejecting nuisance
5 alarms.

6
7 **INTELLIGENT DUCT SMOKE DETECTORS**

8 Duct detectors shall be of the photoelectric type specified above. It shall be possible to alarm the duct
9 detector by using a remote or local test switch.

10
11 For maintenance purposes, it shall be possible to clean the duct housing sampling tubes by accessing them
12 through the duct housings front cover.

13
14 Detector shall include remote keyed test switch and alarm LED indicator.

15
16 In mechanical rooms, alarm LED indicators and test switches for duct detectors shall be grouped on a
17 stainless steel cover plate mounted adjacent to the main mechanical room door. Each LED/switch shall be
18 labeled with the detectors loop and address. A floor plan of the room showing the detectors and addresses
19 shall be located adjacent to the cover plate. Provide Plexiglas cover over the plan.

20
21 **CARBON MONOXIDE DETECTORS**

22 Carbon monoxide detector shall be listed to Underwriters Laboratories UL 2075 for Gas and Vapor
23 Detectors and Sensors. The detector shall be equipped with a sounder and a trouble relay. The detector's
24 base shall be mountable to a single-gang electrical box. Wiring connections shall be made by means
25 screws. The detector shall provide dual color LED indication that blinks to indicate normal standby, alarm, or
26 end-of-life. When the sensor supervision is in a trouble condition, the detector shall send a trouble signal to
27 the panel. The detector shall provide a means to test CO gas entry into the CO sensing cell. The detector
28 shall provide this with a test mode that accepts CO gas from a test agent and alarms immediately upon
29 sensing CO entry.

30
31 Carbon monoxide alarm signals shall be displayed as SUPERVISORY signals on the fire alarm system
32 displays.

33
34 **SMOKE/HEAT DETECTOR GUARDS**

35 Smoke/heat detector guard shall be of two-piece construction perforated metal for ease of installation and
36 maintenance of equipment once installed and shall have the following properties:

- 37 • Constructed of 16-gauge perforated steel with 3/16" diameter on 1/4" staggered centers
- 38 • Welded on all sides with reinforcement for a solid unit construction
- 39 • Painted with white epoxy coating
- 40 • Dimensions I.D. 7 1/2" x 7 1/2" x 4" deep
- 41 • Shall have provisions for electrical conduit
- 42 • Shall have tamper-proof screws

43
44 **ADDRESSABLE PULL STATIONS**

45 Pull stations shall contain circuits that communicate the station's status (alarm, normal or trouble) to the
46 control panel over two wires, which also provide power to the pull station. The address shall be field
47 programmable on the station.

48
49 Manual stations shall be [single-action] [double-action] type, constructed of metal or of high impact, red
50 Lexan with raised white lettering and a smooth high gloss finish.

51
52 Station shall mechanically latch upon operation and remain so until manually reset by means of a key
53 common to all system locks. Stations that require Allen wrenches or special tools to reset them shall not be
54 accepted.

55
56 Manual stations shall be fitted with screw terminals or wire leads for field wire attachment.

57
58 **INTERFACE MODULES - GENERAL**

59 If external power to Addressable Interface Modules is required, such power shall be 24VDC, and shall be
60 derived from a supervised fire alarm power supply.

61
62 Addressable Interface Modules may be provided in either a Class B or Class A supervision version.

63
64 In the Class B version the wiring shall be supervised by an end-of-line device.

1 In the Class A version the wiring shall be looped back through a separate conduit/route and connected to
2 the module to allow continual operation of the controlled devices even if the wiring sustains a single break.

3
4 The interface modules shall be supervised and uniquely identified by the control panel. Device identification
5 shall be transmitted to the control panel for processing according to the program instructions.

6 7 **INTERFACE MODULES - SUPERVISED CONTROL**

8 Supervised Control Modules shall be utilized where needed, for control of Notification Appliances.

9
10 For Notification Appliances, speakers, and other device control with Class B or Class A wiring supervision,
11 the interface module shall provide a double-pole/double-throw relay output, with supervision.

12
13 These interface modules shall communicate the supervised wiring status (normal, trouble) to the fire alarm
14 control panel and shall receive from the fire alarm control panel a command to transfer the relay.

15 16 **INTERFACE MODULES - SUPERVISED MONITORING**

17 Addressable Monitor Modules shall be suited for monitoring of water-flow, valve tamper, fire Suppression
18 Control Panels, and other non-intelligent detectors and systems.

19
20 Addressable Monitor Modules shall be provided in any needed configuration, and may be used to interface
21 any of the following initiation devices to a Signaling Line Circuit, as follows:

- 22 ○ Conventional 2-wire smoke detectors, including providing suitable power to the IDC.
- 23
- 24 ○ Normally Open, dry contact type devices - with class B or class A wiring supervision:
 - 25 ■ These interface modules shall communicate the Initiating Device Circuit status
 - 26 (normal, alarm, trouble) to the control panel.
 - 27

28 **INTERFACE MODULES - NON-SUPERVISED CONTROL**

29 This interface module shall provide double-pole/double-throw relay switching for loads up to 120VAC. It
30 shall contain easily replaceable 2 amp fuses, one on each common leg of the relay.

31 32 **FAULT ISOLATOR MODULE (FIM)**

33 The system shall employ Fault Isolator Modules (FIM) on the Signaling Line Circuits. These FIM units shall
34 be utilized in order to isolate portions of SLCs, in the event of short circuit conditions. The SLC segment
35 protected by each FIM shall be separated from the SLC in a manner such that a single short-circuit condition
36 may not affect more than 25 Addressable Field Devices / Detectors, which are served by the isolated SLC
37 segment.

38
39 The FIM shall be located as close as practical to the point where the isolated SLC sub-circuit branches and
40 shall also be located at an accessible location.

41 42 **CONVENTIONAL PERIPHERAL DEVICES**

43 44 **NON-ADDRESSABLE HEAT DETECTORS**

45 Non-Addressable Heat Detectors shall of the fixed temp type and only to be used at locations where the
46 ambient conditions are unsuitable for Analog Addressable units, or where the required operation (set point /
47 response index, etc.) cannot be achieved with Analog Addressable units. Where used, these devices shall
48 be UL listed for their intended purpose. These heat detectors do not have to be made by the same
49 manufacturer supplying the other fire alarm equipment for the project.

50 51 **PROJECTED BEAM TYPE SMOKE DETECTORS**

52 The Projected Beam Type Smoke Detectors shall be listed per UL 268 and shall functionally interface
53 to the FACP as a standard, 4-wire type smoke detector.

54
55 The Projected Beam Type Smoke Detectors shall incorporate built-in "aiming-aid" features, such as optical
56 sights or indicator LEDs. Where additional wiring or particular configurations are recommended by the
57 manufacturer, in order to take advantage of built-in aiming features, such wiring or configurations shall be
58 provided.

59
60 Installation methods utilized with these units shall be in strict compliance with the manufacturer's
61 instructions.

62
63 A Remote Test Station shall be supplied for each TX / RX pair.

1 Power to each TX / RX pair shall be supervised, by means of either built-in Trouble relay outputs at each
2 detector, or by means of end-of-line relays at each detector. Such Trouble Relay outputs and / or end-of
3 line relays shall be connected to the IDC which monitors each TX / RX pair in a manner, such that
4 Trouble conditions indicated by such relays / outputs do not prevent the transmission of an Alarm over the IDC.
5

6 Each TX / RX pair shall be individually monitored for Alarm status conditions, via addressable Monitor
7 Modules, or via dedicated IDC circuits.
8

9 Each TX / RX pair shall be individually monitored for Trouble status conditions.
10

11 **DOOR HOLDERS**

12 Magnetic door holders shall have an approximate holding force of 25 lbs (minimum) (recommended 35 lbs.)
13

14 The door portion shall have a stainless steel pivotal mounted armature with shock absorbing nylon bearing.
15

16 Unit shall be capable of being either surface, flush, or semi-flush mounted as required.
17

18 Power for 24 v dc door holders shall be independent and separate from the main power supply of the fire
19 alarm panel.
20

21 When reusing existing 120 v ac type door holders, the new power shall be obtained from the nearest
22 emergency power source where available. If no emergency power, the power shall be obtained from the un-
23 switched lighting circuit serving the immediate area
24

25 **AUDIO VISUAL NOTIFICATION APPLIANCES**

26 **SPEAKERS**

27 Speakers shall have vandal resistant metal or Lexan white housing or grills with field adjustable output taps
28 ranging from 1/4 watt to 2 watts. Speakers selected for this project shall produce a Sound Pressure Level,
29 at the 1 watt tap of at least 86 dBA at 10 feet – as tested per UL Standard 1480. Speakers shall have sealed
30 backs to protect the phenolic impregnated cone.
31
32

33 **SUPERVISED HORN LOUDSPEAKERS**

34 Supervised horn loudspeakers shall be equipped with a compression driver providing up to 15 Watt RMS
35 power handling capability.
36

37 Horn loudspeakers when installed outdoors, shall be of the weather-resistant metal construction to provide
38 protection against water, humidity, vermin, and corrosion.
39

40 The mounting bracket allows directional sound dispersion via the vertical and the horizontal positioning.
41 Provisions shall include for surface or strap mounting for the installation to pillars and I-beams.
42

43 Horn loudspeakers shall include 25/70/100V transformer with adjustable 7-position Watt/ impedance
44 selection switch.
45

46 **HORNS**

47 Horns shall have vandal resistant metal or Lexan white housing or grills. Horns shall be polarized, and
48 shall be compatible with the 24 VDC NACs provided by the control panel and/or NAC Booster
49 Panels/Supervised Control Modules. Each horn assembly shall include separate wire leads for in/out wiring
50 for each leg of the associated signal circuit.
51

52 Horns shall be UL listed to provide a minimum sound pressure level of 93 dB at 10 feet, per UL Standard
53 464.
54

55 **STROBES**

56 ALL strobes, and the strobe portion of audible/strobe combination units, shall be of the Xenon type.
57

58 FIRE alarm strobes shall have clear lenses and labeled "FIRE".
59

60 ALERT strobes shall have amber lenses and labeled "ALERT". When mounted on the same box or when
61 dual strobe expander plate is used, the ALERT strobe shall be on the bottom.
62

63 ALL strobes shall be designed for synchronized flash operation at one flash per second (1 Hz) minimum
64 over the device's listed input voltage range. Strobes shall be synchronized such that all strobe units

1 within the building shall flash simultaneously (As a minimum, all devices on each floor shall flash
2 simultaneously, with flash timing within the limits established by current UL standards.).
3

4 **PRINTERS**

5 If existing, a printer shall remain unmodified.

6 **SPECIAL DEVICES**

7 **TOOLS/KEYS**

8 Contractor shall provide two (2) keys per pull station. Keys shall be identical and usable in all keyways
9 associated with this project – including, but not limited to Manual Pull Stations, the FACP, [and FAAP] [and
10 RFCC] Panel(s).
11

12 Provide one device programmer tool and case for fire alarm systems utilizing hand-held or briefcase-style
13 programming tools used to electronically assign addressees and/or programming parameters.
14

15 **PART 3 - EXECUTION**

16
17 **GENERAL**

18 The complete installation shall be done in a neat, workmanlike manner in accordance with the applicable
19 requirements of NFPA 70 - Article 760 and the manufacturer's recommendations.
20

21 Smoke detectors shall not be mounted until the construction is completed, unless they are covered with
22 plastic bags or fitted covers immediately after installation to maintain cleanliness.
23

24 **RACEWAYS**

25 All fire alarm wiring shall be installed to match the methods of the existing system, unless AHJ dictates
26 otherwise.
27

28 IF EXISTING FIRE ALARM WIRING IS IN CONDUIT ALL FIRE ALARM SYSTEM WIRING SHALL BE
29 INSTALLED WITHIN METALLIC CONDUIT UNLESS SPECIFIED OTHERWISE. IF EXISTING FIRE
30 ALARM WIRING IS IN FREE-AIR, INSTALLATION SHALL CONFORM TO THE FREE AIR WIRING
31 SECTIONS, BELOW.
32

33 All wiring shall be in a conduit system separate from other building wiring. See Section 26 05 33 – Raceway
34 and Boxes for Electrical Systems for specifications.
35

36 All wiring shall be in minimum ½" steel raceway, unless free-air wiring is approved by DFD.
37

38 40% fill factor shall be applied to all conduit sizes.
39

40 The contractor shall size conduit and boxes by circular mil size of each cable in each conduit or box. The
41 circular mil sizing can be found on the manufacture's spec sheet, then use the NEC codebook to make
42 calculation to follow NEC Chapter 9 Tables and Annex C for box and conduit fill.
43

44 The contractor is encouraged to use red conduit for fire alarm systems.
45

46 There shall be no sharp edges with installed materials.
47

48 Use only identified conduit entries or request approval for other penetrations in cabinets; (certain areas
49 require clear space for interior components / batteries). Cabinet shall be grounded to either a cold water
50 pipe or grounding rod.
51

52 Existing conduit and surface metal raceway that is ½" in size or larger may be reused if found to have
53 adequate space provided that it only serves the fire Alarm system and doesn't contain any AC wiring. All
54 existing conduit that is reused MUST be brought up to the current State of Wisconsin Electrical Code and
55 Approved for usage by the Engineer prior to work being done.
56

57 **FREE AIR WIRING:**

58
59 All wiring shall be run "free-air", in conduit or in surface raceway. "Free-air" wiring for horizontal cable runs
60 of Power Limited FIRE Alarm (PLFA) DC circuits as approved by the Engineer shall be the method of
61 installation only in the following areas:

- 62 • Finished accessible ceiling
 - 63 • Rooms designated as 'mechanical' rooms
- 64

1 All **other** wiring shall be installed in conduit.

2
3 Where installed "free-air", installation shall consider the following:

- 4 • Cable shall run at right angles and be kept clear of other trades work.
- 5 • All cable run as "Free-Air" shall be Tray Cable rated.
- 6 • All splices shall be done in approved junction boxes. Junction boxes or at minimum the cover shall be red with FA inscribed on it.
- 7 • Cables shall be supported according to code utilizing "Bridal-type" mounting rings or J hooks anchored to ceiling concrete, piping supports or structural steel beams. Rings shall be designed to maintain cables bend to larger than the minimum bend radius (typically 4 x cable diameter).
- 8 • Supports should be spaced at a maximum 4-foot interval unless limited by building construction. If cable "sag" at mid-span exceeds 12-inches, another support shall be used.
- 9 • Cable shall never be laid directly on the ceiling grid.
- 10 • Cables shall not be attached to or supported by, existing cabling, plumbing or steam piping, ductwork, ceiling supports or electrical or communications conduit.

11
12 A coil of 4 feet in each cable shall be placed in the ceiling at each "free-air" wired fire alarm device. These "service loops" shall be secured 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.

13
14 Devices wired with conduit shall be provided with an 8-inch wire tail at each device box and 36-inch wire tails at the FACP, FAAP, FCC, and RFCC.

15
16 To reduce or eliminate EMI, the following minimum separation distances from $\leq 480V$ Power lines shall be adhered to:

- 17 • Twelve (12) inches from power lines of $<5\text{-kVa}$.
- 18 • Eighteen (18) inches from high voltage lighting (including fluorescent).
- 19 • Thirty-nine (39) inches from power lines of 5-kVa or greater.
- 20 • Thirty-nine (39) inches from transformers and motors.

21
22 All cable shall be free of tension at both ends. In cases where the cable must bear some stress, Kellom grips may be used to spread the strain over a longer length of cable.

23
24 Manufacturers minimum bend radius specifications shall be observed in all instances. Care should be taken in the use of cable ties to secure and anchor the fire alarm 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.

25
26 All vertical cable extensions to fire alarm devices located below the finished ceiling shall be in conduit.

27
28 It is the contractors' responsibility to survey the site and include all necessary costs to perform the installation as specified. This includes any modifications required to route and conceal horizontal distribution wiring.

29
30 Beginning installation means contractor accepts existing conditions.

31
32 Contractor shall furnish all required installation tools to facilitate cable pulling without damage to the cable jacket. Such equipment is to include, but not limited to, sheaves, winches, cable reels, cable reel jacks, duct entrance tunnels, pulling tension gauge and similar devices. All equipment shall be of substantial construction to allow steady progress once pulling has begun. Makeshift devices, which may move or wear in a manner to pose a hazard to the cable, shall not be used.

33
34 All cable shall be pulled by hand unless installation conditions require mechanical assistance. Where mechanical assistance is used, care shall be taken to ensure that the maximum tensile load for the cable as defined by the manufacturer is not exceeded. This may be in the form of continuous monitoring of pulling tension, use of a "break-away" or other approved method.

1 The contractor will be responsible for identifying and reporting to the Site Coordinator(s) any existing
2 damage to walls, flooring, tiles and furnishings in the work area prior to start of work. The Contractor must
3 repair all damage to interior spaces caused by the installation of cable, raceway or other hardware. Repairs
4 must match preexisting color and finish of walls, floors and ceilings. Any contractor-damaged ceiling tiles
5 are to be replaced to match color, size, style and texture.
6

7 Where unacceptable conditions are found, the Contractor shall bring this to the attention of the construction
8 supervisor immediately. A written resolution will follow to determine the appropriate action to be taken.
9

10 Qualified personnel utilizing state-of-the-art equipment and techniques shall complete all installation work.
11 During pulling operation an adequate number of workers shall be present to allow cable observation at all
12 points of duct entry and exit as well as the feed cable and operate pulling machinery.
13

14 Cable pulling shall be done in accordance with cable manufacturer's recommendations and ANSI/IEEE C2
15 standards. Manufacturer's recommendations shall be a part of the cable submittal. Recommended pulling
16 tensions and pulling bending radius shall not be exceeded. Any cable bent or kinked to radius less than
17 recommended dimension shall not be installed.
18

19 Avoid abrasion and other damage to cables during installation.
20

21 Pulling Lubricant may be used to ease pulling tensions. Lubricant shall be of a type that is non-injurious to
22 the cable jacket and other materials used. Lubricant shall not harden or become adhesive with age.
23

24 **CONDUCTORS**

25 All wire and cable associated with this system shall be as required by the equipment manufacturer. The
26 following information is intended for estimating purposes only. However, the minimum wire gauges and
27 colors specified shall be strictly adhered to. All cable shall be installed as per NEC Article 760.
28

29 Type FPL wiring is required if the system is run in conduit or 'free-air'.
30

31 All initiation and notification circuit cabling shall be listed Type FPL (300V) in accordance with NEC article
32 760."
33

34 All cables and wires #14 AWG and larger shall be stranded.
35

36 Fire alarm wiring shall be held in place at the device box, by means of a two-screw connector, (do not use
37 squeeze or crimp type connectors).
38

39 All wiring shall be completely supervised. In the event of a primary power failure, disconnected standby
40 battery, disarrangement of any components, any open circuits or grounds in the system, an audible and
41 visual trouble signal shall be activated until the system is restored to normal.
42

43 All conductors shall be color-coded. Coding shall be consistent throughout the facility. Green wire shall be
44 used only for equipment ground.
45

46 Each FIRE Alarm Control Panel, Annunciator Panel, and NAC Panel shall be connected to separate
47 dedicated branch circuit from the building emergency panel, maximum 20 amperes. Circuit shall be labeled
48 as "FIRE ALARM". The breaker shall be painted red and cap-locked.
49

50 Power wiring for FIRE Alarm Control Panel, Annunciator Panel and NAC Panel shall be #12 AWG.
51

52 FIRE Alarm Control Panel, Annunciator Panel and NAC Panel shall have #6 AWG green equipment ground
53 wire.
54

55 Fire alarm risers, notification appliance circuits and interconnections to remote panels (per NFPA 72) shall
56 have a minimum 2Hr fire alarm rating. All notification appliance circuits shall be protected from the fire alarm
57 panel of origination to the signaling zone they serve.
58

59 Leave 8-inch wire tails at each device box and 36-inch wire tails at the fire Alarm Control Panel and Remote
60 Annunciator Panels.
61

62 Cable for Intelligent detector Loops shall be 18 to 12 AWG twisted pair with a shield jacket or per
63 manufacturers recommendations installed in 1/2" conduit. Shield continuity must be maintained and
64 connected to earth ground only at the control panel.

1 SLC wiring must not be in the same conduit with AC power wiring or other high current circuits. T-taps or
2 branch circuit connections are allowed for all class B SLCs.

3
4 Cable for RS 232-c devices (CRT, PRINTER) shall be dual pair twisted- shielded.

5
6 Cable for RS 485 devices (Remote Annunciators) shall be twisted-shielded pair (Belden 9841 or equivalent)
7 for the data signal. Power wiring shall be 12 AWG.

8
9 All splices or connections shall be made within approved junction boxes and with approved fittings. Boxes
10 shall be red and labeled "FIRE ALARM SYSTEM" or "FA" by decal or other approved markings.

11
12 Speaker and strobe circuits shall have separate conductors and shall operate independently of each other.

13
14 Speaker wiring shall be #18 AWG twisted-shielded cable or per manufacturers recommendations.

15
16 Strobe wiring shall be #14 AWG minimum.

17
18 Tray cable is not acceptable for use as fire alarm system wiring installed in conduit.

19
20 **DEVICE MOUNTING**

21 Unless otherwise noted on the drawings, plans, specifications or by the Architect or Engineer; the
22 recommended mounting heights, and requirements are as follows:

23
24 **FIRE ALARM CONTROL PANELS**

25 Mount control panels such that all visual indicators and controls are located at 60 inches above floor level.

26
27 **ANNUNCIATOR/REMOTE FIRE COMMAND CENTER PANELS**

28 Mount FAAP/FCC/RFCC panels such that all visual indicators and controls are located at 60 inches above
29 floor level.

30
31 **VISUAL AND AUDIO / VISUAL NOTIFICATION APPLIANCES**

32 In Public-Mode Areas, as defined within NFPA-72, install flush, semi-flush or surface between 80 inches and
33 96 inches or 6 inches below finished ceiling or at 80 inches from the bottom of the device to the highest level
34 of the finished floor. No devices protruding 4 inches or more shall be installed lower than 80 inches. If these
35 requirements are not achievable, consult with the Engineer before installation.

36
37 Audio/visual devices may be installed on the ceilings only where indicated, or where approved in writing by
38 the Engineer. (In such cases, these devices shall be installed in accordance with current NFPA 72
39 standards). Audio/visual devices installed on ceilings shall have white grills

40
41 Except as noted in the previous paragraph, all audio/visual devices shall be wall-mounted at the same
42 height throughout the facility.

43
44 Spacing of speakers shall not exceed 25 feet on center. Strobes spacing shall be in accordance with NFPA
45 72.

46
47 For surface mounting, use manufacture-supplied back boxes and trim plates, which shall be painted Red or
48 off White, and shall contain no visible conduit knockouts. Mark each device with its circuit number.

49
50 **MANUAL STATIONS**

51 The operable part of the manual stations shall be installed not less than 3 ½ ft. (42") and not more than 4 ft.
52 (48") above finished floor. All Manual Stations shall be in unobstructed locations. Mark the unit's address on
53 the inside and outside of housing.

54
55 All manual pull stations shall be installed at the same height throughout the facility.

56
57 For surface mounting, use manufacture-supplied back boxes and trim plates. Back boxes shall be painted
58 Red or off White and shall contain no visible conduit knockouts. Mark each device with its loop and address.

59
60 During the installation of the new fire alarm systems, new pull stations should be covered or identified as not
61 being operable so building occupants will not be confused as to which fire alarm pull station should be pulled
62 during an alarm condition. Likewise, after the new system is installed, tested and accepted, the existing pull
63 stations should be identified as not being operable (or permanently removed as soon as possible).

1 **HEAT AND SMOKE DETECTORS**

2 The location of detectors shown on the plans is schematic only. The detectors must be located according to
3 code requirements.

4
5 Surface mounted detectors shall be installed using back boxes equal to the base's size. Standard octagon
6 and square boxes are not acceptable.

7
8 Detectors should be located on the highest part of a smooth ceiling so that the edge of the detector is no
9 closer than 4 inches from a sidewall. Ceilings with beams, joists or soffits that exceed 8 inches in depth
10 require special planning and closer spacing.

11
12 If it is necessary to mount a detector upon a sidewall, the top of the detector (the sensing chamber portion of
13 the device) shall be located no closer than 4 inches from the ceiling and no further away than 12 inches.

14
15 Smoke detectors should be installed to favor the air flow towards return openings and not located closer
16 than 3 feet from air supply diffusers which could dilute smoke before it reaches the detector. No detectors
17 shall be installed in direct airflow.

18
19 Duct smoke detector installation to be by this contractor and should be installed in the locations shown on
20 the mechanical and electrical plans. Ensure that the duct smoke detectors are in serviceable locations.
21 Consult with the mechanical designer for alternate locations if these are shown in non-serviceable locations.
22 When locations on mechanical plans are not available, install in locations called for that provide accessibility
23 for service. For duct smoke detectors that are associated with shaft smoke dampers, ensure the sampling
24 tubes protruding into the duct are located within five feet of the smoke damper and there are no air inlets or
25 outlets between the sampling tubes and the damper. Do not install within four feet of a fan discharge.

26
27 Heat and smoke detectors should be located near the center of the open area which they are protecting,
28 thus providing coverage generally for 15-foot radius for heat and smoke detectors. Questionable locations
29 shall be verified with Architect or Engineer before installation takes place.

30
31 Heat and smoke detectors / Sensors – both Intelligent and non-addressable, shall be installed in accordance
32 with their UL Listed Spacing. The quantity of Heat and smoke detectors / Sensors depicted on the drawings
33 is based on the 900 square foot per detector rule. If detectors with significantly different spacing
34 requirements are selected by the fire Alarm equipment provider / Contractor, then additional detectors /
35 sensors, if required, shall be provided at no additional cost to the project.

36
37 **IDENTIFICATION**

38 Attach the label containing the address and SLC designation to:

- 39 Each addressable detector. Label shall be visible and readable from the floor, 3/16" minimum
- 40 character size (1/4" is recommended).
- 41 Each manual pull station. Label shall be placed on the top part
- 42 Each Addressable Module. Label shall be attached to the faceplate

43
44 Label shall consist of black writing on white or clear background.

45
46 All fire alarm boxes shall be painted red and labeled "Fire Alarm" or "FA". When red conduit is used for the
47 fire alarm system installation, there is no need to paint the boxes. Non-factory device boxes shall also be
48 painted red.

49
50 All circuits must be labeled with the name of circuit and the area being served by the circuit.

51
52 Wire/cable splices in junction boxes shall be labeled indicating where the wire/cable is coming from and
53 where it is going.

54
55 All conductors terminated in control panels, annunciator panels and extension panels shall be labeled.

56
57 All audio-visual devices shall be labeled by each circuit and the order of the device on that circuit such as
58 "Circuit No. 2, strobe No. 05 of 10".

59
60 All labels shall be permanent, and be machine generated. NO HANDWRITTEN OR NON-PERMANENT
61 LABELS SHALL BE ALLOWED. Submit a sample for approval before using any labeling schemes.

62
63 Label size shall be appropriate for the conductor or cable size(s) and design. All labels to be used shall be
64 self-laminating, white/transparent vinyl and be wrapped around the cable (sheath). Flag type labels are not

1 allowed. The labels shall be of adequate size to accommodate the circumference of the cable being labeled
2 and properly self-laminate over the full extent of the printed area of the label.

3
4 Adhesive type labels not permitted except for phase and wire identification.
5

6 **TESTING**

7 Before proceeding with any testing, all persons, facilities and building occupants whom receive alarms or
8 trouble signals shall be notified by the contractor to prevent unnecessary response or building occupant
9 distress. At the conclusion of testing, those previously notified shall be notified that testing has been
10 concluded.

11
12 The manufacturer's authorized representative shall provide on-site supervision of installation of the complete
13 fire alarm system installation, perform a complete functional test of the system, and submit a written report to
14 the Contractor attesting to the proper operation of the completed system prior to final inspection.

15
16 Contractor shall pre-test each and every device in the system before the system is considered ready for final
17 inspection.

18
19 The completed and pre-tested fire alarm system shall be fully tested in accordance with NFPA-72 by the
20 Contractor in the presence of the Engineer, Owner's representative and the local Fire Marshal.

21
22 The Engineer or his authorized representative may suspend or discontinue the tests at any time
23 performance is considered unsatisfactory. Resumption of testing will cover untested elements and any
24 replaced elements. The contractor shall furnish all test personnel, test instruments and equipment of the
25 accuracy necessary to perform the test. Arrangements for testing must be made with the Construction
26 Manager and the Engineer at least two weeks before the proposed testing date.

27
28 Upon the completion of a successful test, and prior to the final request for payment the Contractor shall:

- 29 • Certify the system to the Owner in writing
- 30 • Complete the NFPA 72 record of completion form
- 31 • Provide as built and O&M manuals.
- 32 • Provide a signed statement that the Owner had received the specified system operation and
33 maintenance training

34
35 The final payment will not be processed unless these documents are complete and are on hand.

36 **WARRANTY**

37
38 The Contractor shall warrant the completed fire alarm system wiring and equipment to be free from inherent
39 mechanical and electrical defects for a period of two (2) years from the date of substantial completion of the
40 project.

41
42 At the end of the project, the Contractor shall post the warranty period along with the company's name and
43 telephone number inside the fire alarm panel.

44
45 Any occupied facility shall not be without a UL and an NFPA approved and fully operational fire alarm
46 system for a period longer than two (2) hours. Emergency response shall be provided within two (2) hours
47 of the notification, to the contractor, of the failure of the system to perform operationally per UL and NFPA
48 standards. Non-emergency service calls shall be responded to within twenty-four (24) hours of the
49 notification to the contractor.

50
51 Emergency situations may include, but not limited to:

- 52 • System can't be acknowledged or reset
- 53 • System is non-responsive to commands
- 54 • System in non-responsive to actuated alarm devices
- 55 • Malfunction of notification/initiating circuit(s)
- 56 • System going into alarm/trouble without indicating the source
- 57 • System is dead (no power), etc.

58
59 Repairs and/or replacement arising from emergency situations shall be completed within twenty-four (24)
60 hours of the time of notification. Other than emergency, actual repairs and /or replacement shall be provided
61 within seventy-two (72) hours of the time of notification during normal working hours, Monday through
62 Friday, excluding holidays. If the repairs involve parts that are not shelf items and require lead time, the
63 contractor shall inform the Owner within twenty-four (24) hours from the time of notification of the exact time
64 when the repairs will be completed.

1
2 If repair and/or replacement cannot be made within the prescribed time, then other means and methods of
3 protection shall be provided to ensure the safety of the building's occupants during which time the system is
4 not in compliance with the standards. This may involve up to and include hiring Owner approved qualified
5 personnel to stand a fire watch, all at the contractor's expense.

6
7 Warranty service for the equipment shall be provided by the system supplier's factory trained representative.
8 Further, Warranty shall include all parts, labor and necessary travel.

9
10 **TRAINING**

11 The Contractor through his/her supplier shall provide, as part of this contract, training on the system
12 operation for owner, the Architect/Engineer, and fire department personnel. The training shall consist of the
13 following sessions:

- 14 • Two 1-hour sessions for the purpose of training personnel who will need to operate the
15 system – primarily, Level 1 and Level 2 system operators / users.
- 16
17 • A single 1-hour session for the purpose of training personnel who will need to administrate
18 and maintain the system. This training session shall familiarize these "power-users" with
19 High-Level functions and shall also familiarize Electrical Department personnel with an
20 overview of the as-built drawings and equipment configuration / basic troubleshooting.

21
22 All training sessions shall be coordinated and scheduled by the Contractor and shall be conducted at a time
23 to be stipulated by the owner. All training and other indoctrination shall be completed prior to final
24 inspection.

25
26 Training shall not take place until all systems are 100% operational as determined by the Owner. The
27 purpose of training is to fully prepare the facility maintenance staff for complete operational responsibility of
28 the fire alarm system.

29
30 The facility maintenance staff shall be fully trained and be given the capability by the product Vendor and
31 installing Contractor to modify, to program, to fully repair, to service, and to maintain the system after (and if
32 desired, during) the warranty period.

33
34 The above training shall include, but not be limited to, providing, and reviewing all programming software,
35 access codes, and licenses that allow the Owner to add or to delete any points (i.e.: The mapping of
36 devices), and to change a heat detector to a smoke detector. To meet this requirement, provide the
37 necessary configuration and/or access code (hardware and/or software key). If the Vendor cannot meet this
38 requirement, the product is not acceptable

39
40 **SPECIAL CONSIDERATIONS**

41 Contractor shall refer to Division 1, General Requirements, "SPECIAL SITE CONDITIONS".

42
43 The contractor must maintain the existing fire alarm system operational during the construction period.
44 During periods of construction where dust or dirt may contaminate the existing detectors, the contractor shall
45 cover the detectors to avoid nuisance alarms and trouble-calls.

46
47 Individual zones and/or devices of the existing fire alarm system can be bypassed by the contractor during
48 construction under the following requirements:

- 49
50 • The Superintendent of Buildings and Grounds is notified of which zones and/or devices are
51 inoperative and for how long in writing, hand delivered.
- 52
53 • The contractor covers all manual-pull stations that are not active and post temporary fire alarm
54 notification procedures next to each inactive manual-pull station.
- 55
56 • Ensure the fire alarm system is fully operational before leaving the job site.

57
58 **END OF SECTION**



1600 N. High Point
Middleton, WI 53562
p 608.440.9594
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Sauk County West Square Office Suite Remodel

505 Broadway St, Baraboo, Wi 53913

HVAC Load Calculations

Date:

11/16/2022

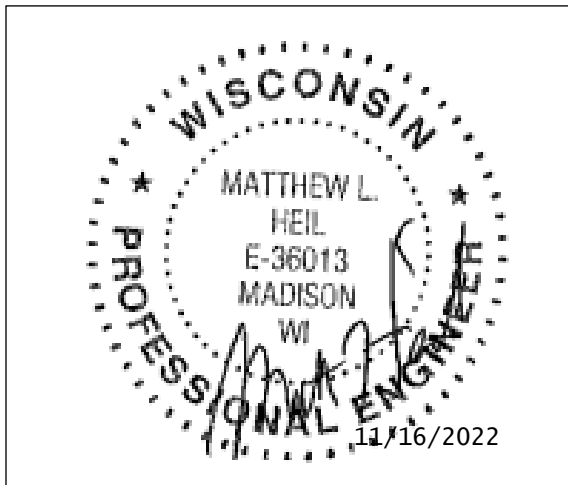
Software:

Carrier HAP Program

Contents:

HVAC Load Calculations

HVAC Vent Calculations



PROJECT NAME: Sauk County West Square Office Suite Remodel					ABBREVIATIONS									
LOCATION: 505 Broadway St, Baraboo, Wi 53913					1. THE MIN. O.A. CFM IS ON 7.5 PER PERSON					A.C. AIR CHANGES PER HOUR				
DATE: 11/09/2022										BTUH BRITISH THERMAL UNIT/HR				
JOB NO: 22026										CFM CUBIC FEET PER MINUTE				
0.5 Tailored Engineering 1600 North High Point Rd. TEL.(608) 440-9594 MIDDLETON, WI 53562					2. MIN O.A. THE AHU IS DELIVERING TO THE SPACE, BASED ON THE MIN % O.A. OF THE AHU					O.A. OUTDOOR AIR				
										S.A. SUPPLY AIR				
										R.A. RETURN AIR				
					3. CALCULATED BASED ON E.A. CFM FOR ROOMS WITH NEGATIVE PRESSURE					E.A. EXHAUST AIR				
										T.A. TRANSFER AIR				
										+ POSITIVE PRESSURE				
					HAP DESIGN NUMBERS				FINAL DESIGN NUMBERS					
DESCRIPTION	CEILING HT. (FT.)	ROOM AREA (SQ. FT.)	ROOM VOLUME (CU.FT.)	# OF PEOPLE	¹ MIN O.A. CFM	ROOM CLG. SENS. LOAD MBH	ROOM HTG LOAD MBH	DESIGN COOLING LOAD CFM	ROOM S.A. CFM	ROOM R.A. CFM	ROOM E.A. CFM	CFM / SQFT	³ ACTUAL A.C.	
Office 201A	9.0	96.0	864	3.0	23	3.5	1.2	169	245.0	245.0	-	2.6	17.0	
Office 201B	9.0	96	864	3.0	23	3.5	1.2	169	245.0	245.0	-	2.6	17.0	
Office 202	9.0	155	1395	3.0	23	4.2	2.0	199	200.0	200.0	-	1.3	8.6	
Office 203	9.0	147	1323	3.0	23	4.1	2.0	197	200.0	200.0	-	1.4	9.1	
Office 204	9.0	119	1071	3.0	23	4.0	1.6	190	185.0	185.0	-	1.6	10.4	
Office 209	9.0	109	981	3.0	23	3.2	0.3	154	200.0	200.0	-	1.8	12.2	
Office 212A	9.0	83	747	3.0	23	3.1	0.2	148	150.0	150.0	-	1.8	12.0	
Office 212B	9.0	85	765	3.0	23	3.1	0.2	149	150.0	150.0	-	1.8	11.8	
Office 211	9.0	144	1296	3.0	23	3.4	0.4	161	190.0	190.0	-	1.3	8.8	
Office 213	9.0	128	1152	3.0	23	3.3	0.3	158	120.0	120.0	-	0.9	6.3	
Office 215	9.0	122	1098	3.0	23	3.3	0.3	156	120.0	120.0	-	1.0	6.6	
Reception 216A	9.0	95	855	2.0	15	2.9	0.2	141	140.0	140.0	-	1.5	9.8	
Waiting 216B	9.0	240	2160	3.0	23	3.8	0.6	181	140.0	140.0	-	0.6	3.9	
Consult 218A	9.0	235	2115	3.0	23	3.8	0.6	180	310.0	310.0	-	1.3	8.8	
Consult 218B	9.0	179	1611	3.0	23	3.5	0.5	168	310.0	310.0	-	1.7	11.5	
Copy Work Area	9.0	550	4950	1.0	8	4.7	1.4	226	355.0	355.0	-	0.6	4.3	
Office 209A	9.0	83	747	3.0	23	3.1	0.2	148	145.0	145.0	-	1.7	11.6	
Total		842	9828	21	203	21		1198	1315	1315	0			

Air System Sizing Summary for Whole BuildingProject Name: Sauk CO
Prepared by: Tailored Engineering11/09/2022
11:54AM**Air System Information**

Air System Name	Whole Building	Number of zones	8
Equipment Class	PKG ROOF	Floor Area	2666.0 ft ²
Air System Type	VAV	Location	Madison, Wisconsin

Sizing Calculation Information

Calculation Months	Jan to Dec	Zone CFM Sizing	Peak zone sensible load
Sizing Data	Calculated	Space CFM Sizing	Individual peak space loads

Central Cooling Coil Sizing Data

Total coil load	6.7 Tons	Load occurs at	Jul 1500
Total coil load	80.0 MBH	OA DB / WB	90.0 / 73.0 °F
Sensible coil load	63.3 MBH	Entering DB / WB	78.0 / 64.3 °F
Coil CFM at Jul 1500	2629 CFM	Leaving DB / WB	55.0 / 53.8 °F
Max block CFM at Jul 1400	2886 CFM	Coil ADP	52.4 °F
Sum of peak zone CFM	2891 CFM	Bypass Factor	0.100
Sensible heat ratio	0.792	Resulting RH	48 %
CFM/Ton	394.5	Design supply temp.	55.0 °F
ft ² /Ton	400.1	Zone T-stat Check	8 of 8 OK
BTU/(hr-ft ²)	30.0	Max zone temperature deviation	0.0 °F
Water flow @ 10.0 °F rise	N/A		

Preheat Coil Sizing Data**No heating coil loads occurred during this calculation.****Supply Fan Sizing Data**

Actual max CFM at Jul 1400	2886 CFM	Fan motor BHP	0.00 BHP
Standard CFM	2797 CFM	Fan motor kW	0.00 kW
Actual max CFM/ft ²	1.08 CFM/ft ²	Fan static	0.00 in wg

Outdoor Ventilation Air Data

Design airflow CFM	360 CFM	CFM/person	7.50 CFM/person
CFM/ft ²	0.14 CFM/ft ²		

Zone Sizing Summary for Whole BuildingProject Name: Sauk CO
Prepared by: Tailored Engineering11/09/2022
11:54AM**Air System Information**Air System Name **Whole Building**
Equipment Class **PKG ROOF**
Air System Type **VAV**Number of zones **8**
Floor Area **2666.0** ft²
Location **Madison, Wisconsin****Sizing Calculation Information**Calculation Months **Jan to Dec**
Sizing Data **Calculated**Zone CFM Sizing **Peak zone sensible load**
Space CFM Sizing **Individual peak space loads****Zone Terminal Sizing Data**

Zone Name	Design Supply Airflow (CFM)	Minimum Supply Airflow (CFM)	Zone CFM/ft ²	Reheat Coil Load (MBH)	Reheat Coil Water gpm @ 20.0 °F	Zone Htg Unit Coil Load (MBH)	Zone Htg Unit Water gpm @ 20.0 °F	Mixing Box Fan Airflow (CFM)
Zone 1	535	167	1.54	7.0	-	0.0	-	0
Zone 2	387	137	1.45	5.7	-	0.0	-	0
Zone 3	154	23	1.41	0.9	-	0.0	-	0
Zone 4	297	45	1.77	1.9	-	0.0	-	0
Zone 5	161	23	1.12	0.9	-	0.0	-	0
Zone 6	635	83	1.09	3.5	-	0.0	-	0
Zone 7	348	45	0.84	1.9	-	0.0	-	0
Zone 8	374	63	0.59	2.6	-	0.0	-	0

Zone Peak Sensible Loads

Zone Name	Zone Cooling Sensible (MBH)	Time of Peak Sensible Cooling Load	Zone Heating Load (MBH)	Zone Floor Area (ft ²)
Zone 1	11.2	Jul 1300	4.4	347.0
Zone 2	8.1	Jul 1000	3.6	266.0
Zone 3	3.2	Jul 1500	0.3	109.0
Zone 4	6.2	Jul 1500	0.4	168.0
Zone 5	3.4	Jul 1500	0.4	144.0
Zone 6	13.3	Jul 1500	1.5	585.0
Zone 7	7.3	Jul 1400	1.1	414.0
Zone 8	7.8	Jul 1400	1.6	633.0

Zone Sizing Summary for Whole BuildingProject Name: Sauk CO
Prepared by: Tailored Engineering11/09/2022
11:54AM**Space Loads and Airflows**

Zone Name / Space Name	Mult.	Cooling Sensible (MBH)	Time of Peak Sensible Load	Air Flow (CFM)	Heating Load (MBH)	Floor Area (ft ²)	Space CFM/ft ²
Zone 1							
Office 201A	1	3.5	Jul 1400	169	1.2	96.0	1.76
Office 201B	1	3.5	Jul 1400	169	1.2	96.0	1.76
Office 202	1	4.2	Jul 1000	199	2.0	155.0	1.28
Zone 2							
Office 203	1	4.1	Jul 1000	197	2.0	147.0	1.34
Office 204	1	4.0	Jul 1000	190	1.6	119.0	1.59
Zone 3							
Office 209	1	3.2	Jul 1500	154	0.3	109.0	1.41
Zone 4							
Office 212A	1	3.1	Jul 1500	148	0.2	83.0	1.79
Office 212B	1	3.1	Jul 1500	149	0.2	85.0	1.75
Zone 5							
Office 211	1	3.4	Jul 1500	161	0.4	144.0	1.12
Zone 6							
Office 213	1	3.3	Jul 1500	158	0.3	128.0	1.23
Office 215	1	3.3	Jul 1500	156	0.3	122.0	1.28
Reception 216A	1	2.9	Jul 1500	141	0.2	95.0	1.48
Waiting 216B	1	3.8	Jul 1400	181	0.6	240.0	0.75
Zone 7							
Consult 218A	1	3.8	Jul 1400	180	0.6	235.0	0.77
Consult 218B	1	3.5	Jul 1400	168	0.5	179.0	0.94
Zone 8							
Copy Work area	1	4.7	Jul 1400	226	1.4	550.0	0.41
Office 209A	1	3.1	Jul 1500	148	0.2	83.0	1.79

Air System Design Load Summary for Whole Building

Project Name: Sauk CO
Prepared by: Tailored Engineering

11/09/2022
11:54AM

	DESIGN COOLING			DESIGN HEATING		
	COOLING DATA AT Jul 1500			HEATING DATA AT DES HTG		
	COOLING OA DB / WB 90.0 °F / 73.0 °F			HEATING OA DB / WB -15.0 °F / -15.5 °F		
ZONE LOADS	Details	Sensible (BTU/hr)	Latent (BTU/hr)	Details	Sensible (BTU/hr)	Latent (BTU/hr)
Window & Skylight Solar Loads	80 ft ²	2043	-	80 ft ²	-	-
Wall Transmission	384 ft ²	469	-	384 ft ²	1471	-
Roof Transmission	2666 ft ²	5380	-	2666 ft ²	6935	-
Window Transmission	80 ft ²	239	-	80 ft ²	1836	-
Skylight Transmission	0 ft ²	0	-	0 ft ²	0	-
Door Loads	0 ft ²	0	-	0 ft ²	0	-
Floor Transmission	2666 ft ²	0	-	2666 ft ²	3063	-
Partitions	0 ft ²	0	-	0 ft ²	0	-
Ceiling	0 ft ²	0	-	0 ft ²	0	-
Overhead Lighting	2000 W	6092	-	0	0	-
Task Lighting	0 W	0	-	0	0	-
Electric Equipment	11050 W	35900	-	0	0	-
People	48	10186	9840	0	0	0
Infiltration	-	0	0	-	0	0
Miscellaneous	-	0	0	-	0	0
Safety Factor	0% / 0%	0	0	0%	0	0
>> Total Zone Loads	-	60309	9840	-	13304	0
Zone Conditioning	-	58651	9840	-	13038	0
Plenum Wall Load	0%	0	-	0	0	-
Plenum Roof Load	0%	0	-	0	0	-
Plenum Lighting Load	0%	0	-	0	0	-
Return Fan Load	2629 CFM	0	-	585 CFM	0	-
Ventilation Load	328 CFM	4697	6774	73 CFM	6390	0
Supply Fan Load	2629 CFM	0	-	585 CFM	0	-
Space Fan Coil Fans	-	0	-	-	0	-
Duct Heat Gain / Loss	0%	0	-	0%	0	-
>> Total System Loads	-	63347	16614	-	19428	0
Central Cooling Coil	-	63347	16617	-	-1988	0
Preheat Coil	-	0	-	-	0	-
Terminal Reheat Coils	-	0	-	-	21416	-
>> Total Conditioning	-	63347	16617	-	19428	0
Key:	Positive values are clg loads Negative values are htg loads			Positive values are htg loads Negative values are clg loads		

Zone Design Load Summary for Whole Building

Project Name: Sauk CO
Prepared by: Tailored Engineering

11/09/2022
11:54AM

Zone 1	DESIGN COOLING			DESIGN HEATING		
	COOLING DATA AT Jul 1300 COOLING OA DB / WB 87.6 °F / 72.4 °F			HEATING DATA AT DES HTG HEATING OA DB / WB -15.0 °F / -15.5 °F		
	OCCUPIED T-STAT 75.0 °F			OCCUPIED T-STAT 70.0 °F		
ZONE LOADS	Details	Sensible (BTU/hr)	Latent (BTU/hr)	Details	Sensible (BTU/hr)	Latent (BTU/hr)
Window & Skylight Solar Loads	40 ft²	1102	-	40 ft²	-	-
Wall Transmission	219 ft²	320	-	219 ft²	839	-
Roof Transmission	347 ft²	730	-	347 ft²	903	-
Window Transmission	40 ft²	97	-	40 ft²	918	-
Skylight Transmission	0 ft²	0	-	0 ft²	0	-
Door Loads	0 ft²	0	-	0 ft²	0	-
Floor Transmission	347 ft²	0	-	347 ft²	1719	-
Partitions	0 ft²	0	-	0 ft²	0	-
Ceiling	0 ft²	0	-	0 ft²	0	-
Overhead Lighting	260 W	780	-	0	0	-
Task Lighting	0 W	0	-	0	0	-
Electric Equipment	1950 W	6293	-	0	0	-
People	9	1871	1845	0	0	0
Infiltration	-	0	0	-	0	0
Miscellaneous	-	0	0	-	0	0
Safety Factor	0% / 0%	0	0	0%	0	0
>> Total Zone Loads	-	11194	1845	-	4379	0

Zone 2	DESIGN COOLING			DESIGN HEATING		
	COOLING DATA AT Jul 1000 COOLING OA DB / WB 77.7 °F / 69.5 °F			HEATING DATA AT DES HTG HEATING OA DB / WB -15.0 °F / -15.5 °F		
	OCCUPIED T-STAT 75.0 °F			OCCUPIED T-STAT 70.0 °F		
ZONE LOADS	Details	Sensible (BTU/hr)	Latent (BTU/hr)	Details	Sensible (BTU/hr)	Latent (BTU/hr)
Window & Skylight Solar Loads	40 ft²	1402	-	40 ft²	-	-
Wall Transmission	165 ft²	358	-	165 ft²	632	-
Roof Transmission	266 ft²	388	-	266 ft²	692	-
Window Transmission	40 ft²	21	-	40 ft²	918	-
Skylight Transmission	0 ft²	0	-	0 ft²	0	-
Door Loads	0 ft²	0	-	0 ft²	0	-
Floor Transmission	266 ft²	0	-	266 ft²	1344	-
Partitions	0 ft²	0	-	0 ft²	0	-
Ceiling	0 ft²	0	-	0 ft²	0	-
Overhead Lighting	200 W	581	-	0	0	-
Task Lighting	0 W	0	-	0	0	-
Electric Equipment	1300 W	4147	-	0	0	-
People	6	1202	1230	0	0	0
Infiltration	-	0	0	-	0	0
Miscellaneous	-	0	0	-	0	0
Safety Factor	0% / 0%	0	0	0%	0	0
>> Total Zone Loads	-	8099	1230	-	3586	0

Zone Design Load Summary for Whole Building

Project Name: Sauk CO
Prepared by: Tailored Engineering

11/09/2022
11:54AM

Zone 3	DESIGN COOLING			DESIGN HEATING		
	COOLING DATA AT Jul 1500 COOLING OA DB / WB 90.0 °F / 73.0 °F			HEATING DATA AT DES HTG HEATING OA DB / WB -15.0 °F / -15.5 °F		
	OCCUPIED T-STAT 75.0 °F			OCCUPIED T-STAT 70.0 °F		
ZONE LOADS	Details	Sensible (BTU/hr)	Latent (BTU/hr)	Details	Sensible (BTU/hr)	Latent (BTU/hr)
Window & Skylight Solar Loads	0 ft ²	0	-	0 ft ²	-	-
Wall Transmission	0 ft ²	0	-	0 ft ²	0	-
Roof Transmission	109 ft ²	220	-	109 ft ²	284	-
Window Transmission	0 ft ²	0	-	0 ft ²	0	-
Skylight Transmission	0 ft ²	0	-	0 ft ²	0	-
Door Loads	0 ft ²	0	-	0 ft ²	0	-
Floor Transmission	109 ft ²	0	-	109 ft ²	0	-
Partitions	0 ft ²	0	-	0 ft ²	0	-
Ceiling	0 ft ²	0	-	0 ft ²	0	-
Overhead Lighting	82 W	249	-	0	0	-
Task Lighting	0 W	0	-	0	0	-
Electric Equipment	650 W	2112	-	0	0	-
People	3	637	615	0	0	0
Infiltration	-	0	0	-	0	0
Miscellaneous	-	0	0	-	0	0
Safety Factor	0% / 0%	0	0	0%	0	0
>> Total Zone Loads	-	3217	615	-	284	0

Zone 4	DESIGN COOLING			DESIGN HEATING		
	COOLING DATA AT Jul 1500 COOLING OA DB / WB 90.0 °F / 73.0 °F			HEATING DATA AT DES HTG HEATING OA DB / WB -15.0 °F / -15.5 °F		
	OCCUPIED T-STAT 75.0 °F			OCCUPIED T-STAT 70.0 °F		
ZONE LOADS	Details	Sensible (BTU/hr)	Latent (BTU/hr)	Details	Sensible (BTU/hr)	Latent (BTU/hr)
Window & Skylight Solar Loads	0 ft ²	0	-	0 ft ²	-	-
Wall Transmission	0 ft ²	0	-	0 ft ²	0	-
Roof Transmission	168 ft ²	339	-	168 ft ²	437	-
Window Transmission	0 ft ²	0	-	0 ft ²	0	-
Skylight Transmission	0 ft ²	0	-	0 ft ²	0	-
Door Loads	0 ft ²	0	-	0 ft ²	0	-
Floor Transmission	168 ft ²	0	-	168 ft ²	0	-
Partitions	0 ft ²	0	-	0 ft ²	0	-
Ceiling	0 ft ²	0	-	0 ft ²	0	-
Overhead Lighting	126 W	384	-	0	0	-
Task Lighting	0 W	0	-	0	0	-
Electric Equipment	1300 W	4224	-	0	0	-
People	6	1273	1230	0	0	0
Infiltration	-	0	0	-	0	0
Miscellaneous	-	0	0	-	0	0
Safety Factor	0% / 0%	0	0	0%	0	0
>> Total Zone Loads	-	6220	1230	-	437	0

Zone Design Load Summary for Whole Building

Project Name: Sauk CO
Prepared by: Tailored Engineering

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Zone 5	DESIGN COOLING			DESIGN HEATING		
	COOLING DATA AT Jul 1500 COOLING OA DB / WB 90.0 °F / 73.0 °F			HEATING DATA AT DES HTG HEATING OA DB / WB -15.0 °F / -15.5 °F		
	OCCUPIED T-STAT 75.0 °F			OCCUPIED T-STAT 70.0 °F		
ZONE LOADS	Details	Sensible (BTU/hr)	Latent (BTU/hr)	Details	Sensible (BTU/hr)	Latent (BTU/hr)
Window & Skylight Solar Loads	0 ft ²	0	-	0 ft ²	-	-
Wall Transmission	0 ft ²	0	-	0 ft ²	0	-
Roof Transmission	144 ft ²	291	-	144 ft ²	375	-
Window Transmission	0 ft ²	0	-	0 ft ²	0	-
Skylight Transmission	0 ft ²	0	-	0 ft ²	0	-
Door Loads	0 ft ²	0	-	0 ft ²	0	-
Floor Transmission	144 ft ²	0	-	144 ft ²	0	-
Partitions	0 ft ²	0	-	0 ft ²	0	-
Ceiling	0 ft ²	0	-	0 ft ²	0	-
Overhead Lighting	108 W	329	-	0	0	-
Task Lighting	0 W	0	-	0	0	-
Electric Equipment	650 W	2112	-	0	0	-
People	3	637	615	0	0	0
Infiltration	-	0	0	-	0	0
Miscellaneous	-	0	0	-	0	0
Safety Factor	0% / 0%	0	0	0%	0	0
>> Total Zone Loads	-	3368	615	-	375	0

Zone 6	DESIGN COOLING			DESIGN HEATING		
	COOLING DATA AT Jul 1500 COOLING OA DB / WB 90.0 °F / 73.0 °F			HEATING DATA AT DES HTG HEATING OA DB / WB -15.0 °F / -15.5 °F		
	OCCUPIED T-STAT 75.0 °F			OCCUPIED T-STAT 70.0 °F		
ZONE LOADS	Details	Sensible (BTU/hr)	Latent (BTU/hr)	Details	Sensible (BTU/hr)	Latent (BTU/hr)
Window & Skylight Solar Loads	0 ft ²	0	-	0 ft ²	-	-
Wall Transmission	0 ft ²	0	-	0 ft ²	0	-
Roof Transmission	585 ft ²	1181	-	585 ft ²	1522	-
Window Transmission	0 ft ²	0	-	0 ft ²	0	-
Skylight Transmission	0 ft ²	0	-	0 ft ²	0	-
Door Loads	0 ft ²	0	-	0 ft ²	0	-
Floor Transmission	585 ft ²	0	-	585 ft ²	0	-
Partitions	0 ft ²	0	-	0 ft ²	0	-
Ceiling	0 ft ²	0	-	0 ft ²	0	-
Overhead Lighting	439 W	1337	-	0	0	-
Task Lighting	0 W	0	-	0	0	-
Electric Equipment	2600 W	8447	-	0	0	-
People	11	2334	2255	0	0	0
Infiltration	-	0	0	-	0	0
Miscellaneous	-	0	0	-	0	0
Safety Factor	0% / 0%	0	0	0%	0	0
>> Total Zone Loads	-	13299	2255	-	1522	0

Zone Design Load Summary for Whole Building

Project Name: Sauk CO
Prepared by: Tailored Engineering

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Zone 7	DESIGN COOLING			DESIGN HEATING		
	COOLING DATA AT Jul 1400 COOLING OA DB / WB 89.3 °F / 72.8 °F			HEATING DATA AT DES HTG HEATING OA DB / WB -15.0 °F / -15.5 °F		
	OCCUPIED T-STAT 75.0 °F			OCCUPIED T-STAT 70.0 °F		
ZONE LOADS	Details	Sensible (BTU/hr)	Latent (BTU/hr)	Details	Sensible (BTU/hr)	Latent (BTU/hr)
Window & Skylight Solar Loads	0 ft ²	0	-	0 ft ²	-	-
Wall Transmission	0 ft ²	0	-	0 ft ²	0	-
Roof Transmission	414 ft ²	877	-	414 ft ²	1077	-
Window Transmission	0 ft ²	0	-	0 ft ²	0	-
Skylight Transmission	0 ft ²	0	-	0 ft ²	0	-
Door Loads	0 ft ²	0	-	0 ft ²	0	-
Floor Transmission	414 ft ²	0	-	414 ft ²	0	-
Partitions	0 ft ²	0	-	0 ft ²	0	-
Ceiling	0 ft ²	0	-	0 ft ²	0	-
Overhead Lighting	311 W	939	-	0	0	-
Task Lighting	0 W	0	-	0	0	-
Electric Equipment	1300 W	4210	-	0	0	-
People	6	1261	1230	0	0	0
Infiltration	-	0	0	-	0	0
Miscellaneous	-	0	0	-	0	0
Safety Factor	0% / 0%	0	0	0%	0	0
>> Total Zone Loads	-	7286	1230	-	1077	0

Zone 8	DESIGN COOLING			DESIGN HEATING		
	COOLING DATA AT Jul 1400 COOLING OA DB / WB 89.3 °F / 72.8 °F			HEATING DATA AT DES HTG HEATING OA DB / WB -15.0 °F / -15.5 °F		
	OCCUPIED T-STAT 75.0 °F			OCCUPIED T-STAT 70.0 °F		
ZONE LOADS	Details	Sensible (BTU/hr)	Latent (BTU/hr)	Details	Sensible (BTU/hr)	Latent (BTU/hr)
Window & Skylight Solar Loads	0 ft ²	0	-	0 ft ²	-	-
Wall Transmission	0 ft ²	0	-	0 ft ²	0	-
Roof Transmission	633 ft ²	1341	-	633 ft ²	1647	-
Window Transmission	0 ft ²	0	-	0 ft ²	0	-
Skylight Transmission	0 ft ²	0	-	0 ft ²	0	-
Door Loads	0 ft ²	0	-	0 ft ²	0	-
Floor Transmission	633 ft ²	0	-	633 ft ²	0	-
Partitions	0 ft ²	0	-	0 ft ²	0	-
Ceiling	0 ft ²	0	-	0 ft ²	0	-
Overhead Lighting	475 W	1435	-	0	0	-
Task Lighting	0 W	0	-	0	0	-
Electric Equipment	1300 W	4210	-	0	0	-
People	4	840	820	0	0	0
Infiltration	-	0	0	-	0	0
Miscellaneous	-	0	0	-	0	0
Safety Factor	0% / 0%	0	0	0%	0	0
>> Total Zone Loads	-	7827	820	-	1647	0

System Psychrometrics for Whole BuildingProject Name: Sauk CO
Prepared by: Tailored Engineering11/09/2022
11:54AM**July DESIGN COOLING DAY, 1500****TABLE 1: SYSTEM DATA**

Component	Location	Dry-Bulb Temp (°F)	Specific Humidity (lb/lb)	Airflow (CFM)	CO2 Level (ppm)	Sensible Heat (BTU/hr)	Latent Heat (BTU/hr)
Ventilation Air	Inlet	90.0	0.01408	328	400	4697	6774
Vent - Return Mixing	Outlet	78.0	0.01015	2629	1858	-	-
Preheat Coil	Outlet	78.0	0.01015	2629	1858	0	-
Central Cooling Coil	Outlet	55.0	0.00878	2629	1858	63347	16617
Supply Fan	Outlet	55.0	0.00878	2629	1858	0	-
Cold Supply Duct	Outlet	55.0	0.00878	2629	1858	-	-
Zone Air	-	76.3	0.00959	2629	2066	58651	9840
Return Plenum	Outlet	76.3	0.00959	2629	2066	0	-

Air Density x Heat Capacity x Conversion Factor: At sea level = 1.080; At site altitude = 1.047 BTU/(hr-CFM-F)

Air Density x Heat of Vaporization x Conversion Factor: At sea level = 4746.6; At site altitude = 4599.9 BTU/(hr-CFM)

Site Altitude = 866.0 ft

TABLE 2: ZONE DATA

Zone Name	Zone Sensible Load (BTU/hr)	T-stat Mode	Zone Cond (BTU/hr)	Zone Temp (°F)	Zone Airflow (CFM)	CO2 Level (ppm)	Terminal Heating Coil (BTU/hr)	Zone Heating Unit (BTU/hr)
Zone 1	11147	Cooling	10891	76.3	489	2068	0	0
Zone 2	7984	Cooling	7782	76.3	350	2052	0	0
Zone 3	3217	Cooling	3164	76.4	142	2101	0	0
Zone 4	6220	Cooling	6121	76.4	274	2109	0	0
Zone 5	3368	Cooling	3297	76.3	148	2090	0	0
Zone 6	13299	Cooling	12956	76.3	580	2074	0	0
Zone 7	7278	Cooling	7035	76.3	315	2075	0	0
Zone 8	7796	Cooling	7405	76.3	332	1991	0	0

System Psychrometrics for Whole BuildingProject Name: Sauk CO
Prepared by: Tailored Engineering11/09/2022
11:54AM**WINTER DESIGN HEATING****TABLE 1: SYSTEM DATA**

Component	Location	Dry-Bulb Temp (°F)	Specific Humidity (lb/lb)	Airflow (CFM)	CO2 Level (ppm)	Sensible Heat (BTU/hr)	Latent Heat (BTU/hr)
Ventilation Air	Inlet	-15.0	0.00024	73	400	-6390	0
Vent - Return Mixing	Outlet	58.2	0.00024	585	462	-	-
Preheat Coil	Outlet	58.2	0.00024	585	462	0	-
Central Cooling Coil	Outlet	55.0	0.00024	585	462	1988	0
Supply Fan	Outlet	55.0	0.00024	585	462	0	-
Cold Supply Duct	Outlet	55.0	0.00024	585	462	-	-
Zone Air	-	68.7	0.00024	585	471	-13038	0
Return Plenum	Outlet	68.7	0.00024	585	471	0	-

Air Density x Heat Capacity x Conversion Factor: At sea level = 1.080; At site altitude = 1.047 BTU/(hr-CFM-F)

Air Density x Heat of Vaporization x Conversion Factor: At sea level = 4746.6; At site altitude = 4599.9 BTU/(hr-CFM)

Site Altitude = 866.0 ft

TABLE 2: ZONE DATA

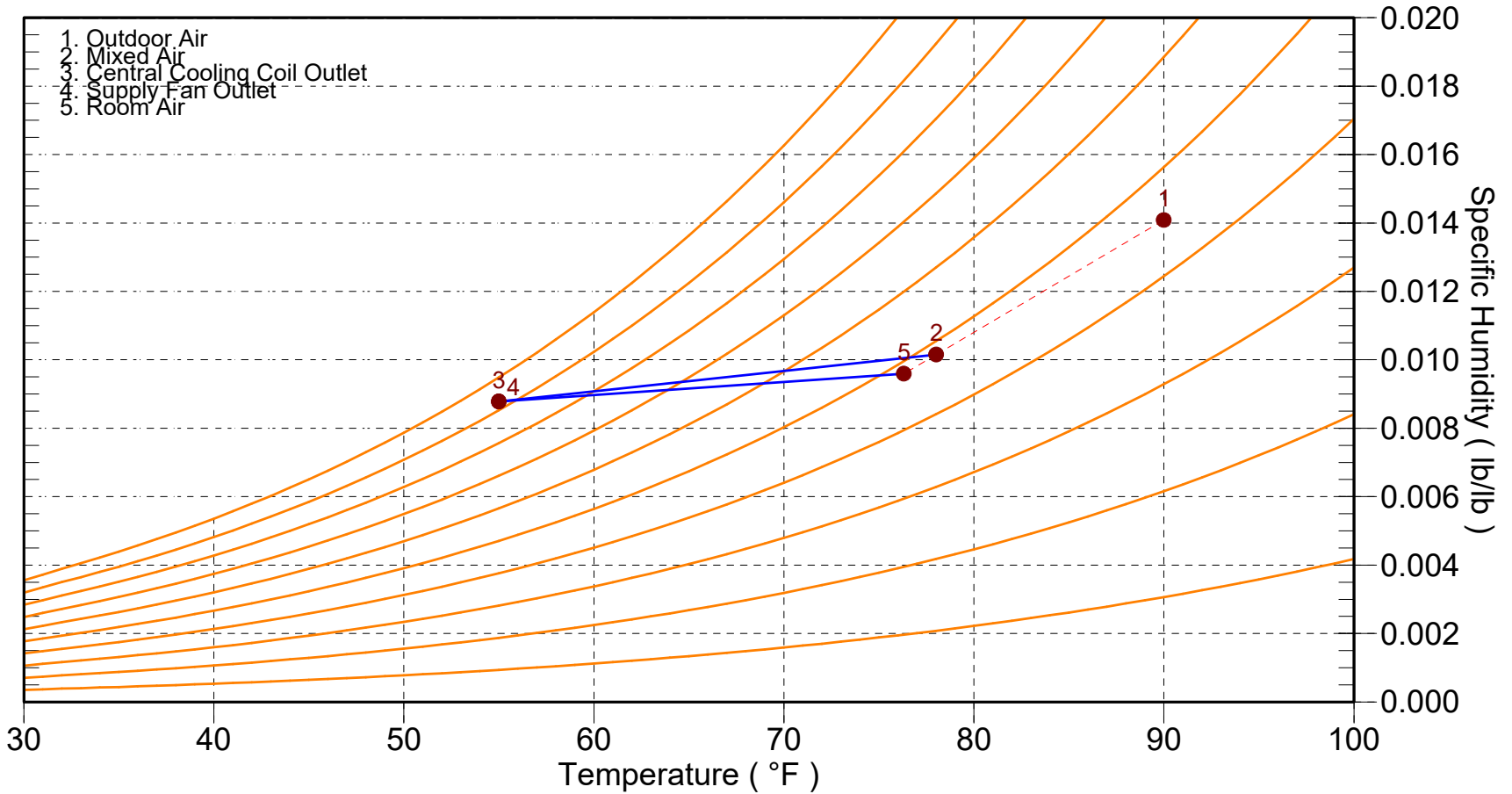
Zone Name	Zone Sensible Load (BTU/hr)	T-stat Mode	Zone Cond (BTU/hr)	Zone Temp (°F)	Zone Airflow (CFM)	CO2 Level (ppm)	Terminal Heating Coil (BTU/hr)	Zone Heating Unit (BTU/hr)
Zone 1	-4379	Heating	-4326	68.6	167	471	6702	0
Zone 2	-3586	Heating	-3542	68.6	137	471	5488	0
Zone 3	-284	Heating	-280	69.0	23	471	611	0
Zone 4	-437	Heating	-429	69.1	45	471	1095	0
Zone 5	-375	Heating	-369	68.9	23	471	697	0
Zone 6	-1522	Heating	-1477	68.8	83	471	2672	0
Zone 7	-1077	Heating	-1036	68.7	45	471	1680	0
Zone 8	-1647	Heating	-1578	68.6	63	471	2473	0

System Psychrometrics for Whole Building

Project Name: Sauk CO
Prepared by: Tailored Engineering

11/09/2022
11:54AM

Location: Madison, Wisconsin
Altitude: 866.0 ft.
Data for: July DESIGN COOLING DAY, 1500



System Psychrometrics for Whole Building

Project Name: Sauk CO
Prepared by: Tailored Engineering

11/09/2022
11:54AM

Location: Madison, Wisconsin
Altitude: 866.0 ft.
Data for: WINTER DESIGN HEATING

